January – December 2007 Annual Report

Fort Lewis Conservation Project

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Fort Lewis is a key military installation and the most important conservation area in the Puget Trough region. The Nature Conservancy strives to assist Fort Lewis in the conservation of its natural resources within the framework of the Fort's military training mandate. Fort Lewis and The Nature Conservancy have shared interests because:

- ***Healthy natural ecosystems are essential for realistic and sustainable training lands.***
- ***Rare species recovery throughout the region reduces the burden of recovery on any single landowner or site.***
- ***Pest plants harm natural areas and reduce their suitability for military training.***

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Project Overview

Fort Lewis continues to play a vital role in the regional effort to restore western Washington prairie and oak habitats. The Fort has the largest and best quality remnants of these threatened habitat types, and The Nature Conservancy is assisting the Fort to reach its conservation goals. Fort Lewis and The Nature Conservancy have a shared vision of conservation at the Fort which simultaneously promotes sustainable military training lands and robust natural ecosystems. The following three points provide a framework for this vision.

1. *Healthy natural ecosystems are essential for realistic and sustainable training lands.*
2. *Rare species recovery throughout the region reduces the burden of recovery on any single landowner or site.*
3. *Pest plants harm natural areas and reduce their sustainability for military training.*

The open structure of prairie and oak woodland habitats is highly desirable for military training and essential to many rare species. These habitats are currently threatened by invasive trees, shrubs and weeds that can quickly degrade large areas into dense woodlands and brush patches with reduced visibility and native diversity. It is realistic to pursue a vision of prairie and oak ecosystem management that supports sustainable military training and conservation values simultaneously.

Fort Lewis has developed a number of valuable plans to guide conservation actions, including the Fort Lewis Fish and Wildlife Plan, The Integrated Natural Resources Management Plan, Endangered Species Management plans, the Pest Management Plan, the Installation Sustainability Program and the prairie and oak management plans. Such plans demonstrate the Fort's commitment to conservation on its training lands and throughout the region. These plans share common goals with The Nature Conservancy's Ecoregional Planning and Conservation Area Plan, which identify prairie and oak habitats as critical conservation targets.

Robust native ecosystems are more resilient to the impacts of training and better able to support rare species. Degraded oak and prairie habitats can be restored and maintained to provide the open habitat structure that is beneficial to training and conservation. High quality natural areas that are used for compatible types of training can be managed to provide maximum conservation benefit. It is also important that critical natural processes, such as fire, be in place to help maintain desired habitat structures.

Invasion by pest plants is one of the most significant threats to the Fort's training lands. These pest plants degrade training areas, displace native plant and animal communities, and dramatically modify existing habitats. Once established, many of these invasives can be nearly impossible to eradicate using practical control measures. Known noxious weed infestations must be persistently and effectively controlled in training areas. New infestations need to be discovered and controlled before they degrade training lands and become unmanageable.

Proactive management of candidate and rare species can eliminate the need for them to become federally listed as threatened or endangered and greatly reduce regulatory burdens. Depending on species requirements, rare species habitat can be compatible with various types of military training. Rare species populations should be established and or enhanced where compatibilities exist.

Prairie and oak woodland conservation is most effective when conducted in a coordinated and comprehensive manner throughout the region. Region-wide proactive recovery efforts increase the likelihood of success. This is especially true with rare species recovery where the regulatory burden can be reduced for single landowners. Effective collaboration facilitates the sharing of information and techniques among partners and focuses recovery on the most appropriate sites in the region. Also, increased funding opportunities often result from cooperative recovery efforts.

Fort Lewis uses many approaches to promote its regional conservation goals. Direct funding provides Fort Lewis, TNC and others with the opportunity to conduct habitat enhancement and species management on base. Fort Lewis' Forestry program also provides funding for habitat work. Additional funding from the Legacy and Army Compatible Use Buffer programs and other Defense sources facilitate improvements region wide. This multi-pronged approach has proven an effective catalyst to establish and energize local conservation partnerships. As the partnership has grown, so have the opportunities to reach our mutually held goals of sustainability.

Fort Lewis Conservation Project

Review of 2007

In spite of two unforeseen complications in 2007, TNC was able to maintain a high level of productivity at Fort Lewis. Access restrictions during the peak of weed control season caused several planned activities to be uncompleted. Similarly, the cool, wet summer altered growth patterns, which restricted or altered many planned activities. In spite of these complications, TNC and Fort Lewis Fish and Wildlife staff were able to complete all of our major shared goals. Due to an increase in staffing and training, Fort Lewis Fish and Wildlife staff were able to make significant contributions to several joint projects and our combined resources allowed us to adaptively respond.

We have advanced our management strategies in several new areas. Treatment monitoring and trials have helped us to develop several new weed control protocols that are lower risk for people and the environment and are more effective. We have implemented a new cavity creation program to benefit cavity dependent wildlife. We have also initiated an experimental design to improve our planting efforts and butterfly enhancement activities.

The summary table below presents highlights of the conservation activities accomplished in 2007 with a comparison to 2005-6 activity.

Summary of significant 2007 conservation actions on Fort Lewis, with 2005-6 comparison.

Invasive Plant Control	**2006**	**2005**
• Treated approximately 2300 acres of Scotch broom on:	2074	1340
○ 2035 acres of prairie for rare butterfly, streaked horned lark, Mazama pocket gopher and general prairie enhancement.	1680	990
○ 265 acres of oak and pine to enhance understory structure, remove encroaching Douglas-fir and enhance western gray squirrel habitat.	394	350
• Controlled 19 species of invasive weeds – five of which were in aquatic environments.	19	11
• Removed and girdled encroaching Douglas-fir from about 142 acres of prairie.	387	100
• Controlled 53 acres of reed canarygrass along Muck Creek.	5	
• Implemented weed control trials to inform management protocols on several species.		
Enhancement Plantings		
• Developed and implemented a butterfly habitat enhancement plan with experimental design. Planted 17,000 plugs and direct seeded.		
• Initiated work on EcoPark landfill restoration project. Conducted site preparation and planted 600 plugs in a planting trial.		
• Added 5760 ft^2 of covered growing and other improvements space at Shotwell's Nursery.		
Miscellaneous Conservation Actions		
• Installed 108 in-tree nesting cavity structures for birds and mammals.		
• Continued restoration work on William's Pipeline project at 13th Division Prairie.		
• Conducted salmon spawning enhancements project at Mortar Point 13.		

INTRODUCTION

Conservation at Fort Lewis

Fort Lewis and The Nature Conservancy (TNC) have had a long and successful partnership that is based on mutual interest in maintaining healthy prairie and oak ecosystems and rare species recovery. The Fort contains many of the largest and best quality remnants of the prairie/oak mosaic in Western Washington and is therefore the most important conservation area in the Puget Trough region for this habitat type. For more than a decade, Fort Lewis resource managers have provided funding, support and guidance for the management of these critical habitats both on the Fort and in the region.

Conservation of these ecosystems and associated rare species is mutually important to both the Fort and TNC. The open structure of prairie and oak woodland habitat is highly desirable for military training and essential to many rare species. These habitats are currently threatened by invasive trees, shrubs and weeds that can quickly degrade large areas into dense woodlands and brush patches, with reduced visibility and native diversity. It is realistic to pursue a vision of prairie and oak ecosystem management that supports sustainable military training and conservation values simultaneously.

In total, the prairies and oak woodlands on Fort Lewis comprise a large area with a multiplicity of training and conservation needs. Noxious weeds can quickly become unmanageable and threaten continued degradation of important habitat structures in both oaks and prairies.

The onslaught of non-native invasive weeds has contributed to the decline of many native species. In the prairies, streaked horned lark, Mazama pocket gopher and several species of butterflies have suffered significant declines. Western gray squirrels are associated with oak habitats and have declined dramatically. On-the-ground management for rare species largely includes controlling invasive pests and enhancing native habitat components such as planting species that provide important forage and structure.

Wet and mesic prairies are one of the least understood components of the south Puget prairie system. Prairie sites near water or with significant soil moisture were often the first sites to be settled and cultivated. As a result, there are few current or recorded examples of these ecological communities, and those that do exist are seriously degraded. There are opportunities on the Fort and in the region to enhance or re-establish prairie habitat in moist areas, but there is little information to guide the effort. Most of the work to-date has focused on filling that information gap.

Riparian and aquatic sites have also received targeted conservation focus at Fort Lewis. Aside from the conservation values associated directly with the streams and the aquatic species they contain, riparian corridors are often a focal point for diversity in surrounding uplands. Conservation actions include controlling invasive weeds, enhancing native plant communities and improving stream channels that have been impacted by historic land management actions.

2007 Annual Report

This report provides an overview of the past year's conservation activities at Fort Lewis relating to the prairie/oak mosaic. It is a compilation of previous quarterly reports and provides general details relating to project objectives and outcomes.

Twenty task orders were active on Fort Lewis during 2007. These are listed below along with their TNC grant ID numbers. An additional contract with the Williams Pipe Company was developed to restore their recent pipeline upgrade work at 13th Division Prairie. For the purpose of grant tracking, the activities conducted under each task order are summarized in *Appendix I*.

TABLE 1: 2007 FORT LEWIS ACTIVE TASK ORDERS			
Ft Lewis Cavity Creation	3871	Ft Lewis Pine and Oak	4823
Ft Lewis Gophers 06	3872	Ft Lewis Water Howellia	4825
Ft Lewis Training Lands	3873	Ft Lewis Eagles	4826
Ft Lewis Prairie FY 06	3874	Ft Lewis Prairies 2007	4827
Ft Lewis Butterflies	3876	Ft Lewis Upland Weeds	4828
Ft Lewis Larks FY06	3877	Ft Lewis STHL 2007	4830
Ft Lewis Muck Creek	3879	Ft Lewis Butterflies	4831
Ft Lewis Howellia	3887	Ft Lewis Gophers	4833
Ft Lewis Cavity Creation	4822	Williams Pipeline	3010
		Legacy – Seed Production	4816

PRAIRIE HABITAT MANAGEMENT

Prairie management at Fort Lewis is guided by several converging conservation targets. Each conservation target has specific threats which must be addressed. Conservation targets include, the prairie habitat itself, rare prairie butterflies, Oregon vesper sparrow streaked horned lark, purple martin, western toad and Mazama pocket gopher. Each target has similar, yet distinct needs. By addressing a range of key targets, the variability of the prairie system should be largely captured in our conservation efforts.

Priority Prairie Management Areas

Although Fort Lewis has numerous opportunities for prairie enhancement, current resources are not sufficient to launch an intensive restoration effort on all potential sites. Instead, available resources must be thoughtfully allocated in order to sequentially improve conditions for priority prairie sites and conservation target species. Past and present prairie work has focused largely on the two main priority management sites: Johnson/Weir Prairies and 13th Division Prairie. Although Fort Lewis' Artillery Impact Area contains some of the very highest quality prairie, management activities must be severely limited in this area due to ordinance training.

Johnson and Weir Prairies are some of the highest priority prairie areas for conservation on the Fort. They have high quality plant communities and the presence of conservation target species, including valley silverspot and Puget blue butterflies, Oregon vesper sparrows, Mazama pocket gophers, western toad and several rare plants. They are heavily impacted by Scotch broom though the level of infestation has declined significantly over the past ten years due to intensive control efforts.

Thirteenth Division Prairie contains a matrix of degraded and higher quality prairie habitat. Portions of this prairie are now protected from heavy training impacts as riparian buffers and Special Use Areas. Even the most heavily degraded areas contain prairie soils thus providing an excellent opportunity for prairie restoration. Previous efforts to control Scotch broom on 13th Division Prairie have improved vegetation structure and have begun to reduce infestation levels in many areas. This prairie is home to several rare conservation target species including the streaked horned lark, Oregon vesper sparrow, several rare plants and Puget blue butterfly.

Another area of emphasis on Fort Lewis is the Muck Creek Corridor and its wet/mesic prairies. Muck Creek is one of the most significant tributaries for anadromous salmonids in the Lower Nisqually River. The creek is particularly important habitat for chum salmon, winter steelhead, and sea-run cutthroat trout. Coho salmon have also been recently documented in the creek. The broader Muck Creek riparian corridor has also become a focus for upland restoration. It contains areas of quality native prairie and serves as a significant wildlife corridor for the northeastern portion of the base. However, the corridor faces serious challenges from habitat modifying invasive weeds in both upland and riparian conditions. Because of its unique habitat conditions and aquatic conservation target species, the Muck Creek corridor has been given a restoration emphasis.

SCOTCH BROOM CONTROL

Scotch broom control continues to be one of the primary conservation actions necessary to maintain prairie habitat structure. With its ability to quickly and severely alter prairie structure, broom poses an extreme threat to virtually all prairie dependent species, including each of the current conservation target species.

Scotch broom management involves an integrated approach. A combination of mechanical cutting, hand-pulling, herbicide, fire and biological methods have been employed to reach a desired end-state of minimal maintenance. Mowing has been used to successfully kill very mature broom plants and periodic mowing of younger plants (every 2-3 years) will restrict extensive seed production. Periodic mowing does not effectively kill broom however, and lethal control measures such as fire or herbicide are required. These tools can be highly effective at reducing the amount of broom if the seed bank has been largely reduced. To get to this point of control, it is imperative that broom patches are not allowed to bloom extensively. Once broom has reached a very low infestation level, hand pulling becomes a practical maintenance strategy, even across large areas.

In addition, biological controls are being investigated by various agencies and universities. A few biological control agents are on the base, but their effectiveness is not expected to provide a satisfactory level of control. However, any tool that helps restrict seed production is a welcome addition.

A reliable, well designed strategic prescribed burn plan will be the only feasible way to control Scotch broom at larger scales, while simultaneously providing ecological benefit to these fire dependent communities. This has not been available over the past decade. Fort Lewis Fish and Wildlife and TNC are working to develop capacity to implement a collaborative ecological prescribed burning program. This will hopefully be initiated in summer and fall of 2008.

2007 Review

TNC was able to conduct about 2,070 acres worth of broom controlling activities on 1240 acres of prairies in 2007 (many acres had multiple treatments). We mowed broom on 819 acres, hand-cut broom on 505 acres and spray treated 752 acres. In many of the highest priority prairies, years of integrated broom control is beginning to pay off. In these areas, broom densities and seed banks have declined. We have entered a new period of broom control on the high priority prairies, they should continue to require a much reduced level of effort to keep the broom invasion at bay.

2007 had an unusually cool and moist summer, and many of the native forbs did not senesce at usual. This put them at risk to herbicide during late summer spray treatments. Due to these circumstances, we decided to only boom spray in the most degraded areas and concentrate on careful spot treatment. As a result, many scheduled areas were not treated this year.

The broom control summary table below indicates locations, acreages and task orders for each action. The broom control prairie maps at the end of this section provide locations for 2006 broom treatments.

SCOTCH BROOM SUMMARY TABLE

January-March

- *13th Division – Muck Creek Triangle*. Mowed 19 acres of broom and an additional 66 acres were 'spot mowed' to control patches that were missed during 2006 broom spraying. -3874
- *13th Division – Pacemaker Landing Strip.* Mowed 15 acres of dense broom and blackberry that were missed or not successfully killed by the 2007 spray treatment. -3874
- *Upper Weir Prairie*. Mowed 61 acres of dense broom along the western side of the prairie and an additional 27 acres was 'spot mowed' to control denser patches of broom that threaten to bloom in 2007 -3874
- *South Weir Prairie*. Mowed 8 acres in the south west corner and spot mowed 38 acres of patchy broom. -3874
- Johnson Prairie. Mowed 10 acres of broom in the west side of the prairie and spot mowed 12 acres of broom patches that were missed during the 2006 spray treatment. -3874
- *Upper Weir Prairie*. Mowed 66 acres of dense broom along the western side of the prairie. -3876
- *Upper Weir Prairie*. Mowed 65 acres of dense broom along the western side of the prairie -4827
- *Lower Weir Prairie*. Mowed 20 acres of broom on the east edge. -4827
- *Johnson Prairie.* Mowed 15 acres along the outside road edges of the prairie. -4827

April-June

- *Muck Creek Triangle - A* total of 200 acres of the highest quality prairie were brushcut to control scattered flowering scotch broom plants. -4833
- *Johnson* - All of the Johnson Prairie core area (170 acres) was brushcut to control scattered flowering scotch broom plants -4833
- *Upper Weir* - About 75 acres of the highest quality polygons at Upper Weir were brushcut to control scattered flowering scotch broom plants. -4833
- *South Weir* - About 65 acres of the highest quality polygons at Upper Weir were brushcut to control scattered flowering scotch broom plants. -4833
- Analyzed 10 Scotch broom control pilot plots testing effectiveness of reduced herbicide levels and crop oil. -3874

July-September

- *Pacemaker.* Conducted spot treatments on 121 acres of Scotch broom and boom treated an additional 40 acres. -4830
- *Upper Weir*. Spot treated Scotch broom on 76 acres of the highest quality polygons. Conducted a large-scale boom application test of crop oil to control broom. -4831
- *South Weir.* Spot treated broom on 72 acres. -4831
- *Muck Creek Triangle.* 173 acres of the highest quality prairie were spot treated to control broom. An additional 40 acres of lower quality were treated with tractor boom and hand wand. -3874
- *Johnson.* All of the high priority habitat at Johnson Prairie (190 acres) was spot treated to control broom. An additional 10 acres were boom treated in the southern corner. -3874
- *Broom Control Study.* Completed six different treatments for broom control study. -3874

October-December

- *Upper Weir Prairie.* Mowed 182 acres of Scotch broom along western edge. -4833
- *Pacemaker.* Mowed 181 acres of broom around core STHL area. -4830

Tasks

Broom control activities of 2007 are described in the sections below for each of the focal prairie restoration sites. Each section provides a comprehensive look at how the control strategy of mowing, spraying, fire and cutting is working and gives an outlook for upcoming requirements. Unless otherwise stated, all broom spray treatments were made with 1.5-3% Triclopyr amine with 0.25% Nufilm as an adjuvant. Treatments made earlier in the season generally were made with lower percentage concentrations and gradually increased as plant activity slowed later in the season. Maps of the broom treatment areas are provided at the end of the broom section.

2007 was a problematic year for spray treatment. It remained cool and wet throughout the season, and many native forbs didn't senesce. Because of the high numbers of active native plants, we decided that we would only boom spray in the most highly degraded areas, where native plants were virtually non-existent. Spot treatments were conducted with an elevated level of precaution for non-target impact.

Scotch Broom Control Pilot Study – 13th Division Prairie. In summer 2006, we set up a simple pilot study to evaluate the relative effectiveness of a variety of broom control herbicides, concentrations and adjuvants. This pilot study serves a three-fold function: to help fine-tune effective herbicide concentration rates; to determine if salt based triclopyr (ester) could be as effective as oil based (amine); and to see if crop oil surfactant alone could be effective at killing scotch broom. During spring 2007, we conducted careful analysis of the ten broom control test plots. Eight out of ten treatments seem equally effective including Garlon 4, Garlon 3A (2.5%) and crop oil without any herbicide. The lowest rates of Garlon 4 (0.5%) and crop oil (2%) were found not as effective.

As a result of this trial, we switched from Garlon 4 to Garlon 3a a chemical with less impact to invertebrates and labeled for use near water. We have also begun further evaluation of crop oil as a control method.

Scotch Broom Control and Native Response Test Plots – Lower Weir. This newly implemented study compares the efficacy of different control treatments and effects on non-target native vegetation. Five different treatments and a control were replicated three times in 20 meter transects located in the southern portion of Lower Weir Prairie. Of these transects, half were mowed recently (average height <0.5m) and one-half were not so recently mowed broom (average height ~2m). The treatments included 2% triclopyr ester with 0.5% crop oil adjuvant; 1% triclopyr ester with 0.25% NuFilm IR; 3% triclopyr amine with 0.25% NuFilm IR; 5% paraffin crop oil; 5% vegetable crop oil. Within the study block, a total of 180 1x1 meter plots were randomly sampled in the transects. Additionally, three 2x2 meter plots were treated with grocery store varieties of soybean oil, canola oil, and safflower oil. No vegetation data was recorded for these, but all included scotch broom. All plots will be revisited next spring to monitor the effects of treatments.

