Leafy Spurge
(*Euphorbia esula* L.)
Management Plan

Coconino National Forest

2009

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1. Introduction

1.1 Purpose and Need

The purpose of this plan is to serve as a guidance document to reach the goal of eradicating leafy spurge on the Coconino National Forest. Eradication of leafy spurge is one of the goals of the *Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds, Coconino. Kaibab and Prescott National Forests*[1] (FEIS) (USDA-Forest Service 2005). This action is needed because existing conditions within the 3 national Forests indicate that weed populations have expanded from a few, small infestations to over 187,000 acres. These species pose a serious threat to ecosystem diversity and have a high potential to harm native plants and wildlife, especially threatened, endangered and sensitive species. Bull thistle, leafy spurge, knapweeds, and Dalmatian toadflax have made significant increases in their overall population size in the project area over 10 years. Leafy spurge, yellow starthistle, and the knapweeds (Russian, diffuse, and spotted) are of particular concern due to their invasiveness. These plants tend to form monocultures (become the only plants found within a site) and eventually eliminate all other native plants. These plants often alter physical conditions or disturbance regimes that allow the invasive species to spread further and form monocultures. Invasive weeds have been documented to alter soil temperature, soil salinity, water availability, nutrient cycles and availability, native seed germination, infiltration and runoff of precipitation, fire severity and frequency (DiTomaso et al. 2000; Sheley and Petroff 1999; Lym, 2005).

Leafy spurge is ranked as the top species of concern in the FEIS. Eradication of leafy spurge will promote ecosystem health and prevent losses in the productive capacity of the land. Leafy spurge degrades native plant and wildlife habitats by aggressively forming monocultures and displacing native species. Leafy spurge is poisonous to cattle and horses and may negatively affect wildlife as well. The sap of leafy spurge may be hazardous to humans from dermal exposure. It may cause dermatitis or eye irritation.

Implementation of this plan is consistent with the goals of the FEIS and the Coconino National Forest Plan. The FEIS and its accompanying goals for noxious or invasive weed control were incorporated into the Coconino National Forest Plan [2]through the adoption of Amendment 20 (2005).

1.2 Short Term Objectives

Our short term objectives center around detection, eradication, education and prevention of leafy spurge on the Coconino National Forest and adjacent lands.

- Identify affected areas and determine the actual extent of populations.
- Monitor the effectiveness of past and ongoing control efforts for leafy spurge.
- Seek and work cooperatively with partners toward the established objective of eradication of leafy spurge.
- Provide interpretive tools, such as signs, pamphlets, news releases, and web-based information, to educate employees and Forest users of the threats and issues associated with leafy spurge.
- Establish an integrated plan for future management of leafy spurge, using all possible treatment options.
- Identify tasks needed to reduce the spread and introduction of leafy spurge and to control existing populations. Identify responsible parties assigned to these tasks.

[1] Accessible on-line at http://www.fs.fed.us/r3/coconino/nepa/2005/feis-weeds/index.shtml.
[2] Acessible on-line at http://www.fs.fed.us/r3/coconino/projects/plan-revision-2006/1987_cnf_Forest_plan_as_amended.pdf

1.3 Long Term Objectives

The ultimate long-term goal of this plan is to eradicate leafy spurge from the Coconino National Forest and prevent its reintroduction to preserve the vitality and quality of the local ecological, social, and economic communities.
Forest

2. Leafy Spurge

2.1 Origin & Life History

The first record of leafy spurge in the United States was from Newbury, Massachusetts in 1827. By 1921 leafy spurge had become widespread in certain areas of the eastern United States and it was apparent how difficult it would be to control, especially in pasture areas (Dunn, 1979). By 1933, the species had spread to some western states and experts anticipated that it would continue to spread to adjacent states (Dunn, 1979). By 1970, leafy spurge had spread to all southern provinces in Canada and had moved westward, but had not continued to spread southward from its northern distribution (Dunn, 1979). Today, leafy spurge occurs in most states, except in the southeastern U.S. (USDA-NRCS-2008[3]).

Leafy spurge taxonomy is complex and perplexing. Radcliffe-Smith (1985) reviewed the work of several authors and taxonomic treatments of leafy spurge worldwide. Depending on the author and taxonomic treatment, there can be one to many species of leafy spurge. Some authorities regard it as a single variable species while others recognize each variation as a distinct species. According to Radcliffe-Smith, leafy spurge is a polymorphic complex sometimes referred to as the "esula-aggregate" or the "virgata-group". Taxonomic treatments for leafy spurge prepared in the U.S. are generally more conservative and recognize fewer species and varieties than those prepared in Europe.

Most taxonomists in the U.S. recognize all forms of leafy spurge as a single species (*Euphorbia esula*) and only one hybrid, *Euphorbia* x *pseudoesula*, formed from parent species cypress spurge (*Euphorbia cyparissias*) and leafy spurge. Cypress spurge is a non-native weedy species found in the wild in certain areas of the eastern U.S. (Crompton, et al. 1990). A herbarium search using the SEINet[4] database revealed no documented locations for cypress spurge or the hybrid in Arizona. Currently the USDA Plants website (USDA-NRCS-2008) recognizes two varieties within leafy spurge, *Euphorbia esula* var. *esula* and *E. esula* var. *uralensis*. Many forms of spurge previously given full species status by such authors as Dunn and Radcliff-Smith (1980) or Radcliffe-Smith (1985) have been included in these two varieties. We do not know the variety of leafy spurge occurring on the Coconino National Forest but this will not affect management or treatment of the infestations.

2.2 Status and History on the Coconino National Forest

Leafy spurge is identified as the number one priority species for treatment in the *Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds* (USDA-Forest Service 2005, Table 1, p. 16).