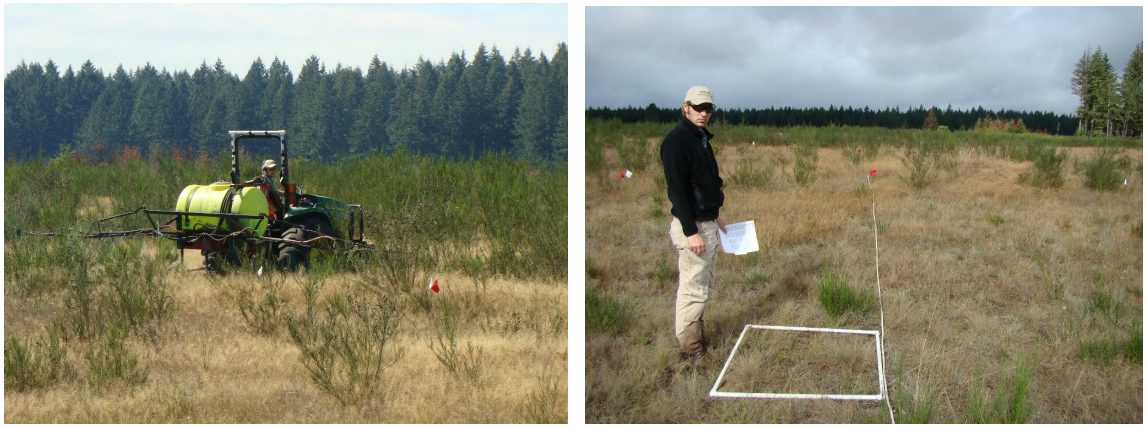

Figure 1: Implementation of the broom control study at Lower Weir Prairie, Fort Lewis.

Johnson Prairie. Johnson remains one of the highest priority prairie habitats. We have made tremendous strides at Johnson Prairie over the past three years. Relentless broom cutting and prescribed burning over the past decade appears to have dramatically reduced the broom seed bank. Recent herbicide treatments have significantly reduced the number of broom plants throughout much of the site. Looking forward, the level of effort that will be required to manage broom will be greatly reduced.

Figure 2: Johnson Prairie in spring 2007 showing virtually no mature Scotch broom.

Due to the high level of broom control, very little mowing should be required at Johnson Prairie in the future except around the outside road edges. This year, we mowed about 22 acres on the eastern edge and a few dense patches of broom that were missed during the 2006 spray season. During spring, an additional 170 acres (the entire core

prairie) were brush cut to control the few plants that were flowering and threatened to set seed.

At the end of summer, when most of the native pant species had senesced, 190 acres of the cut broom was spot sprayed with triclopyr amine and an additional low quality 10 acres at the southern tip was boom sprayed. After repeated control efforts, infestation levels have been dramatically reduced. Certain areas continue to show significant re-sprouting and will need continual follow-up. Treated broom plants were still relatively short and minimal herbicide was required to gain effective coverage. Almost all of Johnson prairie was surveyed and treated.

Broom control in 2008 will continue to require less effort. No mowing (except road edges) will be necessary, especially if an effective prescribed burn program can be established. A quick evaluation during the spring bloom period will be made to determine if brush cutting is advisable. Areas that are not scheduled to receive summer/fall fire will be surveyed and spot sprayed for Scotch broom.

South Weir Prairie. Similar to Johnson Prairie, the portion of South Weir west of the pipeline has been identified as one of the highest priority prairies and it has been treated with similar intensity and duration. East of the pipeline the prairie is greatly degraded and heavily infested with broom. During winter, a 10-acre patch of dense broom was mowed on the southern edge and the entire site was “spot mowed” where dense patches of broom remained. Additional hand cutting was conducted in spring over the whole area to remove plants that were in flower. This was followed-up in August with a spot-treatment.

Looking ahead to 2008, broom densities have been greatly reduced west of the pipeline. This area is difficult to burn because of the smoke risk to the adjacent Rainier Road. It will likely require continual spot treatment and hand-pulling.

Upper Weir Prairie. Upper Weir has a mixture of quality and treatment history. The highest quality portions are in the southwest, with poorer quality prairie in patches along the eastern side. The highest priority portions of this prairie have been intensively managed with a combination of mowing, brush cutting and herbicide and are on-track to reach low-maintenance level for broom control by 2009 or 20010, depending on the area.

During winter 2007, we mowed close to 200 acres along the west edge to control seed set and as preparation for fall burning. Additional acreage to the east was scheduled for boom treatment. However, the prescribed burn never happened and the conditions were not conducive to boom treatments. In order to keep the broom controlled, the same area and an additional 30 acres to the east was mowed again in fall 2007.

Southwest portions of the prairie have highly reduced broom infestation levels and are nearing “maintenance levels”. This 75 acres was hand-cut in the spring and followed-up with a quick summer spot spray treatment.

It will be critical to prescribe burn the western edge of Upper Weir in 2008 in order to kill broom. If conditions are right, we will also try to boom treat whatever else isn't burned or spot treated.

Lower Weir Prairie. Lower Weir is scheduled for a usage change that would permit training by heavy vehicles. The higher quality eastern edge of the prairie may remain off limits to vehicles. Since prairie restoration resources are limited, and Lower Weir is largely of poorer quality, this prairie is not likely to receive as the same intensive treatment as the rest of the RTA. Available resources will be directed along the medium quality eastern edge. Fire should become the primary tool for broom control on this prairie.

Figure 3: Before and after mowing at Upper Weir. Broom growth is up to three feet after one season.

In 2007, we mowed 20 acres along the eastern edge, adjacent to a large mowed polygon that was treated by Fort Lewis LRAM crew. This and additional sites were scheduled as a lower priority for spot and boom treatments, but weather conditions and resources did not permit. We hope to be able to expand our active management area on Lower Weir in 2008.

13th Division – Muck Creek Triangle. The Muck Creek Triangle (the area between Muck Creek and South Creek) is one of the highest priority prairies, in the same rank as Johnson and South Weir Prairies. This area has been intensively managed for broom as well, and many portions are at a low maintenance condition.

This year we were able to quickly spot treat the areas that were sprayed last year and expand our intensive management area. Significant spot mowing was conducted to remove tall dense patches of broom that were not effectively controlled by 2006 spraying. In spring, 200 acres were hand-cut to control blooming broom. This entire area was spot sprayed in summer plus and additional 15 acres of low quality prairie that were selectively "spot boom sprayed".

Figure 4: Muck Creek Triangle Area south of South Creek showing low density dead broom.

The Scotch broom control is highly progressed. Much of the area will only require annual spot treatment and hand-pulling to maintain broom. This area will also benefit from regular prescribed burning.

13th Division – Pacemaker. The Pacemaker area is the portion of 13th Division Prairie that provides core habitat for streaked horned lark, a federal candidate species. Portions of this area are of mid-to-high quality and have low density broom infestation. Other portions are highly degraded and overrun with broom and blackberry. The highest priority portion is adjacent to and to the west of the landing strip. Much of this core area has been intensively managed over the past few years. A large prescribed fire occurred in 2005.

We conducted some winter mowing to control patches of broom that were missed or unsuccessfully spray treated in 2006. This area was scheduled for significant ecological burning in summer 2007, which did not occur. As a backup, about 160 acres were spot and boom treated in September. The large polygon to the north has very minimal broom, especially after last year's successful spot treatment.

In order to restrict blooming and seed set in the core highly infested area to the south, we conducted extensive fall mowing. Many of these plants have been mowed repeatedly, and will quickly recover and set seed if not killed. Therefore, it will be critical to accomplish a successful burn in the larks core area in 2008. Burning in adjacent areas will also be highly beneficial.

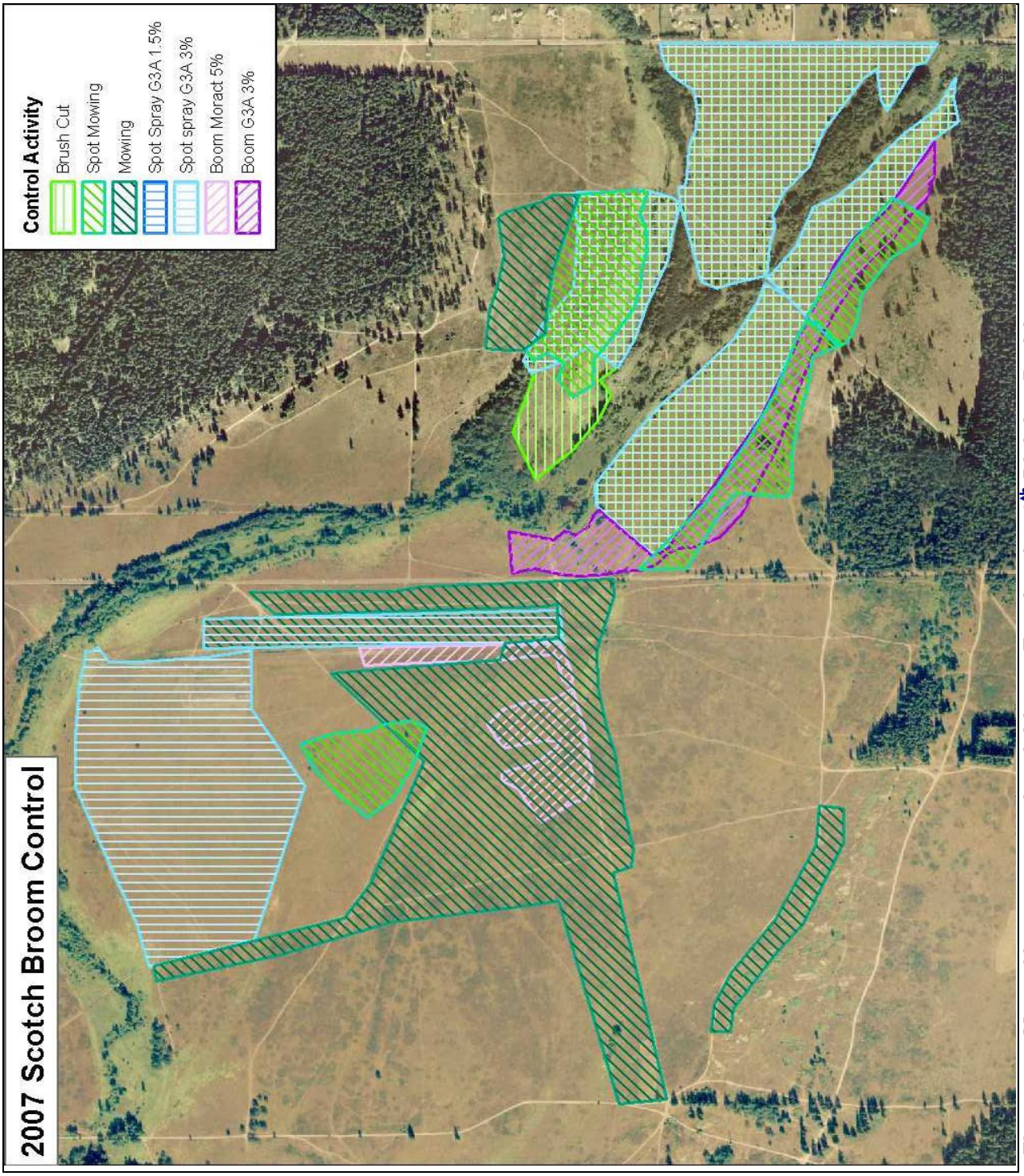

Figure 5:. Map of broom control activities at Fort Lewis 13th Division Prairie

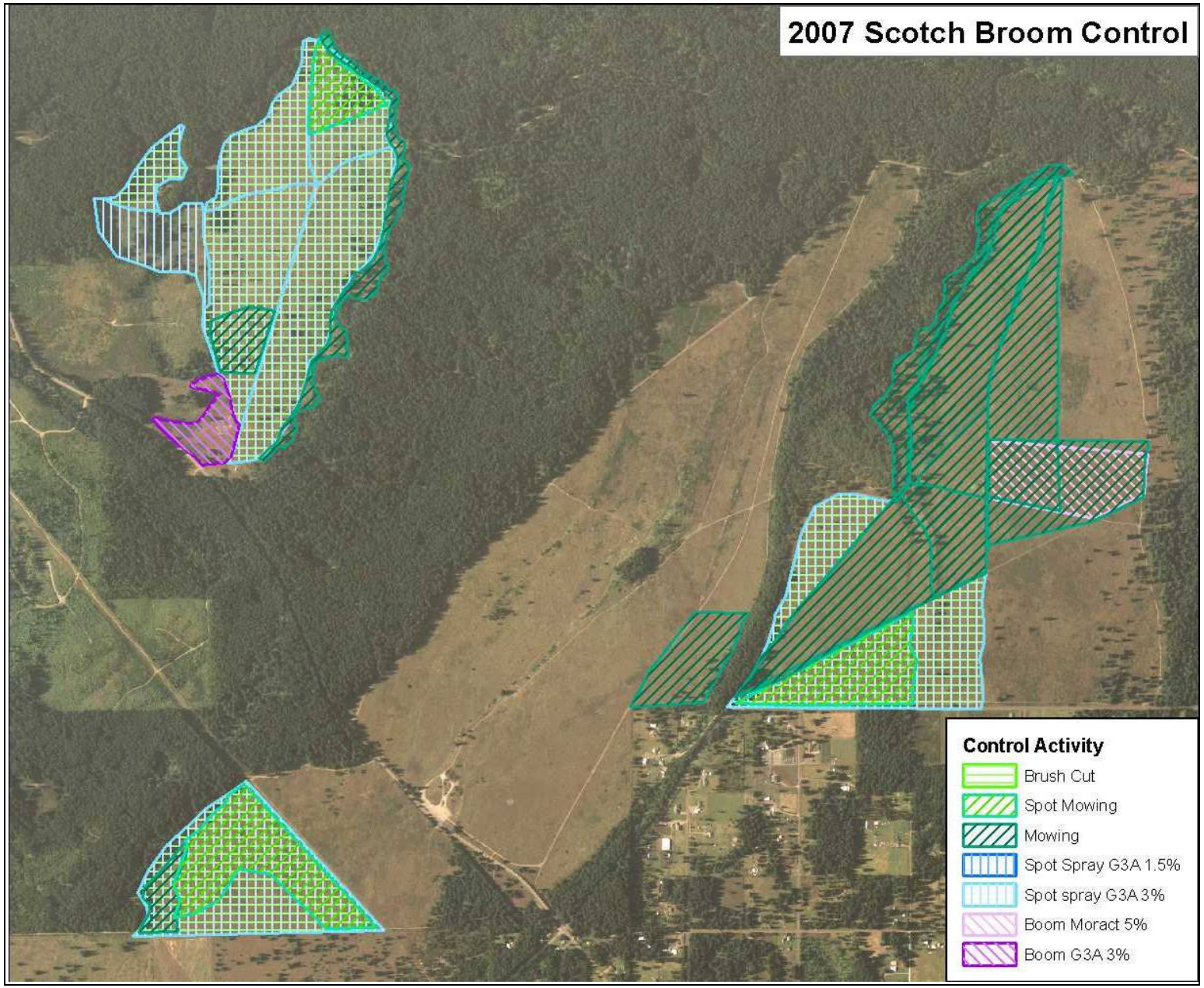

Figure 6:. Map of broom control activities at the Fort Lewis Rainier Training Area.

PASTURE GRASS CONTROL

With the significant decline of Scotch broom in priority prairie areas, non-native invasive pasture grasses have been given an increased control emphasis. Eurasian grasses pose a tremendous threat to native prairies. Many of these species are able to quickly degrade habitat quality and negatively impact native plant and animal populations.

This was the fourth year of gradually ramped up use of the grass specific herbicide Poast. Over the years, use of Poast has increased from small test plots to larger enhancement blocks – though in 2007 we were not able to treat any of the scheduled enhancement sites due to a protocol conflict with Fort Lewis Range Control. . Poast is labeled as a grass specific herbicide that does not harm forbs. With proper timing, Poast is able to impact pasture grasses and does not harm the dominant native Roemer's fescue grass. Many species of non-native grasses have not shown immediate control, and likely will require repeated treatments to eradicate.

Colonial bentgrass and tall oatgrass show significant resistance to Poast, and preliminary observations of a spring 2007 trial of Fusilade suggest that it may be better able to control pasture grasses and still will not impact native fescue.

Control of tall oatgrass, a highly invasive pasture grass, is reported in the invasive weed section of this report. This species still largely occurs in discrete infestations and is not ubiquitous across the prairies. In past years, we tried to treat tall oatgrass simultaneously with colonial bentgrass, with less than desirable results. Tall oatgrass needs to be treated sooner in the spring, and delaying treatment to better control colonial bentgrass has resulted in less-than-adequate control of the oatgrass.

2007 Review

As mentioned above, we were not able to treat the grasses in any of our scheduled enhancement plots this year due to a complication that resulted from scheduling and herbicide use protocols. The amount of colonial bentgrass in the previously treated sites remained reduced, but over the course of the cool, moist spring and summer, it is evident that even after three years of treatment we did not get sufficient control using Poast.

A series of test plots that targeted tall oatgrass were established to compare the effectiveness of Poast with Fusilade DX. Preliminary results show better reduction of bentgrass and oatgrass and no impact to native fescue using Fusilade. These plots will be evaluated in spring 2008 and could result in a switch from Poast to Fusilade.

PROPAGATION, ENHANCEMENT PLANTINGS AND RARE PLANT SPECIES

Prairie plant propagation is an important component of the prairie program. Seed collected from the prairies is used to propagate seedlings, which are strategically planted to meet the following objectives:

- Promote general species diversity in prairies;
- Fill available growing space after invasive plant control, road closures, etc;
- Enhance forage opportunities for conservation target animal species;
- Increase the counts of rare plant species; and
- Create managed seed banks.

Plantings and direct seeding are used to improve general prairie diversity. Core prairie conservation areas may have certain plant species underrepresented and plantings can be an effective way to increase their overall abundance. Likewise, core quality areas can be expanded or connected by planting a diversity of prairie species. Plantings and direct seeding can also be used to fill growing space that becomes available in a prairie after a non-native plant control treatment, disturbance or road closure.

Direct seeding is expected to become increasingly important as methods of restoring at large-scale are developed. The recent Collin's restoration experiment has helped to develop a technique to blend fire, herbicide and seeding to restore native diversity and abundance. The DoD Legacy project is facilitating this effort by funding efforts to develop propagation and seed production protocols for most of the local prairie plants.

Food sources are often the primary limiting factor for rare animal species. Plantings are used to increase the abundance of food sources for conservation target animals (primarily butterflies). They can also facilitate improvement, expansion and establishment of core habitat areas and improve connectivity between core areas.

2007 Review

It has long been recognized that we need a greater understanding of planting success rates for our enhancement plantings. This has proven to be a difficult task. As a result, this year's propagation and planting effort has been somewhat reduced, in order to allow a more rigorous (and labor intensive) planting design.

This year, about 41,210 prairie plants were propagated for Fort Lewis. Most of them were targeted for establishment in the 13th Division Prairie seed beds at the "Cultural Site". However, due to the spring herbicide restriction, a critical pretreatment was missed, which put the planting date off by one year. The surplus plants have instead gone to a newly developed butterfly habitat enhancement experiment and a pilot trial at the Sequalitchew landfill. At the end of December, 11,850 seedlings had been planted for 2007. The remainder will be planted in general prairie enhancement plantings during winter and spring or planted in the fall.