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[3] Available at http://plants.usda.gov/java/profile?symbol=EUES
[4] Homepage of the Southwest Environmental Information Network available at http://swbiodiversity.org/seinet/index.php

In 1997, Clark Franz reported leafy spurge at a single location near Forest Road 91 (Figure 1). Franz removed the plants he found by hand pulling and disposing of them. No follow-up treatments were conducted on the site for several years, so it is unknown what if any effect this treatment had on the plants. Debra Crisp found the main population of leafy spurge at Brolliar Park in 1998 (Figure 1). Since that detection, numerous "outliers" have been detected by various surveyors, some several miles from the initial sites. The Flagstaff Center range crew has inventoried, monitored and treated the area around Brolliar Park yearly since 1999. Personnel from the Supervisor's Office and Mogollon Rim Ranger District have surveyed portions of the Forest near the district boundary between Mogollon Rim and Mormon Lake Ranger Districts from 2004 through 2008 as part of the Upper Beaver Creek Watershed Fuel Reduction Project. Surveys in this area have led to most of the recent detections of outlier populations of leafy spurge.

To date there are approximately 56 detected populations on the Forest totaling roughly 208 acres, or 0.325 square miles, dispersed over an area of about 36 square miles (Figure 1). The extent of most of these individual populations is 1/10th acre or less. The extent of the largest population in Brolliar Park is about 90 acres.

2.3 Distribution.

Leafy Spurge occurs on the Mormon Lake Ranger District portion of the Flagstaff Center and on the Mogollon Rim Ranger District (Figure 1). To date, no infestations have been detected on the Red Rock Ranger District. Leafy Spurge occurs mainly along Forest Roads 91 and 91C, southwest of Mollholland Tank, with the exception of the northernmost outlier which is located along Forest Road 91 north of Long Park Tank. The entire infested area is located to the west of Forest Highway 3, (Lake Mary Road), and spreads south into the northwestern corner of the Mogollon Rim Ranger District past Round-up Park Spring, and west into the Rattlesnake Canyon and Gash Flat areas. Infestations occur in the Tinney Springs and Apache Maid grazing allotments, adjacent to the Windmill Allotment, although leafy spurge has not been located on the Windmill allotment to date. The infested area includes portions of several past or ongoing timber sales and fuels reduction projects including the Mint sale on Mormon Lake Ranger District and the Upper Beaver Creek Fuels Reduction Project on the Mogollon Rim Ranger District. Most of the infestations occur in the Beaver Creek watershed, with one exception in the Oak Creek watershed.

2.4 Impacts

Leafy spurge is an extremely aggressive and persistent weed that when established can eliminate most native species from an area. A native of Eurasia, leafy spurge emerges early in the spring and gets a head start on other vegetation in a race for space, sunlight, nutrients and water. Prolific seed production and an extensive root system give the plant a huge competitive advantage and make consistent, long-term control difficult. Deep tap roots, which can exceed 20 feet in depth, store reserves of nutrients to see the plant through hard times, while lateral roots form a network that enables it to rapidly reproduce and spread. And, perhaps worst of all, leafy spurge is highly adaptable and can thrive in a variety of conditions and situations (USDA -ARS TEAM Leafy Spurge 2002).

Leafy spurge contains the alkaloid euphorbon, which is toxic to cattle and is a known co-carcinogen (increasing the cancer-causing properties of other substances). Its white latex bearing sap can irritate the skin and eyes of people and animals. Leafy spurge is an irritant, emetic and purgative to livestock. It

causes scours and weakness in cattle and may result in death. The toxin has produced inflammation and loss of hair on the feet of horses from freshly mowed stubble during haying and has caused mortality of sheep that grazed leafy spurge exclusively. The root sap gives off a substance that inhibits the growth of grasses and other plants in the surrounding soils (USDA Forest Service, 2002).

The economic and environmental impacts of leafy spurge are significant. It invades a variety of land types, reduces range productivity and species diversity, threatens sensitive species, degrades wildlife habitat and reduces land values. Infestations in Wyoming, Montana and the Dakotas alone are estimated to cost agricultural producers and taxpayers more than $144 million a year in lost production, control expenses and other impacts to the economy (USDA-Forest Service, 2002). In 1998 North Dakota alone reported 850,000 acres of leafy spurge infestation (Lym et al., 1998).

Leafy spurge control must be considered a long-term management problem, requiring a long-term management program as NO SINGLE TREATMENT WILL ERADICATE THIS WEED. Implementation of a management plan that provides for annual treatment is the best strategy for long-term control and eventual eradication. It is important not to skip a year until 90% or more of the infestation area is controlled; otherwise leafy spurge will re-infest rapidly (Lym et al. 1998).

2.5 Management Activities and Treatment History

An *Environmental Assessment for the Treatment of Leafy Spurge in Brolliar Park* was prepared in 1998 (USDA – Forest Service 1998) and the Decision Notice was signed in 2000 (USDA-Forest Service, 2000). The selected alternative for treatment was a series of treatment actions including: an area closure implemented in 2000 (see closure order 04-00-146, exhibit K[5]); elimination of cattle grazing in the area by "resting" the pasture; using sheep to graze the infested area to reduce plants; and mowing which included both machine mowing using a tractor and manual cutting using hand-tools and weed-whackers. As part of project planning, preliminary analysis included use of herbicides, and biological control using insects to treat leafy spurge, but these actions were not part of the selected alternative and were not implemented because further analysis was needed.

Currently, pastures that have leafy spurge have been deferred from livestock grazing in the Apache Maid and Tinny Springs Allotments.

Sheep grazing is a recognized control method for many noxious or invasive weeds including leafy spurge. A herd of about 1000 sheep were placed in Brolliar Park from 2002 -2006. The sheep were allowed to graze on the leafy spurge plants from May 15 to October 31. See Appendix F for further details on the sheep grazing project. Mowing treatments on various populations have been conducted yearly since this decision, usually several times per year during the growing season. Recent mowing treatments have focused on reducing seed set and vitality of existing plants, especially in "outlier" populations.

The Record of Decision for the *Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds on the Coconino, Kaibab and Prescott National Forests* (USDA-Forest Service, 2005) broadened the treatment options for all noxious or invasive weeds including leafy spurge. This enabled the Forest to begin herbicide treatments on selected noxious or invasive weed populations

[5] Available at http://www.redrockcountry.org/about-us/orders/04-00-146-k.pdf

including leafy spurge beginning in June 2005 (Appendix A, Table A-1). In 2006, 445 acres of various leafy spurge treatments were conducted in the project area; these consisted of limited grazing, two mowing treatments and one fall herbicide treatment with 8 ounces of Imazapic[6] per acre to all known populations. The following spring (2007) we started with an herbicide treatment of 4 ounces of Imazapic per acre on all outlier populations. There was considerable re-growth following this treatment especially in the immediate area around the treatments (ring effect). Spring treatment with Imazapic was not found to be very effective because this chemicals mode of action is not very effective during spring growth.

The treatment strategy was then altered to use a higher rate of Imazapic in the fall only and continue mowing in the summer. In the summer of 2007 all known outliers were mowed and further surveys were conducted. Ten ounces of Imazapic per acre were applied in the fall of 2007 to all verified outliers and the outer edges of the Brolliar Park population. In total 256 acres of leafy spurge treatments were completed in 2007. In 2008, a total of 410 acres of treatments were completed in this project area. A spring herbicide treatment was not carried out. All outlier populations were mowed two or three times over the summer. All known outlier populations were treated using 12 ounces per acre[7] rate of Imazapic in mid-September. A contractor conducted the most recent herbicide treatments in the fall of 2008 on the populations around Brolliar Park with this same rate of Imazapic. However, they were unable to complete treatment of the central infestation in the area of Brolliar Park due to early heavy frosts in the first week of October. Spring herbicide treatments of all known populations were conducted in 2009 using a 2,4-D glyphosate mix to reduce vegetative growth. Vegetative growth was also mowed at least once in all populations over the summer. The last treatment to date was a 12 oz per acre of Imazapic in mid September on all currently growing populations (significant reductions in size and density of most outlying populations have been observed).

Increased effectiveness from the higher rates of fall herbicide applications has been observed. However desired treatment effectiveness has not been reached. The proposed plan is to start with two herbicide applications per year: one spring application with two contact herbicides to reduce vegetative growth and minimize seed production; and one fall application with one to two systemic herbicides to stop root growth and minimize carbohydrate reserves. The following year would rest in spring and repeat a similar fall application. Rotating chemicals and using more than one mode of action in one application minimizes the potential for resistance development while maximizing treatment effectiveness. Spring treatments every year run the risk of significantly damaging native perennial species and spring annuals that will help compete against re-establishment of leafy spurge and establishment of other undesirable non-native species.

2.7 Research

In North America, there has been extensive research on leafy spurge and its treatments. For example, a group known as TEAM Leafy Spurge [8] based in Montana, has conducted extensive research on the treatment of leafy spurge in the northwestern United States and has produced numerous publications on leafy spurge. One of the major accomplishments of this group was the development of biologically-based integrated pest management for leafy spurge where they encourage using several techniques

[6] Imazapic (EPA Registration # 241-365) is the active ingredient in the trade marked Plateau herbicide which is used to control leafy spurge (BASF Corporation, 2008).

[7] The variation in the concentration rate from 4 to 12 ounces is following label recommended application rates for this herbicide.

[8] Team Leafy Spurge homepage available at http://www.team.ars.usda.gov/index.html

jointly for control. An example would be use of grazing and biological control insects[9] in unison to control leafy spurge infestations. TEAM Leafy Spurge researched and produced a report on the success of biological control insects titled "*Assessing Long-term Impact of Leafy Spurge Biological Control Agents: Conclusions from a 6-year study*" (Kazmar and Marrs, 2005) which is available on the TEAM Leafy Spurge web site.

There are numerous publications from symposia on the biology and control of leafy spurge available through the Team Leafy Spurge web site. Additionally, numerous federal, state and academic departments throughout the U.S. and Canada have studied leafy spurge. However, the intent of this document is to briefly review past research and not provide an exhaustive compilation of research. Additional information may be found in weed publications and by searching the world-wide web.

2.71 Current Research and Opportunities

Currently, the Forest is considering using biological control insects on leafy spurge infestations on the Forest. These insects have been tested and approved by Animal and Plant Health Inspection Service (APHIS) and have been used in other areas of the U.S. The insects available for control of leafy spurge are flea beetles (*Aphthona* spp.), which control the plants by boring into the roots. The Forest is working with APHIS to test the effects of these beetles on two locally occurring native spurges, *Euphorbia chamaesula* and *Euphorbia brachycera*. The Forest and APHIS established three test sites in 2008 to assess the effects of the insects. If testing is successful (the insects survive and do not eat native spurge) the insects could be released onto infestations in the near future.

Opportunities for research include exploring the taxonomic differences between *Euphorbia chamaesula* and *Euphorbia brachycera*. *Euphorbia chamaesula* is a regional endemic native to New Mexico and Arizona. In preparation of this document, little information was found on its distribution, characteristics and ecology. We did not find any taxonomic key comparing *E. chamaesula*, *E. brachycera* and leafy spurge in the same key, making it difficult to compare characteristics that define each species. There may also be research opportunities to assess various portions of biological control or other treatments. However, we do not anticipate being able to provide funding for any research projects, including taxonomic studies through this plan.

2.8 Education and Outreach

To date, the Forest has mainly concentrated on educating Forest and District employees about leafy spurge identification and use of Best Management Practices to limit the introduction and spread of all noxious and invasive plant species. Project inventories such as that done in 2008 and 2009 with the leafy spurge inventory of the Upper Beaver Creek Watershed Fuel Reduction Project have also served to increase awareness of leafy spurge outlier populations on the Mormon Lake and Mogollon Rim District. Education of Forest employees has increased with the implementation of the *Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds on the Coconino, Kaibab and Prescott National Forests* (USDA-Forest Service, 2005).