PRAIRIE PROPAGATION AND PLANTING SUMMARY TABLE
January-March • Propagated 41,210 seedlings for fall 2007 and winter 2008 (4816, 4831, 4827) • Installed 12 small seed beds and sowed with 12 rare prairie species.
April-June • Installed row cover frames on all seed beds and three 96'X20' cold frames with shade cloth for plug production - 4816 • Installed irrigation in seed beds and cold frames – 4816 • *Sequalichew Ecopark* - Boom sprayed 10 acres of capped landfill to control non-native grasses and forbs as site preparation for future enhancement plantings. Conducted follow-up spot treatment. -4827 • *Pipeline* – Hand controlled weeds at pipeline restoration site to protect emerging native plants near creeks. -3010
July-September • Collected seed from 61 species of prairie plants -4816. • Conducted several nursery trails to guide management protocols – 4816 • *Sequalichew Ecopark* - Conducted follow-up weed spot treatment as site preparation -4827
October-December • Planted 11,250 seedlings and broadcast seeded an equal area with native forb species as part of an experimental butterfly habitat enhancement project -4831. • Planted 600 seedlings at Sequalitchew landfill prairie enhancement site as part of a preliminary pilot study -4830 • *Pipeline* – Boom sprayed pipeline area to control invading weeds - 3010 • *Pipeline* – Delivered 250 tons of topsoil to north pipeline area -3010. • Sowed about 25,000 plugs for spring transplant into legacy seed beds. -4816 • Cleaned, processed and weighed collected seed – 4816 • *Sequalichew Ecopark* - Planted all plug plots, marked seed plots for winter seeding – 4830.

Prairie Plantings

As mentioned above, general prairie enhancement plantings were not conducted in 2007. About 25,000 plugs that remain from the Legacy seed project are scheduled for planting in winter and spring 2008. However, plantings were made for specific projects, and will be discussed under the butterfly enhancement and landfill sections.

Pipeline Restoration

In mid-2006, TNC contracted with Williams Pipeline Company to restore the portion of their gas pipeline project where it crossed 13th Division Prairie at the Muck Creek Triangle. Of the almost one-mile long project area, about 800 feet passes through higher quality prairie, 400 feet goes through medium quality prairie, 800 feet through riparian and aquatic habitat and the remainder through degraded prairie habitat. The disturbed area that resulted from the pipeline work is adjacent to a Fort Lewis road and averages about 70 feet in width.

The previously mentioned spring restriction on herbicide use also impacted the pipeline project, and effectively set it back by about one year. Due to the unexpected access restrictions set in place from early May through the end of June, several herbicide spraying activities didn't happen. However, as a positive result, several native prairie species germinated unexpectedly in the pipeline near Muck and South Creeks, many of which are likely wet prairie species. This accidental result should prove valuable to future wet prairie restoration efforts. After the discovery of these species (including the very rare blue toadflax) by Fort Lewis staff, The Nature Conservancy worked cooperatively with Fort Lewis to rid the area of weeds by hand-pulling.

A fall treatment of the pipeline was conducted to control invasive grasses and forbs. Aquamaster was used in areas that had not been previously planted with fescue. A combination of Fusillade DX and Garlon 3a was used over the fescue planted area. After this treatment, 240 yards of topsoil/compost mix were delivered from the Fort Lewis EcoPark, to be spread across the northern stretch of disturbed soil where native topsoil had bee largely lost.

Figure 7: Topsoil delivery at Williams Pipeline restoration site.

Sequalitchew Earthworks Landfill Restoration

Sequalitchew Earthworks is located on and managed by Fort Lewis. The site has several landfill mounds that have been capped with sand and gravel and an impermeable poly-liner. Landfills represent a regional opportunity to conduct grassland habitat restoration, which could eventually support conservation target animal and plant species. Due to the size of the landfill site, it is not practical to rely on plug planting to establish native plants. Though some targeted planting will probably be a helpful tool, direct seeding will likely prove more effective at large-scales.

TNC and Fort Lewis have conducted soil moisture measurements and extensive site preparation for future native plant establishment at the Earthworks site. During spring,

TNC boom sprayed 10 acres of the central capped landfill with a 2% Roundup solution to control weed grasses and forbs. Initial control was quite good. A follow-up spot treatment was conducted in summer to control new germinants and re-sprouts that mostly occurred in the lower elevation wetter areas. There is still a significant weed seed bank to contend with, and it is recognized that a large-scale restoration effort is best held off for one and possibly two years of additional herbicide treatments.

In spite of seed bank concerns, we decided to initiate a plug and direct seed pilot study to provide initial information on species establishment and survival. In December, five plots were marked out. Each plot will have two seed sub-plots and one plug plot. The plug plots were planted in December: six species planted at 100 of each species in each plot. Species planted include: *Lupinus lepidus*, *Lomatium utriculatum, Microseris laciniata, Ranunculus occidentalis*, and *Camassia quamash*. Soil conditions were very wet at the time of planting.

Figure 8: Earthworks Landfill restoration site map and plot establishment photograph.

Legacy Seed Production

The project as a whole has progressed as planned – with the exception of site preparation for the Ft Lewis seed beds located at 13th Division Prairie, which was delayed due access complications. Otherwise, objectives of the first phase of the project have been met. Major project infrastructure has been designed and installed, source plants for seed production have been grown in plugs and in seed beds, and early trials have been conducted to inform conservation and cultivation practices for the plant species included in the project.

Seed Production Boxes. Prior to January 2007, 40 large seed production boxes (32'x 4') were installed, filled with growing medium, and sown with seeds collected during the 2005 and 2006 collection seasons. During 2007, an additional 12 smaller boxes were built or retrofitted, filled with soil, and sown with target species. These boxes are intended to produce a foundation for several rare species. Species include: *Calindrinia ciliate, Aster hallii, Brodeia hyacinthine, Lomatium bradshawii, Sidalcea nelsonii, Erythronium oregonum, Lotus nevadensis, Aster eatonii, Brodeia congesta, Silene douglasii, Linaria Canadensis,* and *Sisyrinchium angustifolium*

Figure 9: Photograph of Legacy seed beds constructed in 2006 and hoop houses under construction in 2007.

Irrigation. As an evaluation, three different types of irrigation systems have been installed in the seed boxes. One block of boxes that contains species with reasonably well-known irrigation needs has been installed with a microsprinkler system. This block receives even overhead irrigation delivered at a very low flow rate, and is connected to a solenoid valve which is programmed weekly according to rainfall. A second group of boxes has been installed with high-pressure drip emitters designed to operate concurrently and on the same solenoid valves as the third type of irrigation, overhead misters. A fourth group of boxes remains without irrigation, and is hand-watered infrequently, as per the needs of the species contained.

The entire system is controlled automatically on five different zones which can be programmed according to changing irrigation needs throughout the year. Also, the system of mainlines and lateral lines has been designed for flexibility over the course of the project. As seed crops germinate, grow, mature, and produce seed, their irrigation requirements will change. For example, most of the annual crops are fitted with overhead misters and programmed to run for shorter periods but more frequently, a requirement for germinating seeds directly in the beds every year. Perennial crops that initially need to be germinated in their beds are fitted with the same overhead misters, but can easily be refitted with drip emitters once the crop has reached an appropriate stage.

Row Cover and Crop Protection. Over half of the large seed production boxes have been fitted with frames designed to hold row cover cloth, germination misters, shadecloth, or poly cover. These multipurpose frames have been used to provide early frost protection for annuals, and to hold overhead misters. They will be useful in later

stages of the project for the above-mentioned uses as well as reducing winter rain leaching, conducting a variety of trials, providing shade cover, seed collection, and preventing unwanted inundation of winter rainfall. It may be necessary to build these frames for up to eight more crops, most of which are planted in the smaller boxes.

Ground Cloth. A weed barrier has been installed surrounding all seed production boxes to prevent invasion of weeds and reduce weed seed in beds.

Plug Production. The majority of infrastructure work done during this period has been for the plug production area. The goal for plug production was to build a production area that is easily serviceable, and that provides all components necessary for the production of high quality plugs deliverable on a precise schedule. The plugs grown for this project are to be transplanted into seed production areas outside of the nursery.

Plugs produced for this project need to be grown in an ambient temperature nursery, also known as an "outdoor" nursery. The existing plug production area at the nursery was improved and expanded to provide increased growing capacity. A bulldozer was contracted to grade and level the site. Two terraced areas were created to account for slope. The area was then spread with gravel and drainfields were installed in appropriate areas. An access road was cut to reduce labor during delivery.

Once the site work was completed, engineered non-code metal cold frame buildings were purchased and transported. Three 96' x 20' buildings covering close to 6,000 square feet of production space were installed. They provide a rough capacity for a total of 140,000 forbs at a time. Two of the coldframe buildings were fitted with 55% shadecloth, an essential component to growing perennials in low-volume plugs.

Each coldframe structure has been installed with overhead nursery sprinklers with anti-drip valves, 4X overlap patterning to ensure even water delivery, and a small droplet size designed for seed germination and root development in small plug sizes. Each coldframe irrigation system operates on a separate valve and can be programmed individually. Each system has been installed with an in-line water soluble fertilizer dispenser and 120-micron filter, and contains a head assembly that can be modified if necessary to include a more advanced fertilizer, pesticide, or algaecide injector assembly.

Fifty-five 8'x 4' nursery tables were constructed in addition to the original forty-five tables at the nursery, to allow for the total capacity of the coldframe structures. Each coldframe houses 33 growing tables. Each table has space for 1,400 1.5" diameter ray leach conetainers.

In fall 2007, we sowed about 25,000 plugs of 28 species to augment existing perennial seed beds and to spring transplant winter annuals into seed beds.

Nursery Trials. We have also begun several nursery trials to help improve nursery management and answer important questions. These trials are briefly listed below.

- Two separate irrigation methods are applied during growing season to otherwise identical production beds.
- Developed an improved system for seed drying using simple hand-made Remay bags.
- Completed 100 count samples weighed to milligram accuracy to enable accurate weight-count estimates.
- Conducted germination pretreatment trials to develop protocols for stratification.
- Conducted seed lot viability trails
- Conducted nutrition, mychorrhizae and growth medium trials in seed beds.
- Initiated evaluations of alternative plug container sizes and plug growth medium
- Installed several native bee nesting cavities to improve cross pollination

Figure 10: Legacy project seedbed layout with species and sowing dates.

Legacy Rhinanthis Christ-galli sown Oct. 24 '06	Legacy Collinsia parviflora sown Dec 12 2006
Legacy Gilia capitata sown Oct 24 '06 low priority, might be yanked to make room for something else	Legacy Viola adunca trnsplnted Oct 24 2006
Legacy Triodanis perfoliata sown Nov 04 '06	Legacy Arabis glabra sown Nov 04 2006 germ obsvd Dec 12
Legacy Camassia leichtlinii sown Nov 04 '06	Legacy Silene antirrhina sown Nov 04 2006
Legacy Plagiobothrys figuratus sown Nov 04, germ early Dec '06	Legacy Delphinium nuttali sown Nov 2006
Legacy Gaillardia aristata sown Dec 13 '06 w/seed from '05 and '06	Legacy Lomatium nudicaule sown Nov 2006 oversown Dec 13
Legacy empty as of Dec 13	Legacy Lupinus lepidus trnsplnt Dec 06 2006 Rod salvaged from Ft
Legacy CLAM sown Oct 24 '06 germ Nov 03 '06	Legacy Perideridea gairdneri sown Dec 13 2006
Legacy PLCO sown Oct 24 '06 germ Nov 06 '06	Regional VIAD sown Nov 09 '06
Legacy Trifolium tridentatum sown Nov 2006 poss germ Dec 12 oversown Dec 13	Regional CAHI sown Nov 09 '06 overseeded Dec 13 w/ '05 chaff
Legacy Camassia quamash v. azurea sown Nov 2006 oversown Dec 13	Regional ERLA sown Nov 09 '06
Legacy Brodiea coronaria (?) needs follow-up id confirmation sown Nov 05 2006	Regional LUAL sown Nov 09 '06
Legacy Lupinus lepidus trnsplnt Dec 08 2006 Rod salvaged from Ft	Regional MILA sown Nov 09 '06 germ early Dec '06
Legacy empty as of Dec 13	Regional SOSP still to sow
Legacy VIAD trnsplnted Oct 26 trnsplt Oct 25 2006	Regional LOUT sown Nov 09 '06
Legacy Arabis hirsute v. eschscholtziana sown Nov 04 '06 germ Dec 06	Regional LOTR sown Nov 09 '06
Legacy Trifolium microcephalum sown Nov 04 2006 poss. germ obs Dec 13	Regional SOMI sown Nov 09 '06
Legacy Zigadenus venenosus v. venenosus sown Nov 04 2006	Regional DACA trnsplnted Dec 13 '06 sown Dec 13 '06
Legacy Fritillaria affinis (lanceolata) sown Nov 04 2006	Regional DASP sown Dec 13 '06
Legacy Lupinus lepidus trnsplnt Dec 06 2006 Rod salvaged from Ft	Regional POGR sown Nov 07 '06

Seed Collection

Seed from about 61 species of prairie plants was collected and cleaned by Fort Lewis and TNC staff and volunteer crews during the late spring and early summer Seed was collected from numerous sites, on and off Ft. Lewis and from Shotwell's Legacy seed beds. Some seed was used in fall for plug production and direct seed trials. Other seed will be used for large-scale seed production and additional plug production.

TABLE 2: List of seed collected in 2006 by TNC staff and volunteers and Fort Lewis staff.

Master Seed Collection Sheet 2007	Bald Hills	Ft. Lewis		Glacial	Mima Mounds	Rocky Prairie	Sergeant Road	Scatter Creek	Shotwell's	Volfhave	Total	Total for General use (less BH & RP)
		Rod's List & Seed Plot	TNC						Beds			
Achillea millefolium	no		C,Sept	C,Sept	Sept & C	77.536		C-Sept			77.536	0.000
Agrostis diegoensis				Yes							0.000	0.000
Antennaria neglecta		TA15		Yes							0.000	0.000
Apocynum androsaemifolium		Sept	Sept			Oct					0.000	0.000
Aquilegia formosa				Yes					Yes		0.000	0.000
Arenaria stricta v. puberulenta		No									0.000	0.000
Armeria maritima v.californica		52.300							219.004		271.304	271.304
Asclepias speciosa		No									0.000	0.000
Aster chilensis ssp. hallii		No									0.000	0.000
Arabis hirsuta									Yes		0.000	0.000
Balsamorhiza deltoidea		190.257	489.727	12.079				401.713	3.422		1097.198	1097.198
Barbarea orthoceras		TA6									0.000	0.000
Brodiaea congesta		No									0.000	0.000
Brodiaea coronaria		7S									0.000	0.000
Brodiaea howellii		No									0.000	0.000
Brodiaea hyacinthina			7S	Yes							0.000	0.000
Bromus sitchensis	43.883										43.883	0.000
Calandrinia ciliata		No									0.000	0.000
Camassia leichtlinii		No							Yes		0.000	0.000
Camassia quamash			27.225	241.037							268.262	268.262
Campanula rotundifolia		TA 6,14,15		Yes							0.000	0.000
Cardamine pulcherrima		UW									0.000	0.000
Carex inops				No	1.561	?			15.796		17.357	17.357
Castillja hispida	1.219		3.134						56.244		60.597	59.378
Cerastium arvense		TA14, UW,JP			No	Yes					0.000	0.000
Clarkia amoena	4.475										4.475	0.000
Collinsia grandiflora		No									0.000	0.000
Collinsia parviflora		No									0.000	0.000
Danthonia californica	50.744	Yes	66.769	420.403	140.590	30.475			405.481	No	1114.462	1033.243
Danthonia spicata	No		No	8.700	No					No	8.700	8.700
Delphinium nuttallii		TA 15		Yes						Yes	0.000	0.000
Dodecatheon hendersonii		No	No	No							0.000	0.000
Dodecatheon pulchellum		TA15									0.000	0.000
Elymus glaucus	Yes		TA12,UW	Yes							0.000	0.000
Erigeron philadelphicus		No									0.000	0.000
Erigeron speciosus			JP			78.339			1800cu.		78.339	0.000
Erigeron strigosus		No									0.000	0.000
Eriophyllum lanatum	13.050		21.568	4.339	17.725	7.350			167.29		231.323	210.923
Festuca roemeri	13.050		JP,UW	Yes	193.382	159.666					366.098	193.382
Fragaria virginiana (stolons)				No	Yes	Yes					0.000	0.000
Hieracium cynoglossoides		No		Yes		No					0.000	0.000
Koeleria cristata	1.227		UW, 19D	Yes	Yes	Yes		Yes			1.227	0.000
Linanthus bicolor v. bicolor		No									0.000	0.000
Linaria candaenis		TA15									0.000	0.000
Lithophragma parviflorum		No									0.000	0.000
Lomatium nudicaule		TA14	264.847								264.847	264.847
Lomatium triternatum			248.431	321.960		2.492		246.210			819.093	816.601
Lomatium utriculatum	4.870	92.979	213.722	No	37.182	13.680			X, C	85.973	448.406	429.856
Lotus nevadensis v. douglasii		No									0.000	0.000
Lupinus albicaulis			36.920	183.951		7.170			Yes	No	228.041	220.871
Lupinus lepidus v. lepidus			1.300	0.796		2.673			Yes	No	4.769	2.096
Lupinus micranthus (L.bicolor)			7S,TA14	No							0.000	0.000
Microseris lanciniata		8.25	7S	Yes	Yes	163.918			Yes		163.918	8.250
Montia linearis		13D,TA13&15									0.000	0.000
Panicum occidentale			No	Yes	Yes	1.374				No	1.374	0.000
Panicum scribnerianum			No	Yes	No	No				No	0.000	0.000
Perideridia gairdneri											0.000	0.000
Plagiobothrys figuratus		TA15									0.000	0.000
Plagiobothrys scouleri		TA15									0.000	0.000
Plectritis congesta	8.253						64.609		137.517		210.379	202.126
Potentilla gracilis		R76		Yes	1.524	12.961					14.485	1.524
Ranunculus occidentalis			7S	16.581	58.861				311.583		387.025	387.025
Sanicula crassicaulis		No									0.000	0.000
Sanicula graveolens		7S, UW									0.000	0.000
Senecio macounii		No									0.000	0.000
Silene douglasii v. douglasii		Sept									0.000	0.000
Silene scouleri v.scouleri		Sept		Sept							0.000	0.000
Sisyrinchium angustifolium		R76		Yes							0.000	0.000
Solidago spathulata		Seed Plot,LW		Yes	Yes	6.708			Yes		6.708	0.000
Solidago cand. &/or missour.											0.000	0.000
Trifolium microcephalum		No									0.000	0.000
Trifolium tridentatum		MP13									0.000	0.000
Trillium parviflorum			TA14	Yes							0.000	0.000
Triodanis perfoliata		TA15							Yes		0.000	0.000
Viburnum ellipticum		No									0.000	0.000
Vicia americana v. villosa		No									0.000	0.000
Viola adunca			No	3.999	3.913	0.615		1.141	133.721	0.016	143.405	142.790
Viola nuttallii v. praemorsa			2.315					Yes			2.315	2.315

RARE BUTTERFLIES

The Fort Lewis Military Installation is regionally important because it contains the largest remaining prairies in South Puget Sound and provides critical habitat for a number of rare and declining butterfly species. These include: the mardon skipper (*Polites mardon*), Taylor's checkerspot *(Euphydryas editha taylori),* zerene fritillary (*Speyeria zerene bremnerii*), and the Puget blue (*Icaricia icarioides blackmorei*). The first two species, the skipper and checkerspot, are candidates for federal listing under the Endangered Species Act (ESA). Within Fort Lewis, they are currently restricted to a single locale, the Artillery Impact Area (AIA). The other two butterfly species populations have declined from historic conditions, but exhibit a more widespread distribution on Fort Lewis prairies.