[9]The biological control agent page, Team Leafy Spurge - http://www.team.ars.usda/gov/b&A.html

However, further education for Forest employees is needed to further increase awareness of the threats and impacts of leafy spurge and how the Forest is working to eliminate leafy spurge. For example to better reach Coconino National Forest Employees we would use new employee orientations and District family meetings to educate employees on: 1. Leafy spurge issues & threats, 2. Distribution of leafy spurge on the Forest, 3. Best management practices to avoid spreading leafy spurge, 4. Ongoing management actions to control/eradicate leafy spurge, including the Brolliar Park closure order. To outreach to the Coconino National Forest users, we would post interpretive signs along level three roads at each entry point to the infested area. Interpretive signs should include the following information: 1. A picture/drawing of leafy spurge, 2. A map of the closure/infested area, 3. A description/warning of leafy spurge issues and threats, 4. Management actions the Forest is taking to control/eradicate leafy spurge, 5.What they can do to be safe and not spread leafy spurge. The Forest should obtain/create pamphlets to educate users. These can then be provided to general Forest users, Forest permittees, private land owners in Long Park, Bear Park, Pratt Park, Double Cabin Park, Stoneman Lake, K-T Ranch, as well as the Mormon Lake Lodge for distribution to their guests.

3. Targeted Accomplishments, 2009-2012

The following accomplishments are targeted for completion as part of this management plan, subject to annual funding. Our short term objectives center around detection, eradication, education and prevention of leafy spurge on the Coconino National Forest and adjacent lands. An annual meeting will be conducted by the Forest's weed management team to assess and track accomplishments.

3.1 Detection

Identify affected areas and determine the actual extent of populations.

- 2009: Refine the leafy spurge populations' baseline inventory map.
- 2009-2012: Formalize leafy spurge inventory and GPS mapping procedures and train employees performing surveys.
- 2009-2012: Continue inventories in the Birdie Fire area, and Upper Beaver Creek Watershed Fuel Reduction Project area, the Apache Maid Allotment, the Tinny Springs Allotment, the known sheep grazing area (Appendix F), Munds Park, Mormon Lake, similar tanks and wildlife projects, and adjacent private lands.

3.2 Eradication

Establish an integrated plan for future eradication of leafy spurge, using all possible treatment options. Monitor the effectiveness of past and ongoing control efforts for leafy spurge.

- 2009-2010: Continue herbicide treatments using force account and contractor. Treat twice yearly (approximate dates May 20 and September 20 depending on local weather conditions), using different herbicides, to maximize treatment effectiveness. In the spring a combination of contact herbicides will be used with different modes of action to inhibit vegetative growth and seed set. Plan for 1-2 mechanical treatments in mid-summer each year with the goal of preventing seed set before the fall herbicide treatment. In the fall two systemic herbicides will be used to stop root growth, minimize carbohydrate reserves, and prevent new vegetative bud development.
- 2011: Continue fall herbicide treatments using two systemic herbicides, to continue spurge control while allowing native grass growth in the spring/summer. Introduce biocontrol (if found suitable through current research) to increase stress on the target species

- 2009-2012: Monitor treatments for effectiveness and adjust future treatments as needed. Maintain Forest geo-databases for inventory and treatment.
- Conduct an annual meeting in the Fall to assess and track accomplishments.

3.3 Prevention

Identify tasks needed to reduce the spread and introduction of leafy spurge and to control existing populations. Identify responsible parties assigned to these tasks.

- Identify potential weed risks on District projects, and conduct a weed risk assessment on each project to quantify risk.
- Follow Forest Plan Amendment 20 best management practices for all site disturbing projects.

3.4 Education and Outreach

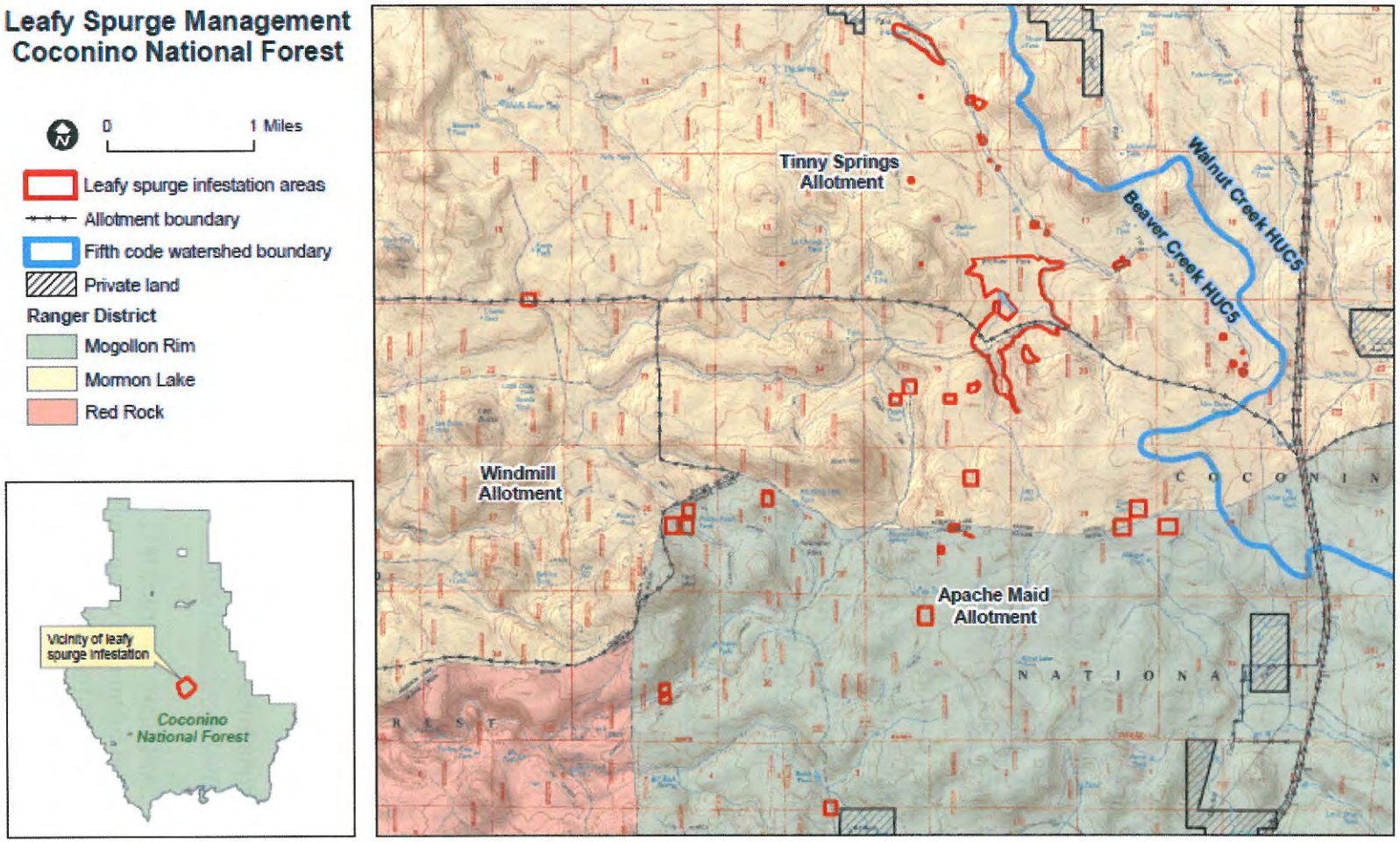
Provide interpretive tools, such as signs, pamphlets, news releases, and web-based information, to educate employees and Forest users of the threats and issues associated with leafy spurge. Seek and work cooperatively with partners toward the established objective of eradication of leafy spurge.