The 2004 report entitled *Habitat Enhancement for Rare Butterflies on Fort Lewis Prairies* by Cheryl Fimbel provides a good outline for management strategies for rare prairie butterflies. Three prairies in the Fort Lewis landscape are identified as high priority sites on which to enhance the composition, structure and processes of prairie habitat. The selection was limited to three prairies in order to concentrate resources into high quality habitat patches in three locales, rather than scattering resources widely across multiple prairies, with fewer significant improvements. The three high priority prairies, the Artillery Impact Area, the 13th Division Research Natural Area (RNA), and Johnson Prairie, were chosen based on their current and historical use by rare butterflies, availability of native prairie vegetation, the presence of diverse structural features, and compatible land uses.

Butterfly habitat enhancement consists of controlling habitat modifying invasive weeds and strategically increasing abundance and diversity of plant species that provide nectar and forage for the various butterfly life stages. While butterfly funding is intended to promote butterfly conservation, butterfly enhancement work simultaneously promotes healthy prairies that support a wide range of native plants and animals.

2007 Review

As usual, habitat enhancement was a major focus main emphasis of this year's butterfly work. Enhancement work largely consisted of Scotch broom, and is reported above. An important advance was made this year with the completion and implementation of a butterfly habitat enhancement plan, which is described below. TNC staff also worked with Chery Schultz on her Poast/butterfly plots.

BUTTERFLY SUMMARY TABLE
April-May

- Reviewed and summarized history butterfly habitat enhancement work 2003 – 2006. -4831
- Developed Butterfly Habitat Evaluation to guide enhancement actions. -4831
- Prepared Butterfly Habitat Enhancement Work Plan -4831
- Collected 'pre-treatment' vegetation data to inform creation of checkerspot resource plots in the triangle portion of the 13th Division RNA between Muck and South Creeks. -4831
- Worked with Cheryl Schultz of Washington State University in a study testing the effects of

Poast herbicide on Puget Blue butterflies. -4831
July-September • *Butterfly Enhancement Plots.* Conducted site preparation on butterfly plots at 13th Division, TA 7S and Johnson. -4831
September-December • Planted 11,250 butterfly resource species and an seeded an equal area in 30 habitat enhancement plots. (4831)

Tasks

In spring 2007, collaborative discussions and field visits were held by Fort Lewis staff, WADFD biologists and TNC to help develop a butterfly habitat enhancement plan. The work was facilitated by Cheryl Fimble of TNC. During this process, we were able to review and summarize the history of TNC's butterfly habitat enhancement work from 2003 – 2006. We also developed a Butterfly Habitat Evaluation form to serve as a framework for enhancement targets. *A Butterfly Habitat Enhancement Work Plan* was developed that emphasized the creation of networks of small (~ 25 m^2) butterfly (primarily checkerspot) resource plots containing dense concentrations of larval host and adult nectar plants among a fescue prairie base. The complete butterfly habitat enhancement plan is available from TNC by request.

Sites at Johnson Prairie and TA7S were evaluated for weed control need during summer. Additional treatments will be required in 2008. Additional fieldwork consisted of collecting pre-treatment vegetation data to serve as a baseline for a series of enhancement plots at Pacemaker and Muck Creek Triangle areas. TNC staff worked cooperatively with Fort Lewis staff to prepare the butterfly enhancement plots according to the butterfly enhancement planting plan. Sites were prepared for fall enhancement plantings and direct seeding. All plots except those at the triangle, were discretely treated with 2% Razor Pro (glyphosate). Additional treatments were conducted at the Triangle site in accordance with the enhancement plan.

Fall planting and seeding was conducted by TNC and Fort Lewis staff at 30 enhancement plots. Each plot was plug planted on half the plot with the species listed below and the other half of each plot was seeded according to Table 3. (All plants except *Fragraria* were obtained from the Legacy seed project as surplus.)

26 - *Balsam* (BADE)
148 - *Castilleja* (CAHI)
42 - *Eriophylum* (ERLA)
60 - *Frageria* (FRVI)
36 - *Armeria* (ARMA)
63 - *Lomatium utric* (LOUT)

Table 3: Seed used in each half-plot of butterfly enhancement trial.

Species	seeds/m^2	seeds/12.5m^2	Approx. Grams per 1/2 plot
Armeria maritima	75	938	2.5875
Balsamorhiza deltoidea	8	100	0.885
Castilleja hispida	120	1,500	0.165
Eriophyllum lanatum	75	938	0.225
Lomatium triternatum	40	500	2.73
Lomatium utriculatum	75	938	1.3875
Plectritis congesta	100	1,250	0.43
Plantago lanceolata (1/4 tsp = 13 germinants)			2 Tablespoons

2008 Outlook

Results from the experimental enhancement will begin to guide future enhancement actions as results are gathered in the coming seasons.

STREAKED HORNED LARK

The streaked horned lark (STHL) (*Eremophila alpestris strigata*) is a federal candidate species for listing under the Endangered Species Act. It is a priority for conservation on Fort Lewis which has three of the five known South Puget Sound populations. STHL are a grassland species that requires large open expanses and short, low density vegetation. Scotch broom and many sod forming pasture grasses create overly dense and tall habitat structure that is not suitable to the lark.

STHL are primarily found on airfields in the south sound area. Airfields meet their requirements for wide open spaces and sparse vegetation. There is only one population on Fort Lewis that TNC has regular access to perform enhancement actions: Pacemaker Airfield, an unused landing strip in 13th Division. This provides a core habitat area of some 250 acres surrounded by much larger open prairie. Scotch broom is a primary current threat to this habitat. Habitat work can sometimes be accomplished for populations of lark in the AIA (Ranges 76 and 51).

2007 Review

This year, most of the lark funding was directed towards STHL habitat enhancement and a habitat enhancement trial. A total of 181 acres of core lark habitat was mowed during the fall. About 161 acres of broom in core habitat was spot sprayed at 13th Division Prairie. These actions have significantly pushed back the broom in critical lark areas and will improved habitat for other prairie plant and animal species well. Scotch broom mowing and spraying activities are reported in the prairie broom section above. Continuing work was conducted on the lark habitat enhancement plots.

A large prescribed fire was planned for the Pacemaker lark habitat area, but did not come to fruition. Due to its ability to control large areas in an extremely affordable manner, fire is a critical tool for expanding the core lark habitat area. Every effort should be made to re-establish fire as the primary restoration tool in this area.

STREAKED HORNED LARK SUMMARY TABLE

April-June

- Mowed lark habitat enhancement plots (24 acres) -4830
- Conducted vegetation surveys on all lark habitat plots. -4830

July-September

- Spot treated broom in lark habitat enhancement plots (24 acres) -4830

Lark Habitat Enhancement Trial

In 2006, we initiated a streaked horned lark habitat enhancement trial to determine effective means to develop suitable lark habitat from areas that have become severely degraded. The project was developed with input from Scott Pearson, and designed to dovetail with elements of his habitat assessment work. It is currently being managed by Hanna Anderson. Further details on this experiment are available in experimental proposal submitted under 2005 Streaked Horned Lark Task Order.

In spring, we conducted follow-up treatments and vegetation surveys for seven test blocks at 13th Division near Pacemaker landing strip. Each block had six treatments for a total of 42 lark habitat plots. Each block is between two and four acres in size and a total of approximately 24 acres were surveyed. We planned to treat scheduled plots with Poast in spring, but were unable to due to unanticipated access conflicts. Scotch broom was successfully mowed in early spring.

In summer, we conducted treatments for seven blocks at 13th Division near Pacemaker landing strip to control Scotch broom with a solution of 3% Tryclopyr amine (Garlon 3a). This area was scheduled to be boom treated to control all broadleaf species, but boom treatments were restricted, so Scotch broom was spot treated instead. In addition, the blocks south of the landing strip burned during the summer, and may therefore have to be removed from the study.

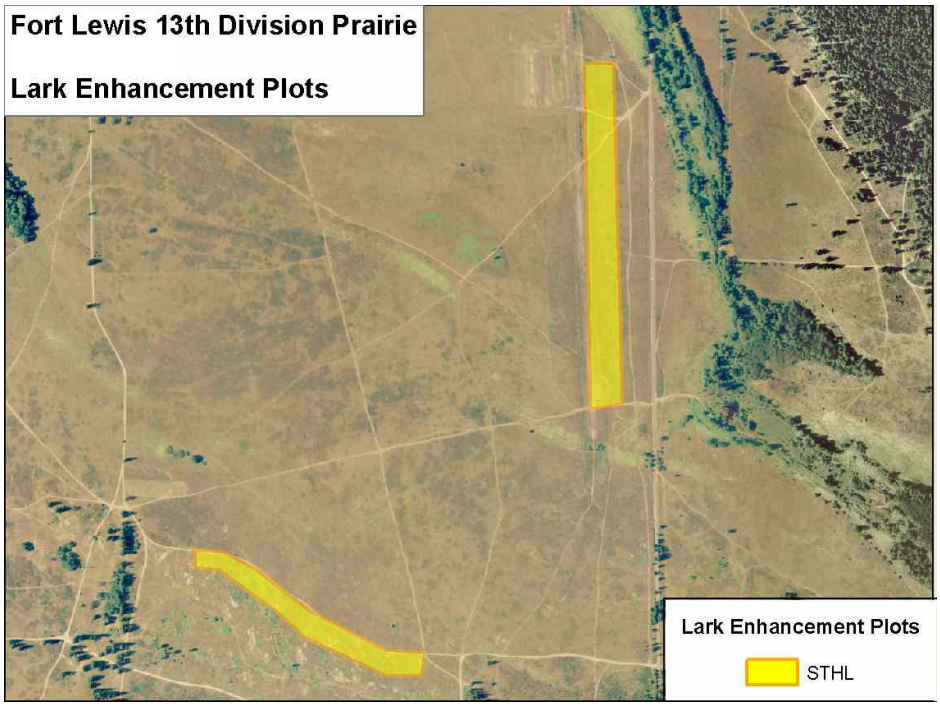

Figure 11: Streaked horned lark experimental habitat enhancement plots at 13th Division Prairie on Fort Lewis.

2008 Outlook

Though there have been many unanticipated problems with implementing the experimental design of this project, there is still enough reason to continue the project. We are currently in the process of entering vegetation data and can thereafter begin analysis of treatment results.

MAZAMA POCKET GOPHER

For years, pocket gopher recovery actions have been tied directly to general prairie enhancement. Though there is currently not a great deal of guidance for their recovery, it has generally been understood that the gophers are a fairly adaptable species, and will opportunistically feed on non-native plant species. Their biggest threat is the invasion of grasslands by woody species. Therefore, prairie broom and fir control actions have been tied to gopher recovery. Based on 2004 and 2006 surveys conducted by ENSR, current populations are thought to be strong on Fort Lewis prairies.

2007 Review

Broom control at the Rainier Training Area and 13th Division Prairie were the gopher habitat enhancement activities for 2007. See the prairie broom section above.

DOUGLAS-FIR CONTROL

Douglas-fir encroachment has long posed a serious threat to prairies. Prior to European and U.S. settlement, prairie fires largely kept Douglas-fir from colonizing prairies and oaks. Since the cessation of widespread fire, the trees have steadily taken over large tracts of former prairie. The threat continues. Prescribed fires, girdling and mechanical removal are effective methods of fir control.

2007 Review

In several areas, fir encroachment onto prairies was controlled while mowing Scotch broom. Our mowing decks are capable of cutting Douglas-fir up to about five inches in basal diameter. Most of the invading fir on our priority prairie habitats are much smaller than this. However, there are areas where fir have become well established and require chainsaws to control or mower access is not feasible. These trees are cut down, or preferably girdled to promote wildlife habitat for rare species, such as the western bluebird and purple martin. Trees are girdled with two horizontal cuts in past the cambium at least six inches apart.

DOUGLAS_FIR CONTROL SUMMARY TABLE
October-December

- *Central Impact Area.* Conducted oak release on about nine acres at two locations.
- *Artillery Impact Area*. Conducted fir and other tree girdling/removal in three locations on a total of 123 acres.

Tasks

Central Impact Area. About nine acres of fir were girdled or cut on two sites in the CIA during fall quarter by Fort Lewis and TNC crews. Actions were primarily targeted to release oaks around the edges of two small and highly encroached grasslands. Management objectives were met in these areas.

Artillery Impact Area. Continuing our effort from past years, TNC and Fish and Wildlife crews were able to get access to control invading fir at two sites in the AIA: one near Range 51and another just north of Exiter Springs. At a third site, we controlled a dense infestation of black cottonwood near Range 76. In total about 123 acres were treated, though we do not have accurate GPS data for treatment perimeters. The Range 76 site concentrated on cut-surface treatment of a large infestation of cottonwood in a core streaked horned lark use site Cut surfaces were immediately sprayed with a 15% solution of Garlon 3A.

2007 Douglas-Fir Outlook

Most of the invading fir in the CIA has been girdled in recent years, and the remainder can be managed with less urgency and as opportunity and resources allow. This year's three-day effort with TNC and Fish and Wildlife crews made a substantial dent in the massive fir invasion of the AIA. Although the AIA is over 7500 acres in size, large portions of this have little to no fir invasion. At the rate we are going, it is conceivable

that in another five years, we may be able to control all the major fir invasions on the AIA.

Figure 12: View of Artillery impact Area from southwest, showing fir invasion.

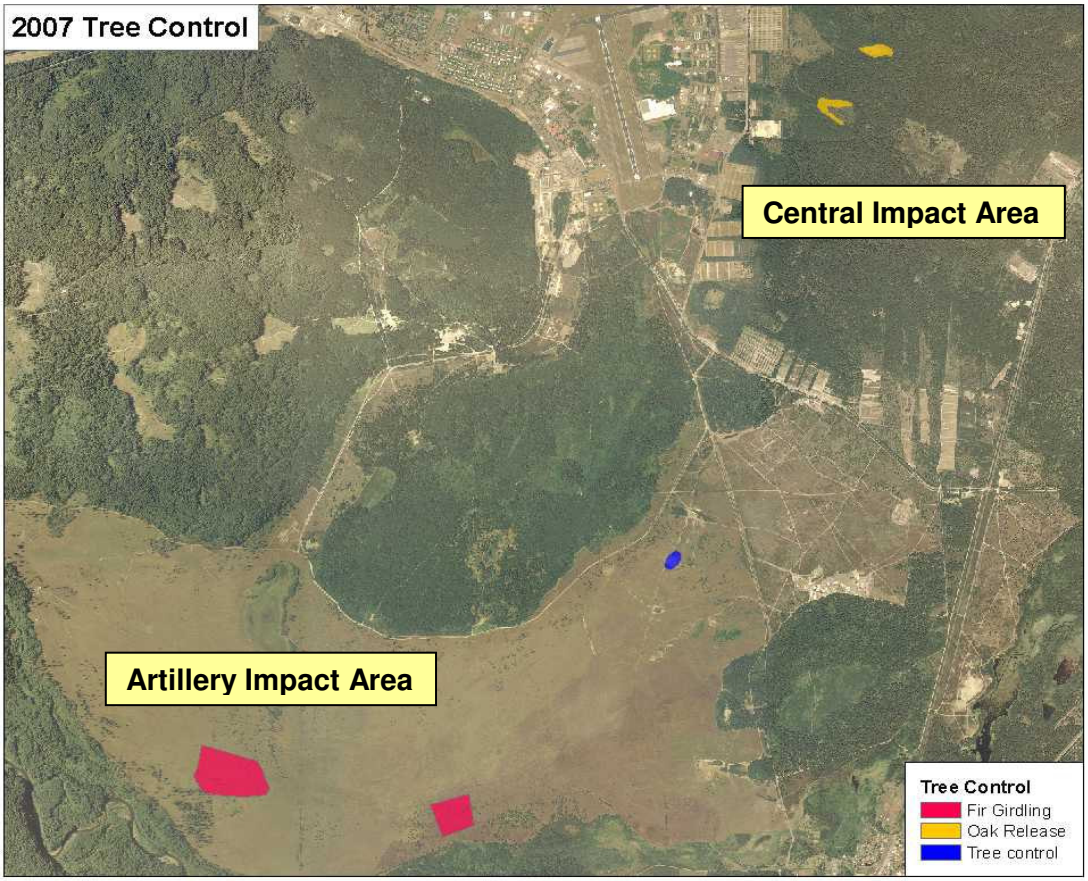

Figure 13: Map of tree control area in the Artillery Impact Area and Central Impact Area at Fort Lewis.

WET PRAIRIE

Wet and mesic prairies are one of the least understood components of the south Puget prairie system. Prairie sites near water or with significant soil moisture were often the first sites to be settled and cultivated. As a result, there are few current or recorded examples of these ecological communities, and those that do exist are seriously degraded.

It is suspected that wet prairie sites played important roles in the overall system. There are opportunities on the Fort and in the region to enhance or re-establish prairie habitat in moist areas, but there is little information to guide the effort. Most of the work to-date has focused on filling that information gap.

2007 Review

WET PRARIE SUMMARY TABLE
October-December
- Wet Prairie enhancement plot treated with Aquamaster in October - 4874

Muck Creek Mesic Prairie

A five-acre area north of Muck Creek has been treated periodically with Glyphsate since spring 2006 to prepare the area for larger scale mesic prairie restoration trial. The area selected had essentially no native species and given the history of the area it has likely been plowed in the past. We have expected it to take 2-4 years to successfully control the weed seed bank. This year we missed our scheduled spring treatment due to unanticipated access restrictions, and the site was quickly overrun with invasive forbs. In October we were able to conduct a boom treatment with 2% Aquamaster. By spring 2008 we will be able to better evaluate the need for continued treatments. Hopefully we will be able to begin seed trials in fall 2008.

OAK, PINE AND WESTERN GRAY SQUIRREL ENHANCEMENT;

The Oregon white oak woodlands were a critical component of the prairie/oak mosaic that was historically a dominant part of the south sound region. They provided necessary habitat for species like the western gray squirrel. In addition, a unique population of native western Washington ponderosa pine is native to Fort Lewis.

Many of the former south sound oak and pine woodlands and savannas have been lost to land development, timber harvesting, and the lack of wildfire that once restrained other aggressive tree and brush species. As a result, the remaining pockets of oak and pine are often degraded in habitat structure and threatened by severe competition and excessive fire hazard.

The western gray squirrel (WGS) is listed as threatened in the state of Washington, and is a federal species of concern for the western Washington region. Populations are small, scattered and declining, primarily due to the loss and fragmentation of oak woodland associated habitat. The only known extant population of western gray squirrels remaining in western Washington is found on Fort Lewis. This population was identified as a focal conservation target for the South Sound region, and appears to be persisting at very low numbers.

Several actions are underway that will improve prospects for western gray squirrels at the Fort. Habitat enhancement actions include planting additional food resources for squirrels, control of pest plants, and improving habitat structure through control of invasive woody species. Population monitoring provides information for targeted habitat enhancement and is a means to evaluate success of treatments. Monitoring also detects eastern gray squirrels (EGS) and is used to plan control measures. Recently, WDFW has become very involved in researching the population and developing a translocation program.

Habitat enhancement actions are currently focused on core WGS habitat, which includes portions of the CIA and areas to the east and southeast of the CIA. Current funding levels are sufficient to make slow gains on long-term core habitat improvement, but limit our ability to enhance additional areas. Fortunately, the Fort Lewis Forestry Department has taken an active interest in oak and pine habitat, and has made strides to improve stands of suppressed oaks outside of the WGS core.