- 2009-2012: One survey and mapping training per year for field going personnel.
- 2009-2012: Provide one weed ID training per year for Forest personnel on each District. Establish awards for survey and treatment on each district.
- 2010: Establish a survey protocol for contractors ie: stand exams on districts, NEPA, vegetation treatments.
- 2009 -2010: Sign area closures.
- 2010-2012: Maintain signs and establish an interpretive kiosk. Create and distribute interpretive material to local Forest users.

4. Maps

The map on Figure 1 shows the occurrence of existing leafy populations on the Forest. The databases used to make this map are accessible through I-Web in the National Resource Information System (NRIS) Invasive Species and the Forest Activities Tracking System (FAcTS).

Figure 1: Locations of Leafy Spurge populations on the Coconino National Forest



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APPENDIX A Leafy Spurge Treatments

Table A-1 Leafy Spurge Treatments 2006-2009

Leafy Spurge Treatments recorded in FACTS database for 2006-2008 include using pesticides, hand pulling, and mowing.

DISTRICT	START DATE	FY	TREATMENT TYPE	TREATMENT ACRES	SITE ID
Mormon Lake	2006-07-10	2006	Manual	0.60	CONF97-0104-EUES
Mormon Lake	2006-07-10	2006	Manual	0.10	CONF98-0005-EUES
Mormon Lake	2006-07-10	2006	Manual	0.10	CONF98-0006-EUES
Mormon Lake	2006-07-10	2006	Manual	0.10	CONF98-0007-EUES
Mormon Lake	2006-07-10	2006	Manual	0.10	CONF98-0010-EUES
Mormon Lake	2006-07-10	2006	Manual	0.10	CONF98-0013-EUES
Mormon Lake	2006-07-10	2006	Manual	0.10	CONF98-0014-EUES
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR127_EUES-003
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR127_EUES-004
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR127_EUES-005
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR127_EUES-006
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR127_EUES-008
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR127_EUES-009
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR127_EUES-010
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR127_EUES-013
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR127_EUES-014
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR127_EUES-015
Mormon Lake	2007-10-10	2008	Pesticide	0.12	030405_FR127_EUES-021
Mormon Lake	2007-10-10	2008	Pesticide	0.39	030405_FR127_EUES-033
Mormon Lake	2007-10-10	2008	Pesticide	0.99	030405_FR127_EUES-034
Mormon Lake	2007-10-10	2008	Pesticide	0.92	030405_FR127_EUES-035
Mormon Lake	2007-10-10	2008	Pesticide	1.51	030405_FR127_EUES-036
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR91_EUES-002
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR91C_EUES_001
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR9473D_EUES-007
Mormon Lake	2007-10-10	2008	Pesticide	0.46	030405_FR9473L_EUES-20
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR9485M_EUES_NEW1
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR9485M_EUES-NEW2
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_FR9485M_EUES-NEW3
Mormon Lake	2007-10-10	2008	Pesticide	2.00	030405_GASH_EUES-UBC1
Mormon Lake	2008-05-30	2008	Manual Hand pulling	2.00	030405_FR127_EUES-008
Mormon Lake	2008-05-30	2008	Manual Hand pulling	2.00	030405_FR127_EUES-009
Mormon Lake	2008-05-30	2008	Manual Hand pulling	2.00	030405_FR127_EUES-010
Mormon Lake	2008-05-30	2008	Manual Hand pulling	2.00	030405_FR127_EUES-011
Mormon Lake	2008-05-30	2008	Manual Hand pulling	2.00	030405_FR127_EUES-013
Mormon Lake	2008-05-30	2008	Manual Hand pulling	2.00	030405_FR127_EUES-014
Mormon Lake	2008-05-30	2008	Manual Hand pulling	2.00	030405_FR935B_EUES-29
Mormon Lake	2008-05-30	2008	Manual Hand pulling	2.00	030405_FR9473E_EUES-012
Mormon Lake	2008-06-04	2008	Manual Hand pulling	2.00	030405_FR127_EUES-004