GRAY SQUIRREL MONITORING AND EASTERN GRAY SQUIRREL CONTROL

Western gray squirrels on Fort Lewis are relatively difficult to survey because they are wary of people and adept at avoiding detection. A relatively new squirrel survey technique was tested in 2005. This method utilizes baited PVC pipes and adhesive strips as hair-snagging devices, and proved to be successful at detecting the presence of squirrels in wooded stands on Fort Lewis. As a result of this this, a WGS monitoring program was developed to detect presence/absence.

The WGS program has recently developed beyond a dominant need for tube monitoring. This year WDFW and Fort Lewis began an intensive radio telemetry and translocation effort. The need for tube monitoring has accordingly been reduced through much of the WGS range. It will continue to be used to inform invasion of EGS into the current "WGS hold zone" (the greater DeBalon area) where EGS will continue to be aggressively trapped and removed. No EGS trapping occurred in 2007 and indications are the DeBalon site remains free from re-invasion after the fall 2006 trapping session.

2007 Review

WGS MONITORING SUMMARY TABLE
January-March • Conducted general and post EGS control monitoring – 3901
April-June • Concluded post eastern gray squirrel control hair-snag monitoring. -4823 • Continued squirrel hair-snag monitoring in DeBalon control area.-4823
July-September • Monitoring put on hold while evaluating needs of expanding program.
October-December • Removed and redeployed hair snag tubes from squirrel triangle – 4823 • Coordinated squirrel management meeting with partners – 4823 • Completed drafts of two publications: one on tube monitoring and one on invasive squirrel control – 4823

Squirrel Monitoring

Monitoring for gray squirrel activity using hair snag tubes has been ongoing for nearly three years. To date, a total of 252 tube sites have been established. Many of the sites that have been found to contain western gray squirrel activity were identified within the first year by targeting sites with large conifers and oaks and relatively sparse understory vegetation within close proximity to water.

Eastern Gray Squirrel Control

Tube monitoring has been adapted for use with the eastern gray squirrel control program. After completing four trapping sessions in 2006, the hair-snag monitoring portion of the eastern gray squirrel control experiment ended with the final data collection conducted by Mary McCallum in April 2007. Data were collected from May

2006 through April 2007. The April 2007 data collection phase yielded more sites with western gray squirrel hairs and fewer sites with eastern gray squirrel hairs compared to the previous six to eight months.

During fall quarter, Sanders Freed and Cheryl Fimble completed drafts of two publications that describe TNC's squirrel work on Fort Lewis. Publications will be suitable for distribution to partners, and ultimately for publication. They are currently submitted for peer review.

- Fimbel and Freed: Monitoring western gray squirrels for management in western Washington
- Freed and Fimbel Invasive squirrel control – a trial on Fort Lewis, Washington

During summer and fall, TNC removed hair-snag tubes from old locations within the squirrel triangle and re-deployed them to new locations outside of triangle to inform future presence absence monitoring.

Squirrel Habitat Management Meetings
A cooperative WGS management meeting and fieldtrip was held in May with Fort Lewis Fish and Wildlife and Forestry, WDFW and TNC staff. It was largely intended as an information sharing meeting for the involved parties to help coordinate strategies around the WGS telemetry and translocation activities, monitoring, EGS control, and silvicultural prescriptions. From this meeting it was agreed that the DeBalon area would be continually monitored and trapped to control EGS, and modifications to thinning prescriptions were discussed to apply to squirrel sensitive areas.

In fall, TNC coordinated a second fall squirrel management meeting at Fort Lewis to review monitoring and WDFW research data and evaluate the need for further eastern gray squirrel control. All recent data suggested that eastern gray squirrels were at considerably lower levels in October 2007 than before the 2006 trapping, and there were no signs of an increasing population threat. Therefore, a decision was taken to re-deploy monitoring tubes in the 2006 trap zone in the late summer of 2008 to determine the need for a fall 2008 trapping effort.

DOUGLAS-FIR AND SCOTCH BROOM CONTROL

Douglas-fir and Scotch broom are the primary plant species currently threatening oak, pine and WGS habitats. These woody species are able to quickly dominate the understory of oak and pine woodlands and savannas, completely altering the historically more open structure. This creates undesirable qualities for the WGS and greatly increases fire fuel loads. In addition, Douglas fir is able to grow up through pine and oak canopies and eventually dominate. The same broom and fir control strategies used on the prairies are applied to the wooded habitats.

Woodland related work can be thought of as focusing on two slightly different aspects. Funding that comes from Fort Lewis Fish and Wildlife targets oak and pine enhancement with an emphasis on WGS recovery. Funding that comes from the Forestry Department emphasizes enhancement primarily of the woodlands themselves. Therefore, Fish and wildlife funding tends to focus on areas that are currently occupied by WGS or could be future habitat.

2007 Review

About 230 acres of pine and oak habitat were treated in 2007. Of this, 140 acres were mowed or cut for broom and small invading firs. This is the first year that we have conducted spot spray broom treatments under oak trees. A total of 92 acres of previously mowed broom was spot treated with a 1.5% solution of Garlon 3A (half the standard rate).

BROOM AND DF CONTROL SUMMARY TABLE

January-March

- Purchased herbicides for future invasive brush control work. -3901

April-June

- *Squirrel Triangle* – Cut Scotch broom and other invasive shrubs on approximately 140 acres of WGS habitat. -4823

July-September

- *Holden and DeBalon* – Spot treated 37 acres of Scotch broom in this key WGS site. -4823
- *Spanaway Marsh complex* – A total of 28 acres of broom were treated along Spanaway Marsh. -4823
- *Northern TA 8 & 9* – 26 acres of broom were treated in northern TA 8 and 9. -4823
- *POP* - Sponsored a volunteer day with injured veterans at the POP - 4823

Western Gray Squirrel Enhancement - Mowing

A total of 140 acres were mowed at 12 different sites throughout Training Areas 8, 9 and 10. Scotch broom and small Douglas-fir were primary targets for mowing. Sites were selected based their continuing history of broom control, proximity to core WGS use areas and as pre-treatment for follow-up spray treatment.

Western Gray Squirrel Enhancement - Spraying

Many of the priority enhancement sites have been repeatedly mowed in the past and are at a point where they require fire or herbicide to control the broom. Broom has begun re-sprouting rapidly after mowing, and we can no longer keep up with the areas we have mowed. Although fire is a preferred method to kill broom, it has proven unreliable to schedule. For this reason, we conducted our first under-oak herbicide broom control this summer.

Treatments were conducted in September, which is late in broom treatment window. We used half the standard rate of Garlon 3A (1.5%) with NuFilm as an adjuvant. Late treatment and low concentrations were used to minimize the potential to negatively impact oaks. The solution was used at a low rate to make sure that incidental injury to oak trees would be minimized. These factors do not create a quick control response in broom, but early indications suggest that a very high percentage of broom will be killed by spring 2008.

2008 Outlook

Upcoming projects will be established with Fish and Wildlife based on new funding. We anticipate sufficient fund to continue broom control actions. This will likely include working through previously sprayed area to cut any missed patches in spring 2008. We will identify areas to expand intensive broom control.

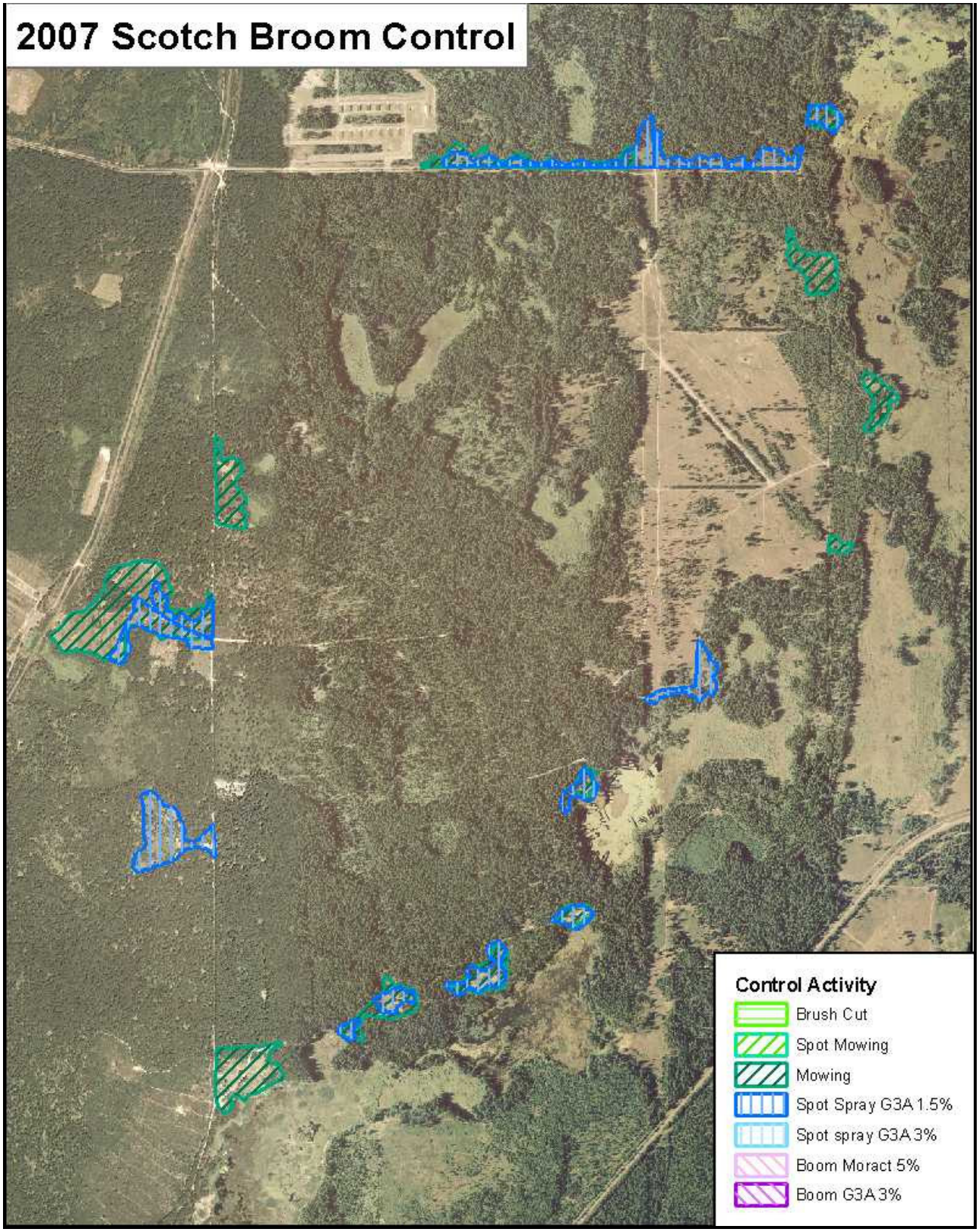

Figure 14: Map of 2006 oak enhancement areas in Training Areas 8, 9 and 10 at Fort Lewis.

CAVITY CREATION

Historic industrial forest management practices have led to a dramatic decrease in the abundance of snags and decaying large wood. Species that rely on cavities for some aspect of their life cycle have declined in many areas. In 1995, Fort Lewis adopted new management guideline which favored retaining more of the natural features common in forests, including snags and decadent trees. Although there is now an existing mandate for this type of habitat tree retention, little remains. The project is designed to introduce cavities at sites favorable to certain cavity using species- such as the wood duck (*Aix sponsa*), and increase the number of standing dead trees for primary and secondary cavity nesters, such as purple martins (*Progne subis*). In addition to these species, bats, western gray squirrels, bluebirds and white breasted nuthatches have been targeted.

2007 Review

This was the first year that we have implemented a cavity creation strategy. We started the year contracting with a highly experienced tree climber/arborist during winter quarter. During this period, one of our staff was trained by the contractor to conduct many of the cavity creation techniques that require climbing (short of tree topping). Several TNC and Fort Lewis staff have been trained to create cavities from the ground. Since that time, our staff has conducted all cavity work.

In total, we created 108 "structures", including cavities, cave starts, topped trees and bat cavities. Of these, 39 were created primarily for wood ducks, 30 for purple martin, 10 for western gray squirrel, 20 for blue birds, four for bats, one for nuthatches and 4 for general purpose. Early monitoring of cavities indicates better than expected use of new cavities.

OAK PLANTING SUMMARY TABLE

January-March

- *13th Division Muck Creek*. Inserted 2 wood duck cavities. -3871
- *13th Division South Creek.* Inserted 1 wood duck cavity. Topped 8 trees for purple martin nesting. -3871
- *Cat Lake.* Created 1 bat roost. Inserted 4 wood duck cavities. -3871
- *Dailman Lake.* Inserted 5 wood duck cavities. -3871
- *Fiander Lake*. Inserted 3 wood duck cavities. Inserted 2 small cavities. Topped 5 trees for purple martin nesting. Created 1 bat roost. -3871
- *Hamilton Lake.* Inserted 3 wood duck cavities. -3871
- *Jolly Lake.* Inserted 3 wood duck cavities and 1 small cavity. Created 1 bat roost. -3871
- *Lower Weir Prairie.* Topped 3 trees for purple martin nesting. Created 1 bat roost. -3871
- *Ranger Lake.* Inserted 3 wood duck cavities. Topped two trees and created hole start in 1 tree for purple martin nesting. Created wildlife cavities in 1 cedar stump. -3871
- *Training Area 11.* Inserted 1 squirrel cavity. Inserted 1 white-breasted nut hatch cavity. -3871

April-June

- *Sequalichew Ecopark* - Created seven cavities for bluebirds and wood ducks. -4822

July- September

- *Cavity Nest Monitoring.* Conducted monitoring of 25 wood duck nest cavities. -4822
- *Sequalichew Ecopark* – two wood duck and four blue bird cavities. -4822
- *Wrights Marsh* – three wood duck boxes. -4822
- *Scouts Out Prairie* – eight bluebird cavities. -4822
- *Halverson Springs* – one wood duck cavity. -4822
- *Lewis Lake* – three wood duck cavities. -4822
- *Lower Weir* – eleven purple martin boxes. -4822

October-December

- *Artillery Impact Area* – created two cavities for bluebird and two for woodducks -4822
- *Central Impact Area* – created 2 Western Gray Squirrel cavities and 1 for bluebirds -4822.
- *Bill Lake* – created one WGS cavity -4822.
- *DeBalon* – created 2 WGS cavities -4822.
- *Holden Woods* – created 2 WGS cavities -4822.
- *Shaver Lake* – created 1 WGS cavity -4822.
- *North Chambers Lake* – created 1 WGS cavity -4822.
- *Cavity monitoring* – conducted second round of monitoring on 24 first year wood duck cavities -4822

Cavity and Snag Creation.

During winter quarter, we contracted with Timothy Brown to create snags and cavities in key habitat areas throughout Fort Lewis. TNC and Fort Lewis crews were also given training for cavity and snag creation. In all, 53 'features' were created at ten different sites (see below).

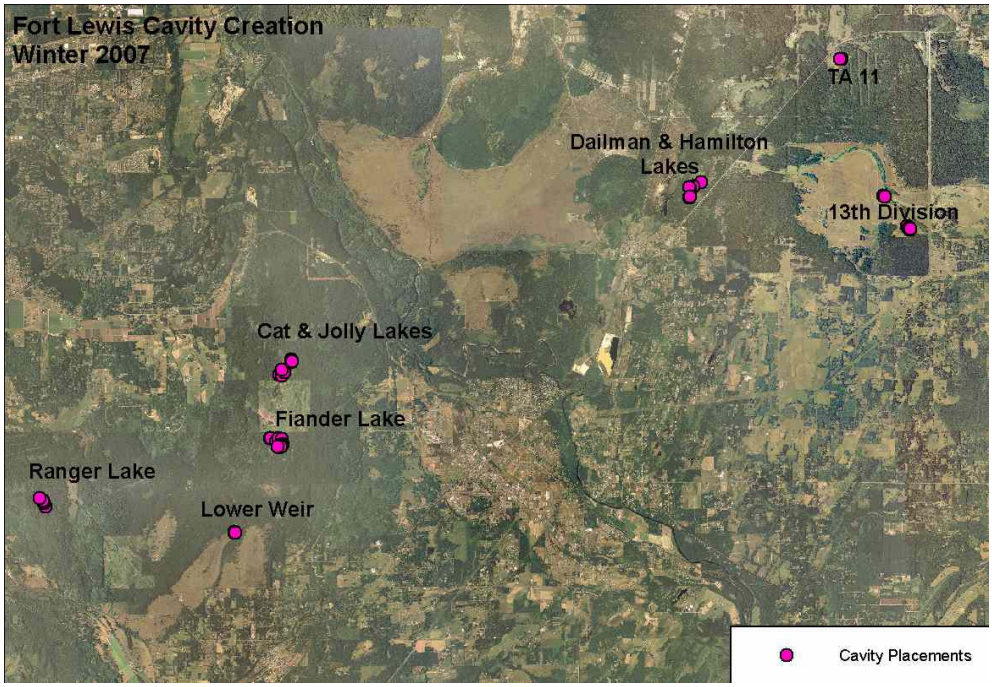

Figure 15: Winter 2006 cavity creation project locations at Fort Lewis.

During summer quarter, TNC staff monitored 25 of the 29 wood duck cavities created in winter and spring 2007. Monitoring was conducted with a telescoping mirror, flex light and camera. Ten of the 25 showed some indication of use, a higher rate than normally expected for first year nests. Although heavy pitching did occur in a few nests, it was more typical that only minor or

Figure 16: Summer 2007 monitoring results inside two wood duck cavities.

no pitching occurred in most nests, Results can be summarized as follows:

- Six nest showed signs of successful incubation and brooding.
- Four had feathers or other signs of activity.
- 15 showed no sign of use.

This work was conducted under Fort Lewis Cavity Creation (TNC# 4822)

Figure 17: Examples of mounted purple martin boxes and a wood duck cavity in a redcedar.

In addition to monitoring, more cavities were created throughout Fort Lewis during the summer quarter, including:

- *Sequalichew Ecopark* – two wood duck and four blue bird cavities.
- *Wrights Marsh* – three wood duck boxes.
- *Scouts Out Prairie* – eight bluebird cavities.
- *Halverson Springs* – one wood duck cavity.
- *Lewis Lake* – three wood duck cavities.
- *Lower Weir* – eleven purple martin boxes.

During winter, we continued to create cavities for western gray squirrel as well as a few more cavities for bluebirds and wood ducks. A second round of monitoring was also conducted concurrently with maintenance (placing additional sawdust into nests that exhibited excessive pitching). Of the 24 monitored, 13 (54%) revealed use in first year. Use included the same wood ducks previously detected, but also revealed signs of other birds, rodents and possibly bats.

2008 Outlook

The first year of cavity work has yielded encouraging results. We will continue to create and monitor cavities through the first half of 2008, but funding is currently uncertain after that. We are particularly looking forward to post nesting results for the second-year cavities.

NOXIOUS WEEDS

One of the most significant threats to the natural environment on the Fort today comes from invasion by exotic pest plants. These pest plants degrade training areas, displace native plant and animal communities, and modify existing habitats across the base. Once established, many of these species can be next to impossible to eradicate using practical control measures.

Numerous pest plants occur on Fort Lewis. Species such as Scotch broom have negatively impacted many training areas across the base. Species such as the knapweeds and sulfur cinquefoil are currently found in much more limited distributions across the base, and some have the potential to seriously degrade habitat and training land function.

This section focuses on noxious weed species other than Scotch broom and pasture grasses associated with enhancement plantings; these are addressed in detail in the Prairie and Oaks sections.

General Management Strategies

All known locations of noxious weed species in priority habitat areas and likely vector locations have been recorded in GIS format. Each year, all infestations are scheduled for survey and control as needed. Any new discoveries of pest plants are similarly documented and scheduled for treatment. In addition, at approximately three-year intervals, weed surveys will be conducted throughout priority habitat areas and likely vector locations.

Furthermore, TNC surveys over 20 miles of road for tansy ragwort and responds to additional occurrences identified by county weed boards.

2007 Summary

2007 was another important weed control year at Fort Lewis. In spite of a major disruption in anticipated TNC access during the height of weed control season, we were able to at least hold our ground with most weeds, and with others make some headway. Fort Lewis staff in particular were able to greatly step-up their control activities due to training they have recently received. The table below indicates the species and estimated control levels for 2007 with a quick comparison from 2006.

Monitoring information continues to help hone our control strategies, as we continually strive to develop integrated approaches that minimize risk to people and the environment while improving effectiveness. In particular, we are hopefully on the verge of a better control technique for oatgrass, and initial monitoring suggests that our strategies for controlling yellow flag iris, canarygrass, toadflax, mouse-eared hawkweed and others have been very effective.

TABLE 4: List of species, number of infestations and estimated number of plants treated by TNC staff on Fort Lewis in 2007.

Common Name	Species	Spp. Code	# of Infestations	Sum (plants)	2006 Sum
Tall Oatgrass	*Arrhenatherum elatius*	AREL	78	27,038	14,565
Diffuse knapweed	*Centaurea diffusa*	CEDI	24	250	2,045
Spotted knapweed	*Centaurea maculosa*	CEMA	4	450	20
Blue Weed	*Echium vulgare*	ECVU	11	373	676
Leafy spurge	*Euphorbia esula*	EUES	7	1,057(stems)	6
Mouse-ear hawkweed	*Hieracium pilosella*	HIPI	96	1,767	5333
Sulfur cinquefoil	*Potentilla recta*	PORE	45	9,181	147,095
Tansy ragwort	*Senecio jacobaea*	SEJA	25	108	519
Yellow toadflax	*Linaria vulgaris*	LIVU	2	1005 (stems)	420
Yellow flag iris	*Iris pseudacorus*	IRPS	6	440(stems)	13,137
Purple Loosestrife	*Lythrum salicaria*	lytsal			700
Japanese knotweed	*Polygonum cuspidatum*	POCU	3	500 (stems)	699
Fragrant waterlilly	*Nymphaea odorata*	nymodo	1	24 acres	
Reed canary grass	*Phalaris arundinacea*	PHAR	6	52.5 acres	11
			473	**42,368**	

NOXIOUS WEEDS SUMMARY TABLE
April-June

- *Sulfur Cinquefoil* - Surveyed and controlled infestations at Mortar Point 13, and Training Areas 6, 12, and 22 (4828).
- *Mouse-ear Hawkweed* - Surveyed and controlled at TA 6 (Leschi Town) and TA 12 (4828).
- *Knapweed Complex* - Surveyed and controlled populations at Lower Weir, TAs 7S, 7N, 5, 6 and area F south of Gray Army Airfield 14 (4828).
- *Tall Oat grass* - Surveyed and controlled infestations at MP 13, TAs 7S, 14, 15, 21, and 22, Johnson, Upper and Lower Weir Prairies, and Mortar Point 13 (4828).
- *Common Toadflax* - Found and controlled infestations at TA 6 (4828)
- *Dalmatian Toadflax* - Western wash rack infestation was surveyed and no plants were found this year.
- *Leafy Spurge* - Discovered and treated large infestation in the AIA, and another at TA 18 (4828).

- *Reed Canary Grass* - Retreated Exeter Spring and expanded treated area (4826)
- *Other Species* - Surveyed and controlled minor infestations of blueweed, tansy ragwort, and Himalayan blackberry.

July-September

- *Knapweed Complex* - Surveyed and controlled infestations at TAs 6, 14 and on North Fort Lewis (4828).
- *Reed Canary Grass* - Cut and sprayed approximately 52.5 acres in four priority areas along Muck Creek (4826, 4834).
- *Purple Loosestrife* – Monitoring bio-control release at American Lake showed significant evidence of insect damage (4825).
- *Yellow Flag Iris* – Surveyed and controlled infestations at Shaver Kettle and Shaver Marsh in TA 12 (4825).
- *Japanese Knotweed* - All known incipient populations were treated. Two new sites, one in TA 8 and TA 19 were treated (4825).
- *White Water Lilly* - Southern half of Chamber's Lake in TA12 was treated by boat (4825).
- *Tall Oat Grass Study* - A study to determine the effects of Poast and Fusilade DX herbicides on native plant species was initiated (4828).
- *Scotch Broom Study* - A study to determine the success of different scotch broom treatments, including the use of crop oil only, was initiated. Results will be recoded next spring (4827).

October-December

- *Sulfur Cinquefoil* – New infestation was mapped and treated near the confluence in TA 15 (4825).
- *Reed Canary Grass* – Followed up treatments of Nixon Spring and Muck Creek (4834).

Upland Invasive Species.

Unless otherwise noted, upland weed control was conducted under the Training Lands task order (4828). See weed control maps at the end of this section.

Sulfur cinquefoil

This highly invasive weed was still present in areas treated last year. Numbers of plants have dramatically decreased from 2006, although Conservancy and Fort Lewis staffs continue to find new populations scattered throughout the Fort. One significant population was discovered and treated at Muck Creek in Training Area 15.

Spray transects established in TA 6 found 98% control of plants treated last year. The same transects were treated again to control the many new cinquefoil germinants. When measured later in the summer, we determined that our method provides at least 95% efficacy.

The Nature Conservancy worked cooperatively with Fort Lewis staff to control sulfur cinquefoil. In fact, fort staff played an especially significant role in cinquefoil control due

to range access restrictions for TNC. Conservancy staff worked on sulfur cinquefoil infestations at Mortar Point 13, and Training Areas 6, 12, and 22. Sulfur cinquefoil was controlled with backpack sprayers and a 2.5% solution of Garlon 3A (triclopyr) with 0.25% NuFilm IR adjuvant.

- Mortar Point 13 - Approximately 4,245 plants were treated by TNC staff in and near high quality prairie habitat and along Muck Creek north of the access road.

Figure 18: Sulfur cinquefoil after treatment with Triclopyr amine.

- Johnson Prairie (TA 22) - One of the three infestations sites at this site appears to have been controlled; the other two saw significant population reductions and were re-treated.
- Training Area 6 – Area was surveyed and treated. Several infestations appear to have been controlled by last year's treatments, while some new infestations were discovered in the area north of Leschi Town.
- Training Area 12 – Two small populations were found and treated near the mouse-ear hawkweed infestation north of Chambers Lake.

Mouse-Ear Hawkweed

The bulk of the control effort for this species focused on the known population in TA 6 north of Leschi Town. Mouse-ear hawkweed was controlled using a 1.5% solution of Transline (clopyralid) with 0.25% NuFilm IR adjuvant. While mouse-ear hawkweed continues to persist, a simple monitoring exercise indicates that clopyralid provides very successful control especially compared to Garlon 3A. Clopyralid has an even lower toxicity ranking and is highly selective against composites. Treatment areas included:

- TA 6 - Leschi Town. This is the fourth consecutive year of treatment for the area. Follow-up survey and treatment was conducted on approximately 65 acres.
- TA 12- The infestation within the Ponderosa pine habitat north of Chambers Lake was surveyed and controlled for a second consecutive year.

Knapweed Complex

Known infestations of knapweed were controlled within high quality prairies in the areas listed below using a 0.5% solution of Transline (clopyralid) with 0.25% NuFilm IR.

- TA 14 - A new technique was tried this year along the Pacemaker airfield. We attempted to make a large one day sweep, treating knapweed with Garlon 3A at 2.5%, incorporating several staff on foot as well as a tractor mounted boom sprayer treating the airfield perimeter. This was done during the last week before streaked horned larks are thought to begin nesting. Unfortunately, weather was not very good and soon after the spraying was completed we received rain showers. Several additional days of follow up treatment was necessary during the season.
- North Fort Lewis - Several new populations were discovered in the North Fort area during a one day noxious weed inventory and were quickly treated.
- Other small populations of diffuse knapweed were controlled at Lower Weir, TAs 7S, 7N, 5, and 6, and area F south of Gray Army Airfield.

Tall Oat Grass.

This species was given greater focus this year and new techniques were developed to combat this threat to prairies and rare species. Funding from the Fort Lewis Army Compatible Use Buffer program facilitated greater control research off-base, including meeting with other natural resource professionals in the Pacific Northwest and assessing different management techniques in the field. Spraying Poast at the maximum label rate was adapted this year, but spraying occurred one month earlier than ever before to hit plants at their most vulnerable stage. This made for a very busy three week period in April and first week of May. Plants were measured weekly in preparation and spraying occurred from north to south beginning in TA 7S and ending at TA 21 as described below. A total of 65 acres were sprayed with Poast for tall oatgrass.

There are many other sites on Fort Lewis where tall oatgrass continues to spread; particularly in the Artillery Impact Area (especially under oaks), TA 6, and TA 7S. The Nature Conservancy looks forward to increasing our collaborative efforts to keep tall oatgrass out of high quality prairie habitat on Fort Lewis.

- TA 7S Prairie - All known plants were sprayed within the cyber-staked area except for a strip surrounding Taylor's checkerspot reintroductions where TOG was carefully mowed with hand-held brush-cutters in June.
- Mortar Point 13 - Plants were treated in the highest priority, from the southwest section working eastward. All plants in eastern section were not treated.
- TA 14 and 15 - Only a few plants were found in TA 14 and 15. The TA 14 infestation was in an area that was prescribe burned in 2006. These burned

plants were not treated and were too small to brush-cut in mid-May (access did not permit herbicide use). Plants in TA 15 were brush-cut in May.

- Johnson, Upper and Lower Weir Prairies - All know plants were treated.

Oatgrass Control Plots. In addition, experimental control plots were established at TA 7S and subsequently treated and measured. With these plots, The Nature Conservancy is comparing effectiveness of Poast and Fusilade DX as a control for invasive grass impacts to native vegetation. In light of Poast's disappointing results to date, we are hopeful that Fusilade will prove to be more effective against targets and will not impact our native fescue. Also, Fusilade has a lower toxicity rating and is used at half the concentration.

Figure 19 Field of Tall oat grass at TA 7S Fort Lewis during summer.

Prior to treatment, a series of replications were established and surveyed to determine a vegetation baseline. This study compares effects of 0.75% Fusilade DX with 0.25% NuFilm IR and the current best management practice of 1.5% Poast with 0.5% crop oil (Agri-Dex). Also tested were 1.5% Poast with 0.25% NuFilm IR and day old (over 24 hours) 1.5% Poast. There is speculation that Poast breaks down in water after about three hours and is then ineffective.

Early season post treatments surveys were conducted four months after spraying. For more reliable data, we will have to wait for spring 2008 survey results. Preliminary results can be summarized as follows:

- No differences were found in efficacy between the three Poast trials, although Poast with NuFilm indicated some non-fatal damage to native forbs not seen in other trials (slight yellow fringing of leaves).
- Poast was found to have a 63% control on tall oatgrass. Fusilade DX was found to have 99% control on tall oatgrass (there was one stem of one plant in one plot).
- Roemer's Fescue increased slightly in Fusilade plots. *Carex inops* remained stable or increased in plots; it is unknown what effects Fusilade has on local *Danthonia*, *Koelaria*, *Elymus*, or *Panicum* species.

More definite answers should present themselves in spring of 2008, but preliminary results look positive for Fusilade DX in its control of tall oatgrass and tolerance of Roemer's fescue. We are also interested in what effects Fusilade DX may have on other native grasses such as California oatgrass and June grass, both of which are negatively impacted by Poast.

- TA 7S Prairie - All known plants were sprayed within the cyber-staked area except for a strip surrounding Taylor's checkerspot reintroductions where TOG was carefully mowed with hand-held brush-cutters in June.
- Mortar Point 13 - Plants were treated in the highest priority, from the southwest section working eastward. All plants in eastern section were not treated.
- TA 14 and 15 - Only a few plants were found in TA 14 and 15. The former was in an area that saw a prescribed fire in 2006. These plants were not treated and were too small to brush-cut in mid-May (access did not permit herbicide use). Plants in TA 15 were brush-cut in May.
    - Johnson, Upper and Lower Weir Prairies - All know plants were treated.

Leafy Spurge

Fort Lewis staff made a disturbing discovery of this incredibly invasive species within the Artillery Impact Area. TNC and Fort Lewis promptly treated this infestation using 2.5% Garlon 3A. This treatment is not believed to provide an effective control of the species, but was intended to top-kill the population and restrict seeding. The infested area burned several weeks after treatment and we believe that with repeated treatments of Garlon, along with frequent fires, this population may be vulnerable without resorting to more hazardous chemicals or soil disturbance.

Another small population was found in Marion Prairie, near the road and this was controlled with a cut and treat method using Tordon RTU. Nature Conservancy staff have not seen the large population elsewhere on Marion Prairie (TA 18) but we recommend that area be surveyed and possibly mowed and covered with black plastic for several years. There is great risk to the high quality prairie remnants on Fort Lewis if this species is not quickly controlled.

Blueweed

The large population at the north end of Training Area 7 South was controlled again this year in cooperation with Fort Lewis. All plants were counted, regardless of who sprayed to get an accurate assessment of last year's treatment efficacy. A new small population was found and treated in the gravel pit area of TA 7S. Blueweed was treated with a 2% solution of Razor Pro (glyphosate). Last year's treatment has cut the level of infestation nearly in half. This seems to indicate that our strategy is working, but we still have concern about this species and it needs to remain a high control priority.

Tansy Ragwort

TNC crew controlled a large infestation at several site within and around Fort Lewis in cooperation with Pierce and Thurston County Noxious Weed Boards. Primary emphasis was along major thoroughfares and Fort Lewis boundaries. Flowering plants were pulled, and some rosettes were sprayed with Garlon 3A while searching for and spraying higher priority species.

Figure 10 Blueweed flowering.

Other Species

Several other upland invasive species were treated, including:

- Dalmation toadflax – The population at the western wash racks was surveyed but no Dalmatian toadflax was found this year. It appears that the cut and treat method with Tordon RTU was effective. This method is only feasible for small populations, however.
- Common toadflax - A large population was found and treated in Training Area 6, just north of Muck Creek. Thousands of stems were sprayed of this noxious, rhizomatous weed. It was sprayed with a 4% solution of Razor Pro. The area near the ENRD building was surveyed and it appeared that last year's treatment with Garlon 4 was not highly effective, encouraging us to research a little more and change treatment technique. Although glyphosate is not necessarily known to be more effective than triclopyr, it appears that multiple treatments will be necessary and glyphosate is substantially less expensive.
- Queen Ann's lace – treated with Garlon 3A northwest of and along Pacemaker airfield at the same time as knapweed treatment prior to streak horned lark nesting. Though not a species of concern for Fort Lewis prairies, this common weed is prolific in this small area and apparently spreading into nearby high quality prairie and may degrade streaked horned lark habitat.

Aquatic Invasive Species.

The aquatic weed control effort was conducted under the Water Howellia task order (4825). See weed control maps at the end of this section for treatment locations.

Reed Canary Grass

A great deal of work was done this year to control reed canary grass. A total of 52.5 acres were treated in four priority areas along Muck Creek. Two different contract crews were employed through the Tacoma Urban League to help facilitate a successful

project of this magnitude. Nature Conservancy staff along with Fort Lewis staff guided and helped the Urban League crews.

A certain amount of adaptive management was required during this project. Based on the experience of other programs and last year's smaller control effort, the canary grass did not respond to our initial cutting in the predicted fashion. This is likely due to the cool, wet season. Instead of being able to cut the grass in the early summer and spray at the end of summer, rapid re-growth necessitated an early spray treatment and some re-cutting.

All treated areas were mowed first using brush-cutters (a few discrete sites were tractor mowed) with follow up chemical treatments using a 2% solution of AquaMaster or AquaNeat (glyphosate) with a 0.25% solution of NuFilm IR adjuvant. Because of the quick rebound of canary grass we experienced, several areas had to be mowed twice before chemical treatment as plants surpassed the boot stage before treatment was possible. Areas treated include:

Figure 21: Reed canarygrass control project with Urban League Crew.

- Muck Creek at Nixon Spring - 14 acres between Shaver Marsh and Chambers Lake.
- Johnson Creek - 5 acres south of Johnson Marsh to Muck Creek confluence, also including part of Muck Creek.
- South Creek from 8th Ave East to North Fork Muck Creek confluence; Muck Creek at triangle, from hardened crossing 200 meters east; Muck Creek from South Creek confluence 100 meters east; 31 acres total for South and North Forks of Muck Creek at Triangle area.
- Muck Creek at 507 crossing - 2.5 acres east of crossing.
- Preacher Creek - from Muck Creek confluence to Roy fence.
- Exeter Spring - Nature Conservancy and Fort Lewis staff worked cooperatively following the success of last year's treatments of reed canary grass here. Re-sprouting reed canary was sprayed again, as well as expanding the treatment area from the spawning channel and gravel beds to the surrounding reed canary meadow. Mowing with brush-cutters and spraying were both conducted here in spring.

Sulfur Cinquefoil

Sulfur cinquefoil infestations were controlled during spring along aquatic corridors. Though work was conducted in riparian areas, no direct aquatic applications were made. As described above in the Upland Weeds section, we used Garlon 3A – which is labeled for use in aquatic environments.

Yellow Flag Iris

Treatments continued in the Shaver Kettle and Shaver Marsh areas in TA 12. These plants are mostly re-sprouts from previous year's treatment, and did not flower this year. The Shaver Kettle population is only a fraction of what was present in 2006, but still hundreds of stems were treated with a cut and treat method using a 25% solution of AquaNeat (glyphosate).

Figure 22 Cut and treat on yellow flag iris

Purple Loosestrife

Last year's treatments of purple loosestrife gave encouraging results, even though treated plants appeared to still be alive. Treated plants were substantially smaller this year, and were not flowering. Other plants, particularly at American Lake, showed evidence of insect damage from earlier bio-control releases by the Fort.

It is the recommendation of The Nature Conservancy that bio-control be the favored treatment type rather than chemical treatments on Fort. It is further recommended that at sites such as American Lake, more bio-control releases take place to build up the insect population that will impact large loosestrife populations that are on other landowners' property. This can be done cooperatively with Pierce County Noxious Weed Board and Washington State University Extension office.

White Water Lily

All of the known populations of this noxious weed located within the southern half of Chamber's Lake in TA 12 were treated. A solution of 4% AquaNeat (glyphosate) with 0.25% NuFilm IR was foliar applied using a battery powered sprayer from a boat provided by the Fort. This was done cooperatively with Fort Lewis staff. The northern half of Chambers Lake contains more white water lily, but was inaccessible with the boat available. Further surveys are recommended in this area.

Knotweed

All known incipient populations were treated, including two new sites at TA 8 and TA 19. Sites treated last year were revisited and it was encouraging to find that the two populations in TA 12 had no stems this year. However, the site along South Fork of Muck Creek did have a small number of stems. The large population in TA 19 had many small stems, many of which showed chemical disfiguration. All knotweed was treated with a foliar treatment of 2% AquaNeat (glyphosate) and 0.25% NuFilm IR. A large population was brought to attention in North Fort Lewis, and further communication will be needed with the Pest Shop for treatment.

2008 Outlook

The 2008 noxious weed control effort will follow roughly the same approach as in past years: known infestation sites will be visited and treated as appropriate and data will be recorded in GIS compatible format. A survey strategy will be developed to detect infestations in likely or critical areas. Many of the areas where canarygrass was controlled will be planted with trees to promote needed shade.