DISTRICT	START DATE	FY	TREATMENT TYPE	TREATMENT ACRES	SITE ID
Mormon Lake	2008-06-04	2008	Manual Hand pulling	2.00	030405_FR127_EUES-005
Mormon Lake	2008-06-04	2008	Manual Hand pulling	2.00	030405_FR127_EUES-006
Mormon Lake	2008-06-04	2008	Manual Hand pulling	2.00	030405_FR127_EUES-015
Mormon Lake	2008-06-04	2008	Manual Hand pulling	2.00	030405_FR91_EUES-002
Mormon Lake	2008-06-04	2008	Manual Hand pulling	2.00	030405_FR91C_EUES_001
Mormon Lake	2008-06-04	2008	Manual Hand pulling	2.00	030405_FR9473D_EUES-007
Mormon Lake	2008-06-19	2008	Manual Hand pulling	2.00	030405_FR9459K_EUES-UBC2
Mormon Lake	2008-06-19	2008	Manual Hand pulling	2.00	030405_FR9459K_EUES-UBC5
Mormon Lake	2008-06-19	2008	Manual Hand pulling	2.00	030405_GASH_EUES-UBC1
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-003
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-004
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-005
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-006
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-008
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-009
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-010
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-011
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-013
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-014
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-015
Mormon Lake	2008-07-14	2008	Manual	0.22	030405_FR127_EUES-018
Mormon Lake	2008-07-14	2008	Manual	0.12	030405_FR127_EUES-021
Mormon Lake	2008-07-14	2008	Manual	0.39	030405_FR127_EUES-033
Mormon Lake	2008-07-14	2008	Manual	0.92	030405_FR127_EUES-035
Mormon Lake	2008-07-14	2008	Manual	1.51	030405_FR127_EUES-036
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR765_EUES-27
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR91_EUES-002
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR91C_EUES_001
Mormon Lake	2008-07-14	2008	Manual	2.00	030405_FR91C_EUES-017
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR935B_EUES-29
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR9471M_EUES-25
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR9473D_EUES-007
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR9473E_EUES-012
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR9485M_EUES_NEW1
Mormon Lake	2008-07-14	2008	Manual	0.21	030405_FR9485M_EUES-23
Mormon Lake	2008-07-14	2008	Manual	0.20	030405_FR9485M_EUES-24
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR9485M_EUES-32
Mormon Lake	2008-07-14	2008	Mechanical (mowing)	2.00	030405_FR9485M_EUES-37
Mormon Lake	2008-07-14	2008	Manual	0.53	030405_FR9485M_EUES-NEW2
Mormon Lake	2008-07-14	2008	Manual	0.57	030405_FR9485M_EUES-NEW3
Mormon Lake	2008-07-14	2008	Manual	0.55	030405_FR9485M_EUES-UBC10
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-003
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-004
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-005
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-006
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-008
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-009

DISTRICT	START DATE	FY	TREATMENT TYPE	TREATMENT ACRES	SITE ID
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-010
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-011
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-013
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-014
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR127_EUES-015
Mormon Lake	2008-08-25	2008	Manual	0.22	030405_FR127_EUES-018
Mormon Lake	2008-08-25	2008	Manual	0.12	030405_FR127_EUES-021
Mormon Lake	2008-08-25	2008	Manual	0.39	030405_FR127_EUES-033
Mormon Lake	2008-08-25	2008	Manual	0.92	030405_FR127_EUES-035
Mormon Lake	2008-08-25	2008	Manual	1.51	030405_FR127_EUES-036
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR765_EUES-27
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR91_EUES-002
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR91C_EUES_001
Mormon Lake	2008-08-25	2008	Manual	0.21	030405_FR91C_EUES-017
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR935B_EUES-29
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR9471M_EUES-25
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR9473D_EUES-007
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR9473E_EUES-012
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR9485M_EUES_NEW1
Mormon Lake	2008-08-25	2008	Manual	0.21	030405_FR9485M_EUES-23
Mormon Lake	2008-08-25	2008	Manual	0.20	030405_FR9485M_EUES-24
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR9485M_EUES-32
Mormon Lake	2008-08-25	2008	Mechanical (mowing)	2.00	030405_FR9485M_EUES-37
Mormon Lake	2008-08-25	2008	Manual	0.53	030405_FR9485M_EUES-NEW2
Mormon Lake	2008-08-25	2008	Manual	0.57	030405_FR9485M_EUES-NEW3
Mormon Lake	2008-08-25	2008	Manual	0.55	030405_FR9485M_EUES-UBC10
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_9354M_EUES-42
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR127_EUES-19
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR765_EUES-27
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR91_EUES-BIR2
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR91C_EUES-016
Mormon Lake	2008-09-16	2008	Pesticide	7.01	030405_FR9345M_EUES_43
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR935B_EUES-29
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR9459K_EUES-UBC2
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR9459K_EUES-UBC4
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR9459K_EUES-UBC5
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR9471M_EUES-25
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR9485M_EUES_NEW1
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR9485M_EUES-32
Mormon Lake	2008-09-16	2008	Pesticide	0.08	030405_FR9485M_EUES-37
Mormon Lake	2008-09-16	2008	Pesticide	0.53	030405_FR9485M_EUES-NEW2
Mormon Lake	2008-09-16	2008	Pesticide	0.57	030405_FR9485M_EUES-NEW3
Mormon Lake	2008-09-16	2008	Pesticide	0.55	030405_FR9485M_EUES-UBC10
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR9485M_EUES-UBC7
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_FR9485M_EUES-UBC8
Mormon Lake	2008-09-16	2008	Pesticide	2.00	030405_GASH_EUES-UBC1
Mogollon Rim	2007-10-10	2008	Pesticide	2.00	030407_FR9362EUES-UBC6