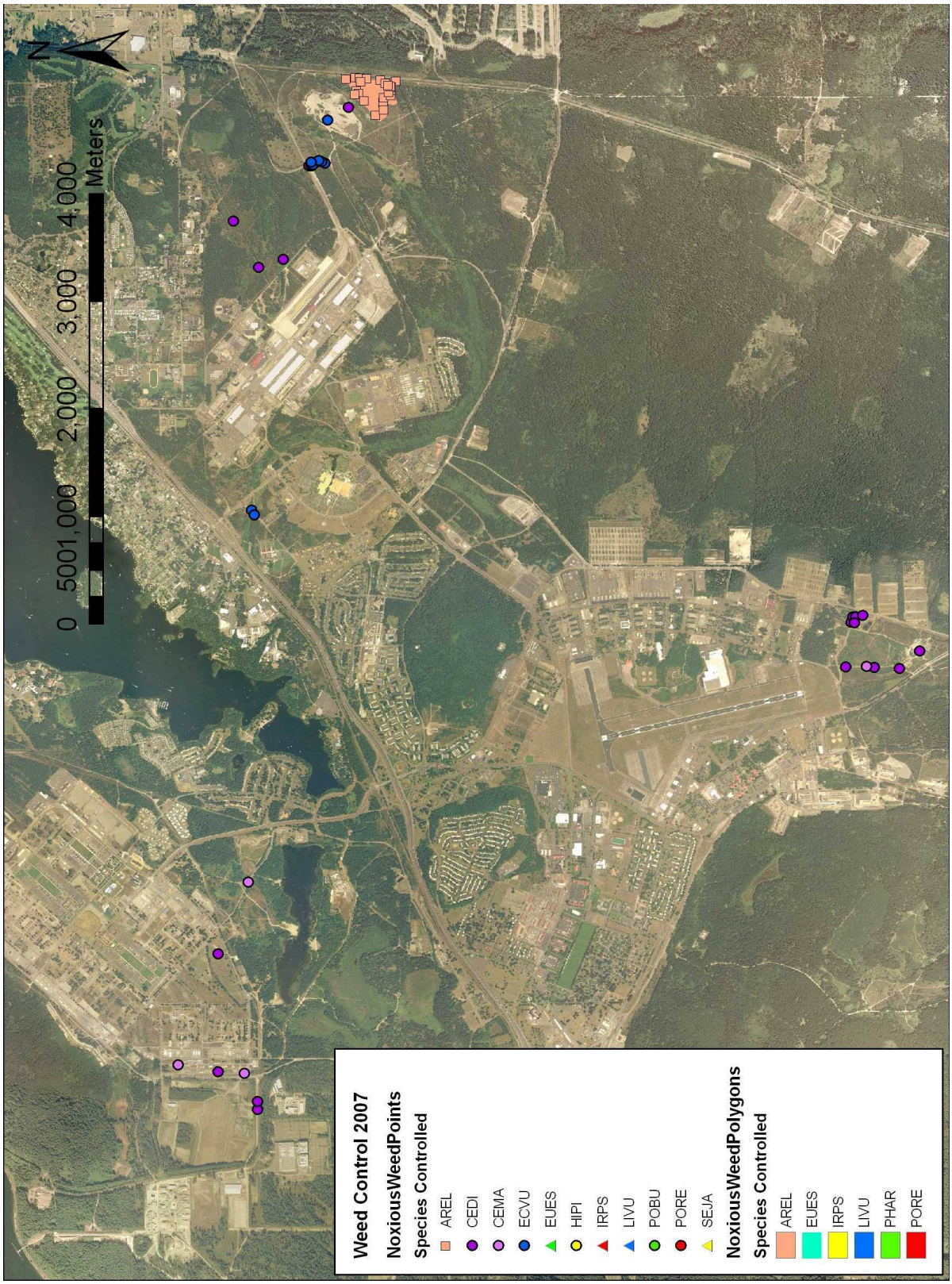

Figure 23: 2007 Weed control activities at Northern Fort Lewis

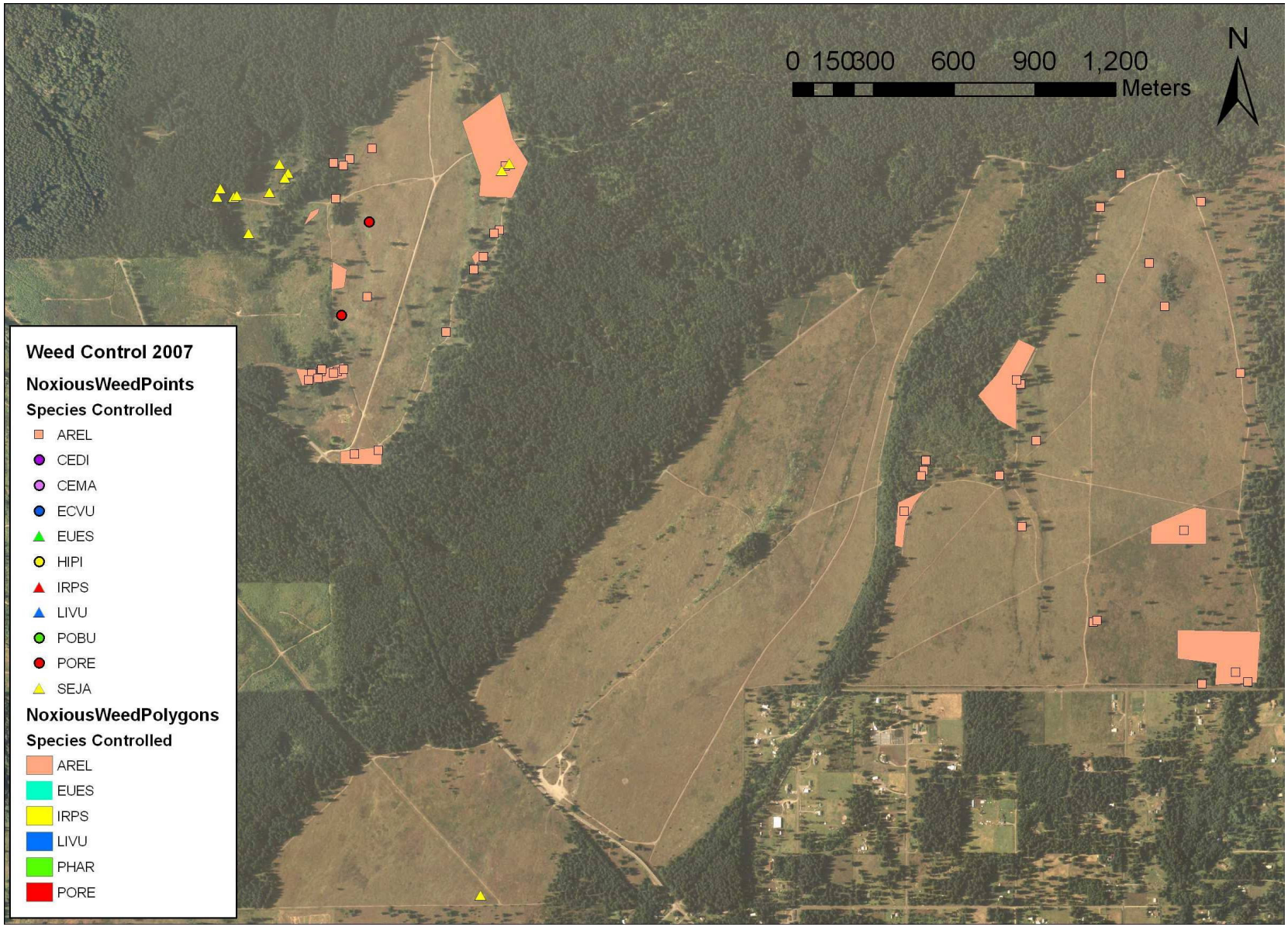

Figure 24: 1007 Weed control activities at the Rainier Training Area, Fort Lewis.

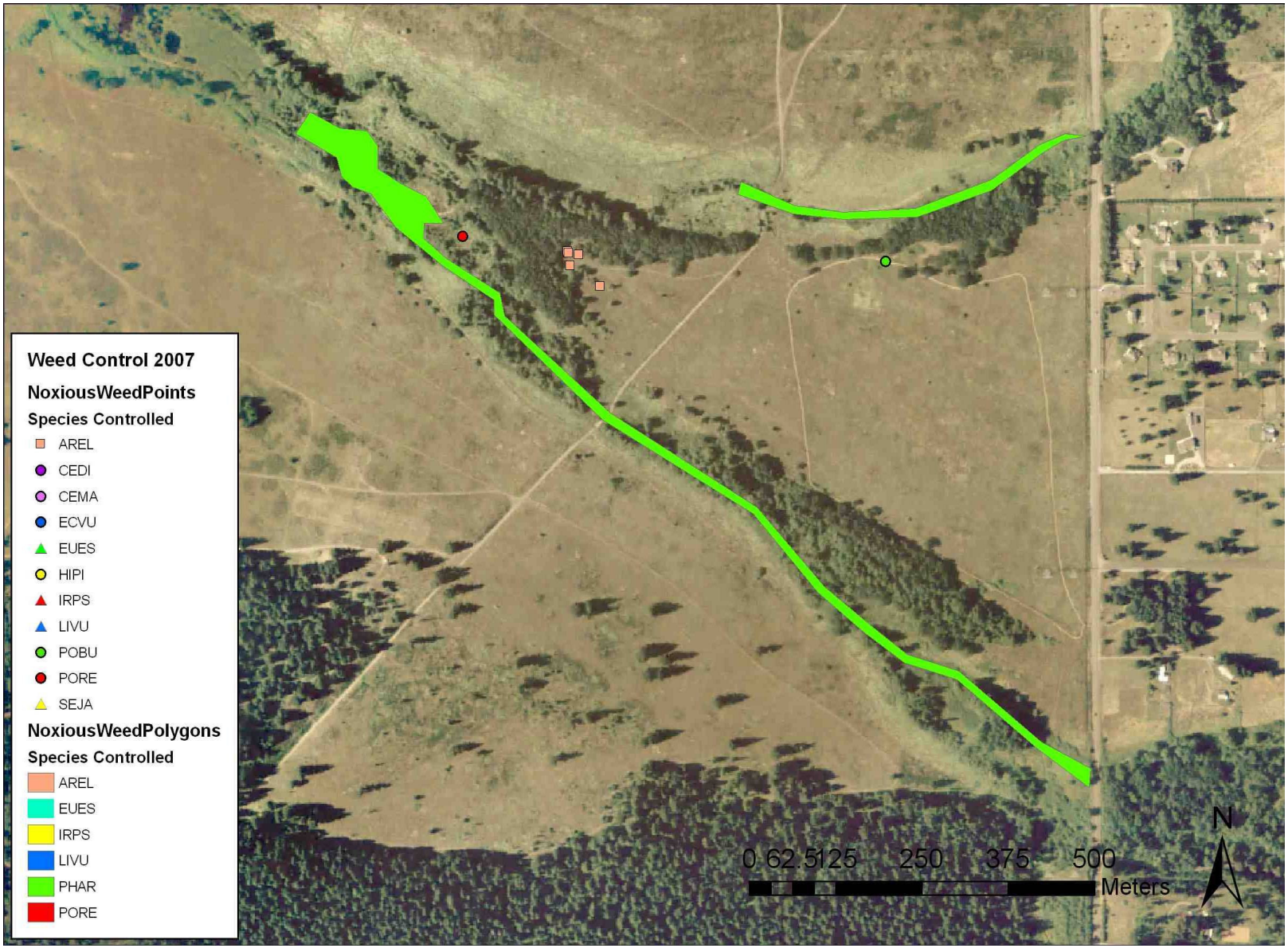

Figure 25: 2007 Weed control activities at Training Area 15, Fort Lewis.

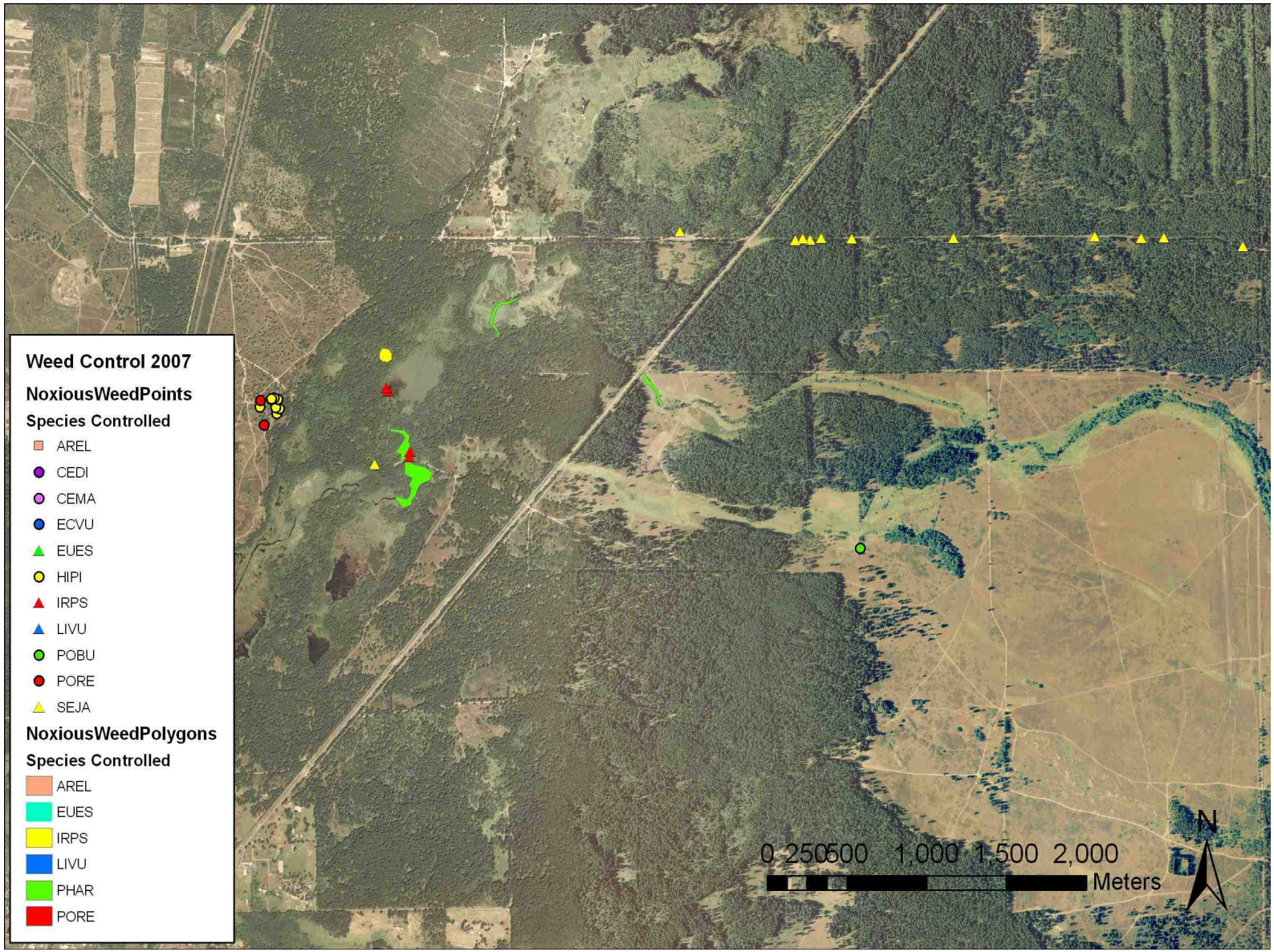

Figure 26: 2007 Weed control activities at Training Areas 12 and 13, Fort Lewis.

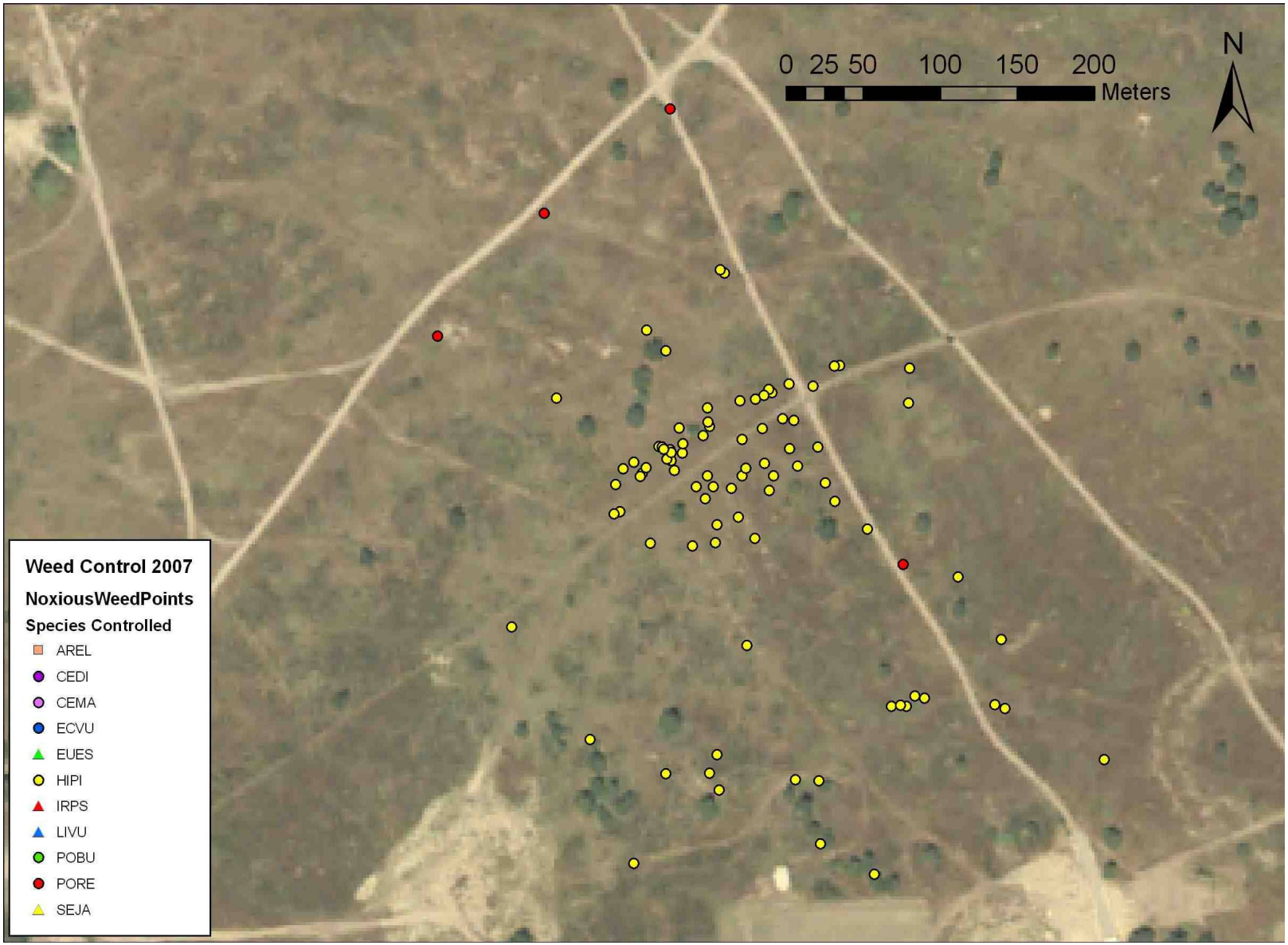

Figure 27: 2007 Weed control activities at Training Area 6, Fort Lewis.