DISTRICT	START DATE	FY	TREATMENT TYPE	TREATMENT ACRES	SITE ID
Mogollon Rim	2007-10-10	2008	Pesticide	2.00	030407_FR9485M_EUES-NEW4
Mogollon Rim	2008-06-13	2008	Manual Hand pulling	2.00	030407_FR9240D_EUES-RATSNK1
Mogollon Rim	2008-06-13	2008	Manual Hand pulling	2.00	030407_FR9240D_EUES-RATSNK2
Mogollon Rim	2008-07-14	2008	Mechanical (mowing)	2.00	030407_FR9485M_EUES-NEW4
Mogollon Rim	2008-07-17	2008	Mechanical (mowing)	2.00	030407_FR9240D_EUES-RATSNK1
Mogollon Rim	2008-07-17	2008	Mechanical (mowing)	2.00	030407_FR9240D_EUES-RATSNK2
Mogollon Rim	2008-08-25	2008	Mechanical (mowing)	2.00	030407_FR9240D_EUES-RATSNK1
Mogollon Rim	2008-08-25	2008	Mechanical (mowing)	2.00	030407_FR9240D_EUES-RATSNK2
Mogollon Rim	2008-08-25	2008	Mechanical (mowing)	2.00	030407_FR9485M_EUES-NEW4
Mogollon Rim	2008-09-16	2008	Pesticide	2.00	030407_FR765_EUES-UBC3
Mogollon Rim	2008-09-16	2008	Pesticide	2.00	030407_FR9240D_EUES-RATSNK1
Mogollon Rim	2008-09-16	2008	Pesticide	2.00	030407_FR9240D_EUES-RATSNK2
Mogollon Rim	2008-09-16	2008	Pesticide	2.00	030407_FR9362EUES-UBC6
Mogollon Rim	2008-09-16	2008	Pesticide	2.00	030407_FR9485M_EUES-NEW4
				240.98leaf	

APPENDIX B – Work plan and Budget, 2009

Work plans and budgets for future years will be similar to 2009 and may include activities related to public outreach and education. Funding will be highly variable from year to year.

Table B-1. Fiscal Year 2009 Proposed Activities

Fiscal Year 2009				
Project	**Description**	**Job Code & Districts**	**Project Cost**	**Person Days**
Leafy Spurge Weed Management Plan	Develop a long-term management plan for dealing with leafy spurge on the Coconino NF	NFVW MR/FC/RR	$35,000	66
Upper Beaver Creek Watershed Fuel Reduction Project – Noxious and Invasive Weeds	Inventory and Monitoring of leafy spurge populations	WFHF MR	$3,338	10
Weed Treatments Birdie Fire	Mitigation and removal of noxious or invasive weeds within fire perimeter and along Forest roads used for access during fire suppression. Herbicide treatment twice a year. Monitoring and inventory.	WFW304 Coconino NF	$34,000 (Includes $15,865 contract cost)	77 (force account)
		Totals	***$88,203.00***	***153***

APPENDIX C – Cooperators and Partners

Internal Forest Service:

- Invasive and Noxious Weeds Management
- Public Affairs
- Fire and Fuels Management
- Burned Area Emergency Response, Post-fire Watershed Rehabilitation
- Range Management
- Wildlife
- Botany Resource Management
- Watershed & Soils Management
- Vegetation Management
- Engineering
- Recreation
- Lands & Minerals

Agency Partners and Other Cooperators:

- San Francisco Peaks Weed Management Area
- Animal and Plant Health Inspection Service (APHIS)
- Natural Resources Conservation Service (NRCS)
- Natural Resources Conservation District (NRCD)
- Hopi Tribe
- University of Arizona Cooperative Extension
- Grazing Permittees – Apache Maid Allotment, Beaver Creek Allotment, Tinney Springs Allotment
- Adjacent landowners
- Coconino County
- State of Arizona – Department of Agriculture
- Arizona Game and Fish Department
- U.S. Fish and Wildlife Service
- Rocky Mountain Elk Foundation
- Arizona Elk Foundation
- Arizona Antelope Foundation
- Diablo Trust
- Cattlegrowers Association
- Northern Arizona University
- Grand Canyon Wildlands Council

APPENDIX D – Potential Funding Sources

EQUIP Grants – The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that helps agricultural producers in a manner that promotes agricultural production and environmental quality as compatible goals. Through EQIP, farmers and ranchers receive financial and technical assistance to implement structural and management conservation practices that optimize environmental benefits on working agricultural land. EQIP is re-authorized through the Food, Conservation, and Energy Act of 2008 (2008 Farm Bill). EQIP can provide financial and technical assistance to plan and design such measures as pest management, which relates to crop and pest monitoring activities, planned pesticide applications, etc. To qualify for assistance related to invasive species, the project proposal must address a resource concern and the target species must be a listed species of concern in Arizona.

State and Private Forest Funds – Federal funds funneled through the Arizona State Land Department for invasive treatment on non-National Forest lands adjacent to National Forest. Non-National Forest lands include state, private and other lands.

San Francisco Peaks Weed Management Area – there may be opportunities to leverage funds through all the parties that are participating in the weed management area to find grant funding for inventory and education and outreach.

National Forest Foundation Grants: funding to non-profit organizations to conduct education and outreach or weed inventory and eradication on the Forest.

The Forest will continue to look for opportunities for grant funds to accomplish targets and objectives with partners.

APPENDIX E – Key Forest Contacts

Name	Office	Title	Phone	Email
Barbara Phillips	Supervisors Office	Forest Noxious Weed Coordinator	928-527-3421	bgphillips@fs.fed.us
Laura Moser	Supervisors Office	Forest Pesticide Use Coordinator	928-527-3423	lmoser@fs.fed.us
Debbie Crisp	Supervisors Office	Forest Botanist	928-527-3424	dcrisp@fs.fed.us
Amanda Roesch	Flagstaff Center	District Weed Coordinator	928-526-8263	aroesch@fs.fed.us
Jerry Gonzales	Mogollon Rim Ranger District	District Weed Coordinator	928-477-5047	jigonzales@fs.fed.us
Henry Provencio	Mormon Lake Ranger Districts	District Biologist	928-214-2436	hprovencio@fs.fed.us
Debbie Hom	Red Rock Ranger District	District Weed Coordinator	928-203-7514	dhom@fs.fed.us
Robert Garcia	Red Rock & Mogollon Rim Ranger District	Range Management Specialist, Mogollon Rim and Red Rock Ranger Districts	928-203-7517	rmgarcia@fs.fed.us

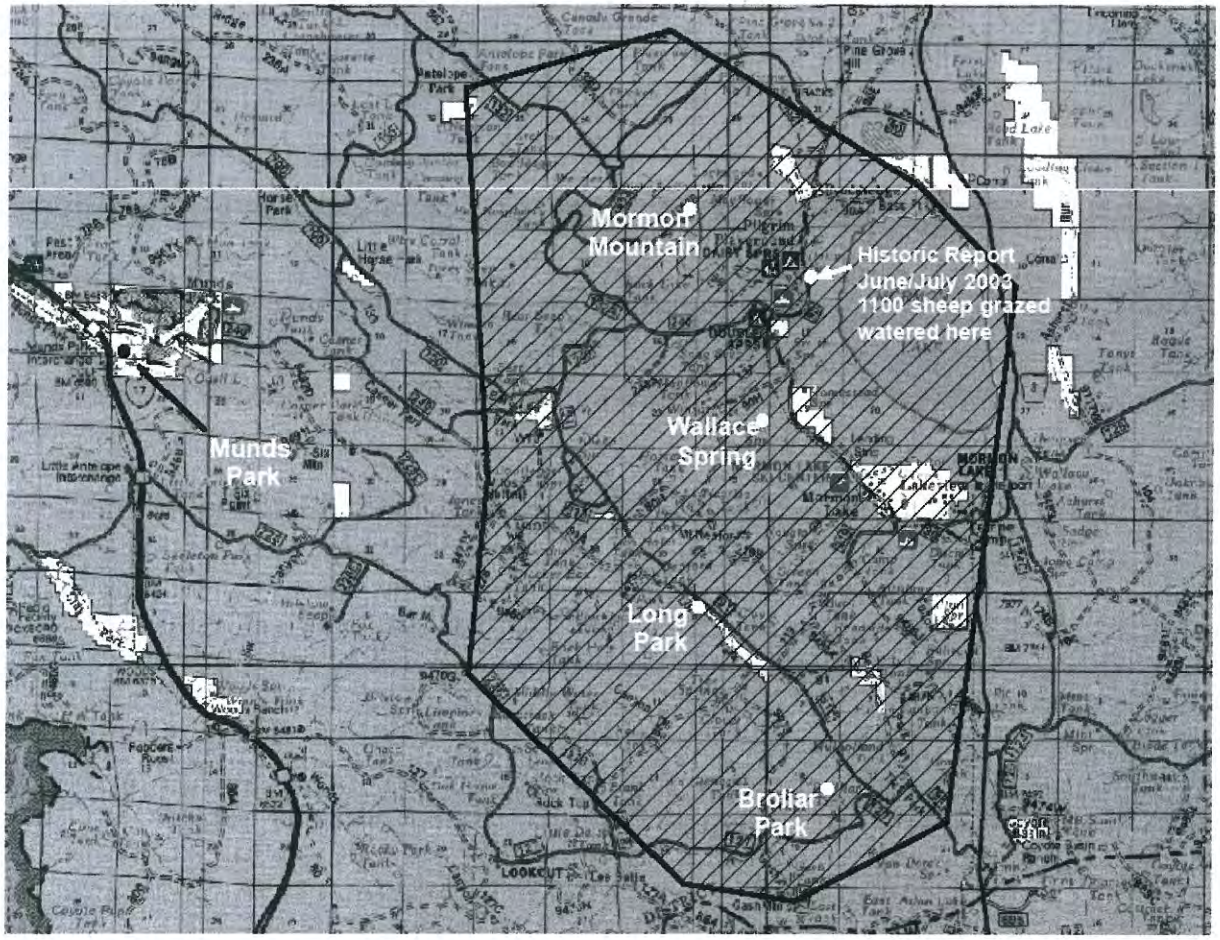
APPENDIX F - Sheep Treatment in the Mormon Lake Area, 2002-2006

Based on discussions with previous Coconino Forest range staff and local sheep operators, domestic sheep used to graze near Mormon Lake from approximately 2002-2006. The operator would truck approximately one-thousand sheep to Munds Park, unload the sheep, and then gather them again at Munds Park to be trucked to their next grazing area. The operator was granted free-graze in exchange for biological control of the leafy spurge. Specifically, the grazing plan involved grazing the spurge prior to its flowering stage to minimize seed production.

According to past conversations between Forest personnel and the sheep herders they used to graze about 1,100 sheep and were paid to rotate them through Brolliar Park to feed on the leafy spurge. One or two sheep would die every time they rotated through that area. From Brolliar Park they would move them up Long Park and then cross over toward Mormon Lake somewhere near Wallace Spring. From Mormon Lake they traveled north, then west, and then south around Mormon Mountain ending up back at Broillar Park. Figure F-1 shows the location of sheep grazing from 2002-2006. The black cross-hatched area indicates the general area where sheep could possibly have deposited dormant spurge seed during their grazing rotation. The rotation required several weeks to complete. The exact route used to move sheep from Munds Park to Brolliar Park is not known.

The Apache Maid Allotment is situated immediately south of the leafy spurge focus area. Past Forest range personnel report that the sheep herders were known to open gates, thus allowing access to Apache Maid rest pastures. The frequency that that actually occurred is not known. There seems to be no evidence that "quarantine areas" were to be used to delay the sheep long enough for them to pass spurge seed (had any been ingested).

The area where the sheep grazed is now known as the Mud-Tinny Allotment. Prior to that it was the "Lockett Allotment" and Joe Lockett used to graze it exclusively with sheep until 1959. However, the first confirmed leafy spurge reports were not documented until the late 1990's.

Figure F-1. Location of sheep grazing from 2002-2006.

The hatched polygon shows the area of sheep grazing.