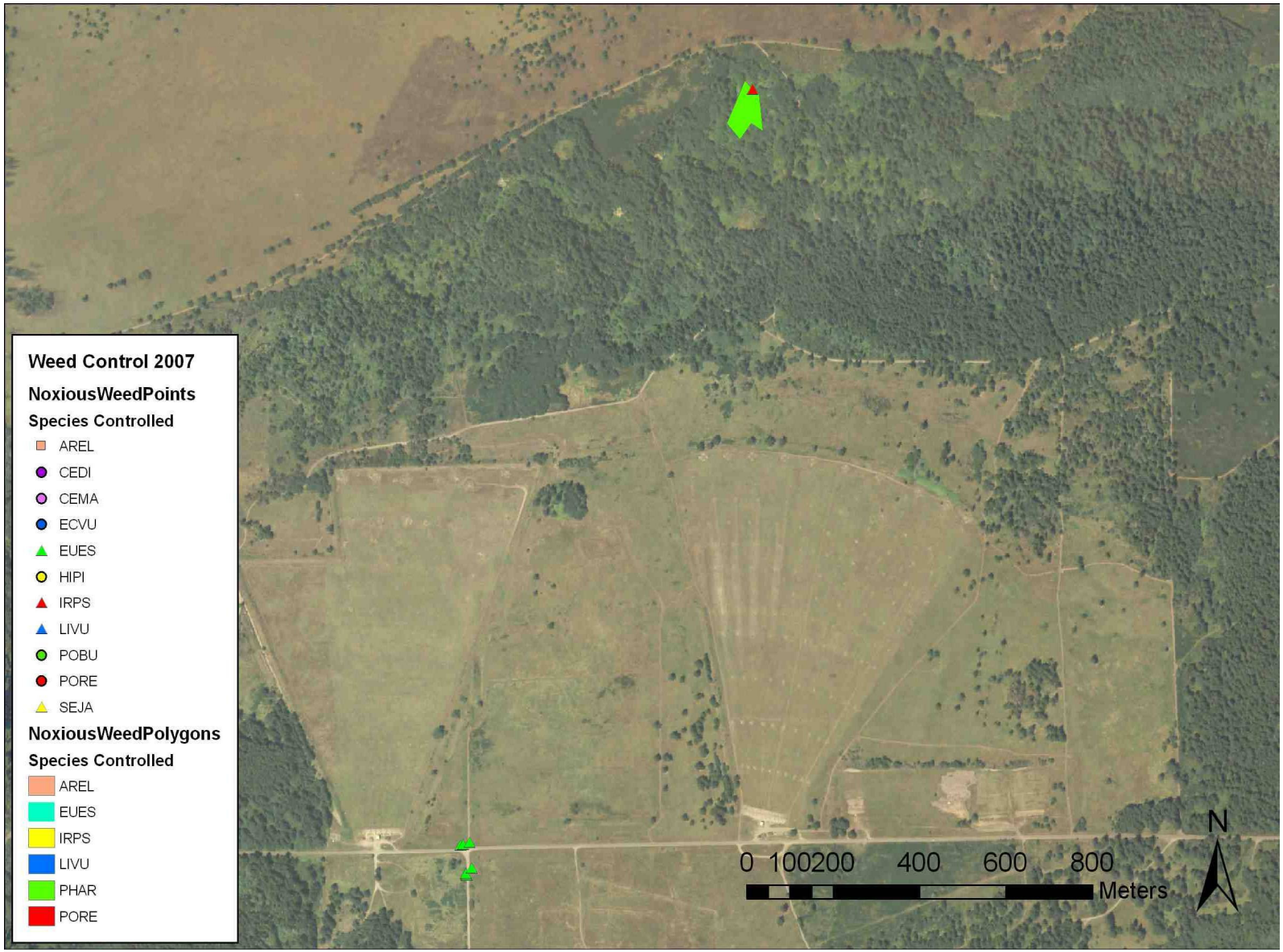

Figure 28: 2007 Weed control activities at South Impact Area, Fort Lewis.

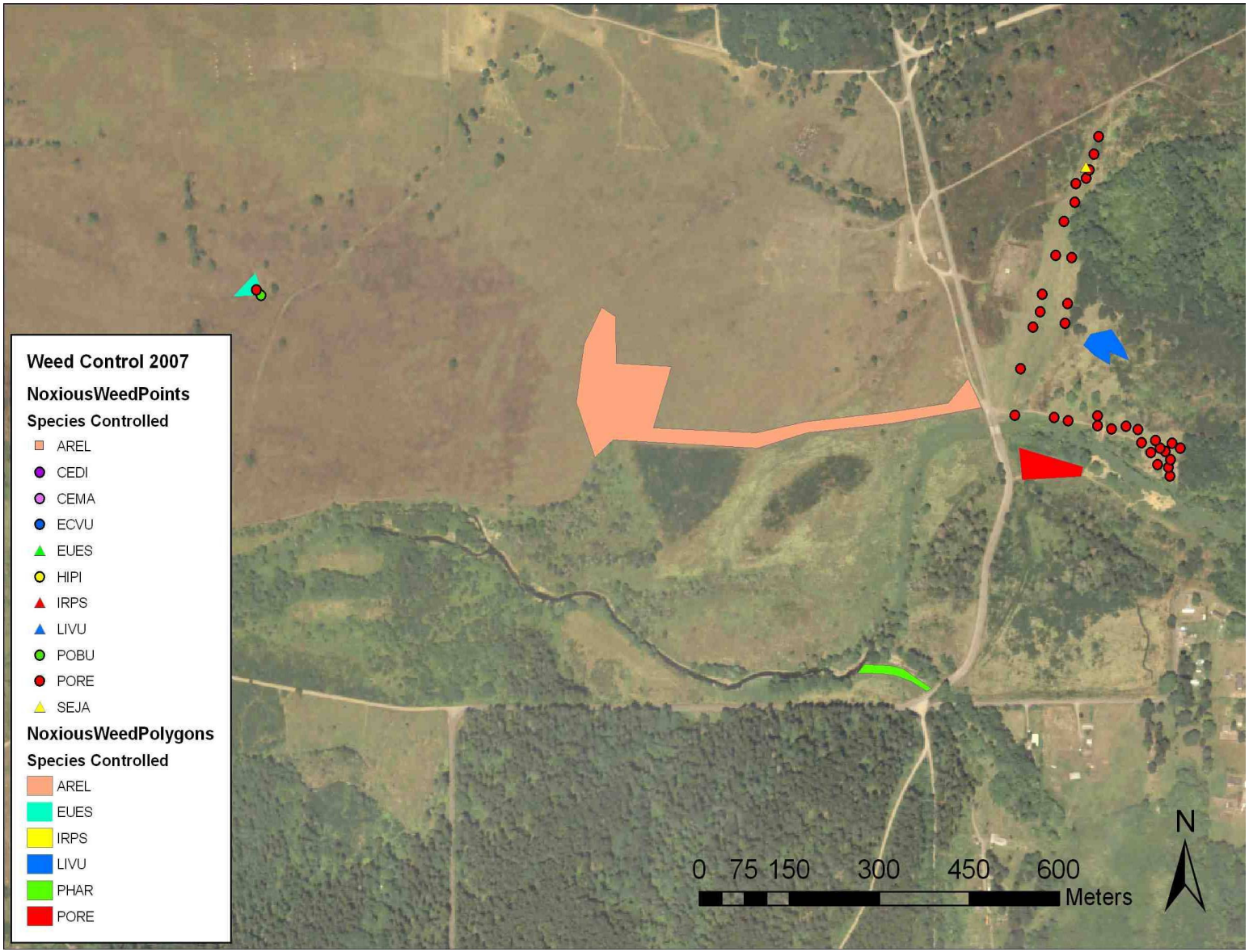

Figure 29: 2007 Weed control activities at Mortar Point 13, Fort Lewis.

Figure 30: 2007 Weed control activities at 91st Division Road, Fort Lewis..

RIPARIAN AND STREAM ENHANCEMENT.

Riparian zones are an important component of any ecosystem and prairies and oak woodlands are no exception. Aside from the conservation values associated directly with the streams and aquatic species they contain, riparian corridors are often a focal point for diversity in surrounding uplands. For example, western gray squirrels are closely associated with water sources, and soils near streams often provide a gradient of moisture conditions that support greater diversities of plant and animal species.

Muck Creek is considered the most significant tributary for anadromous salmonids in the Lower Nisqually River. The creek is particularly important habitat for chum salmon, winter steelhead and sea-run cutthroat trout. Coho salmon have also been documented in the creek.

The broader Muck Creek riparian corridor has also become a focus for upland restoration. It contains areas of quality native prairie and serves as a significant wildlife corridor for the northeastern portion of the base. However, the corridor faces serious challenges from habitat modifying invasive weeds in both upland and riparian conditions. Examples include Scotch broom, diffuse knapweed, reed canarygrass, Himalayan blackberry and others.

Most habitat aspects of Muck Creek are in good condition but the extensive invasion of stream channel choking reed canarygrass has been identified as a significant threat to salmonid habitat. In addition, Himalayan blackberry may have long term negative impacts on habitat because it prevents the establishment of native trees and shrubs that could provide more shade and eventually large woody debris input.

Because of its unique habitat conditions, the Muck Creek corridor has been given a targeted restoration emphasis.

2007 Review

Compared with previous years, a fairly small amount of riparian enhancement was conducted. Most of this year's effort went to two in-stream tasks in Muck Creek to improve salmon habitat. See map at end of section for locations of aquatic projects.

RIPARIAN ENHANCEMENT SUMMARY

April-June

- Delivered 260 tons of 1-man sized rock to salmon spawning channel near Mortar Point 13. -4826
- Completed bald eagle survey. -4826

October-December

- Placed rock delivered in spring along spawning channel at MP13 - 4834
- Planted 500 bigleaf maples along Muck Creek in areas that were treated for reed canarygrass. -4834.

Mortar Point 13 Spawning Channel

The Mortar Point 13 spawning channel is essentially an old abandoned irrigation ditch. It currently acts as a side channel to Muck Creek, and as a result of several enhancement actions taken by Fort Lewis over the years, it has become an active salmon spawning channel. This ditch has over-steepened slopes, and has been loosing mature trees along the edge to fluvial erosion. These trees provide excellent cover and shade out reed canarygrass.

During early spring, we contracted with Washington rock to deliver 260 tons of 1-man sized rock to be used for placement in the spawning channel. In fall, rocks were placed along the channel during a period of no-flow. Rocks were placed using a combination of tracked skid-steer loaders and hand placement. Rock placement should help to stabilize channel banks and reduce further loss of adjacent trees.

Figure 31: Salmon channel after rock placement.

Bald Eagle Survey

TNC contracted with Mark Stahlmaster to conduct bald eagle nesting surveys of Fort Lewis during spring quarter. This is follow-up work for previous monitoring that he has conducted. Two helicopter nest surveys were conducted along with numerous ground surveys. A draft report of this survey was submitted for review to Fort Lewis, and the final will be delivered in winter quarter 2008.

Figure 32: Arial photo from helicopter eagle survey of eagle nest site.

Riparian Planting

The reed canarygrass control sites described in the aquatic weeds section above, will be planted with trees during winter 2008. These trees will be native, riparian species and will help to shade out canarygrass infestations.

APPENDIX – Summary of all 2006 Activities for Each Task Order

TABLE 5: Summary of all tasks completed in 2005 arranged by Fort Lewis task order (with TNC grant numbers).

Williams Pipeline Restoration (TNC#3010)

- *Pipeline* – Hand controlled weeds at pipeline restoration site to protect emerging native plants near creeks.
- *Pipeline* – Boom sprayed pipeline area to control invading weeds.
- *Pipeline* – Delivered 250 tons of topsoil to north pipeline area.

Cavity Creation (TNC#3871)

- *13th Division Muck Creek*. Inserted 2 wood duck cavities.
- *13th Division South Creek.* Inserted 1 wood duck cavity. Topped 8 trees for purple martin nesting.
- *Cat Lake.* Created 1 bat roost. Inserted 4 wood duck cavities.
- *Dailman Lake.* Inserted 5 wood duck cavities.
- *Fiander Lake*. Inserted 3 wood duck cavities. Inserted 2 small cavities. Topped 5 trees for purple martin nesting. Created 1 bat roost.
- *Hamilton Lake.* Inserted 3 wood duck cavities.
- *Jolly Lake.* Inserted 3 wood duck cavities and 1 small cavity. Created 1 bat roost.
- *Lower Weir Prairie.* Topped 3 trees for purple martin nesting. Created 1 bat roost.
- *Ranger Lake.* Inserted 3 wood duck cavities. Topped two trees and created hole start in 1 tree for purple martin nesting. Created wildlife cavities in 1 cedar stump.
- *Training Area 11.* Inserted 1 squirrel cavity. Inserted 1 white-breasted nut hatch cavity.
- *AIA girdling.* Girdled Douglas-fir on 335 acres, and released oak on 74 acres in the AIA.

Training Land Weeds (TNC# 3873)

- Purchase ATV for future weed control work.

Prairies 2006 (TNC# 3874)

- *13th Division – Muck Creek Triangle*. Mowed 19 acres of broom and an additional 66 acres were 'spot mowed' to control patches that were missed during 2006 broom spraying.
- *13th Division – Pacemaker Landing Strip.* Mowed 15 acres of dense broom and blackberry that were missed or not successfully killed by the 2007 spray treatment.
- *Upper Weir Prairie*. Mowed 61 acres of dense broom along the western side of the prairie and an additional 27 acres was 'spot mowed' to control denser patches of broom that threaten to bloom in 2007
- *South Weir Prairie*. Mowed 8 acres in the south west corner and spot mowed 38 acres of patchy broom.
- Johnson Prairie. Mowed 10 acres of broom in the west side of the prairie and spot mowed 12 acres of broom patches that were missed during the 2006 spray treatment.

Butterflies (TNC# 3876)

- *Upper Weir Prairie*. Mowed 66 acres of dense broom along the western side of the prairie.

Squirrel Habitat (TNC#3901)

- Purchased herbicides for future invasive brush control work.
- Conducted post-eastern gray squirrel control and general WGS tube monitoring.

Legacy Seed Production (TNC#4816)

- Propagated 41,210 seedlings for fall 2007 and winter 2008
- Installed 12 small seed beds and sowed with 12 rare prairie species.
- Installed row cover frames on all seed beds and three 96'X20' cold frames with shade cloth for plug production.
- Installed irrigation in seed beds and cold frames.
- Collected seed from 61 species of prairie plants.
- Conducted several nursery trails to guide management protocols.
- Sowed about 25,000 plugs for spring transplant into legacy seed beds.
- Cleaned, processed and weighed collected seed.

Fort Lewis Cavity Creation (TNC# 4822)

- *Sequalichew Ecopark* - Created seven cavities for bluebirds and wood ducks.
- *Cavity Nest Monitoring.* Conducted monitoring of 25 wood duck nest cavities.
- *Sequalichew Ecopark* – two wood duck and four blue bird cavities.
- *Wrights Marsh* – three wood duck boxes.
- *Scouts Out Prairie* – eight bluebird cavities.
- *Halverson Springs* – one wood duck cavity.
- *Lewis Lake* – three wood duck cavities.
- *Lower Weir* – eleven purple martin boxes.
- *Artillery Impact Area* – created two cavities for bluebird and two for woodducks.
- *Central Impact Area* – created 2 Western Gray Squirrel cavities and 1 for bluebirds -4822.
- *Bill Lake* – created one WGS cavity.
- *DeBalon* – created 2 WGS cavities.
- *Holden Woods* – created 2 WGS cavities.
- *Shaver Lake* – created 1 WGS cavity.
- *North Chambers Lake* – created 1 WGS cavity.
- *Cavity monitoring* – conducted second round of monitoring on 24 first year wood duck cavities
- *Central Impact Area.* Conducted oak release on about nine acres at two locations.
- *Artillery Impact Area*. Conducted fir and other tree girdling/removal in three locations on a total of 123 acres.

Ft. Lewis Pine and Oak TNC#4823)

- *Squirrel Triangle* – Cut Scotch broom and other invasive shrubs on approximately 140 acres of WGS habitat.
- Concluded post eastern gray squirrel control hair-snag monitoring.
- Continued squirrel hair-snag monitoring in DeBalon control area.
- *Holden and DeBalon* – 37 acres treated in this key WGS site.
- *Spanaway Marsh complex* – A total of 28 acres were treated along Spanaway Marsh.
- *Northern TA 8 & 9* – 26 acres of broom were treated in northern TA 8 and 9.
- *Holden and DeBalon* – Spot treated 37 acres of Scotch broom in this key WGS site.
- *Spanaway Marsh complex* – A total of 28 acres of broom were treated along Spanaway Marsh.
- *Northern TA 8 & 9* – 26 acres of broom were treated in northern TA 8 and 9.
- *POP* - Sponsored a volunteer day with injured veterans at the POP .

Water Howellia Aquatic Weeds (TNC# 4825)

- *Monitoring*. Monitored last control plots established last year for yellow flag iris, canary grass and knotweed.
- *Purple Loosestrife.* Monitored results of last year control and evaluated bio-control.
- *Yellow Flag Iris.* Evaluated results of last year control and re-treated where required.
- *White Water Lily.* Treated all known populations.
- *Japanese Knotweed.* Treated all known accessible populations.
- *Sulfur Cinquefoil* –Surveyed and controlled infestations in riparian habitat at TA's 6, 12 and 15 and Mortar point 13 along Muck Creek riparian corridor

Fort Lewis Eagles (TNC#4826)

- Delivered 260 tons of 1-man sized rock to salmon spawning channel near Mortar Point 13.
- Completed bald eagle survey.
- *Reed Canary Grass.* Cut 14 acres around Nixon Springs, five acres around J*ohnson Creek* , and 14 acres along Muck Creek east of 507.

Enhance Prairies 2007 (TNC#4827)

- *Upper Weir Prairie*. Mowed 65 acres of dense broom along the western side of the prairie
- *Lower Weir Prairie*. Mowed 20 acres of broom on the east edge.
- *Johnson Prairie.* Mowed 15 acres along the outside road edges of the prairie.
- *Sequalichew Ecopark* - Boom sprayed 10 acres of capped landfill in spring to control non-native grasses and forbs as site preparation for future enhancement plantings. Conducted follow-up summer spot treatment.
- Analyzed 10 Scotch broom control pilot plots testing effectiveness of reduced herbicide levels and crop oil.
- Controlled weeds at pipeline restoration site to protect emerging native plants near creeks.
- *Muck Creek Triangle.* 173 acres of the highest quality prairie were spot treated An additional 40 acres of lower quality were treated with tractor boom and hand wand.
- *Johnson.* All of the high priority habitat at Johnson Prairie (190 acres) was spot treated. An additional 10 acres were boom treated in the southern corner.
- *Broom Control Study.* Completed six different treatments for broom control study.
- Wet Prairie enhancement plot treated with Aquamaster in October.

Upland Weeds (TNC#4828)

- *Mouse-ear hawkweed* – Surveyed and treated 60 acres area north of the Leschi Town and several areas in TA 12, north of Chambers Lake.
- *Sulfur cinquefoil.* Surveyed and conducted some treatment in TA's 6, 12 and 22 and MP 13. Conducted follow-up monitoring on last year's treatment plots.
- *Blueweed*. Treated populations in TA 7S.
- *Dalmatian toadflax*. Surveyed past infestation site at wash rack.
- *Common toadflax*. Surveyed and treated population in TA6.
- *Leafy spurge.* Treated populations in the AIA and TA 18 (Marion Prairie)
- *Tall oatgrass.* Surveyed and controlled at 65 acres at TA's 7S, 21 and 22 and MP 13. Brushcut minor infestations at TA 14 and 15. Established experimental control plots.
- *Knapweed complex.* Surveyed and controlled knapweed at Pacemaker, Lower Weir, TA's 5, 6, 7S, 7N and Area F south of Gray Army Airfield.
- *Knapweed.* Retreated knapweed at Pacemaker and conducted one-day weed survey.
- *Tall Oatgrass study.* Implemented and monitored oatgrass control study.

Fort Lewis STHL (TNC#4830)

- *13th Division* - Mowed lark habitat enhancement plots (24 acres)
- *13th Division* – Conducted vegetation surveys on all lark habitat plots.
- *13th Division* – Spot treated broom in lark habitat enhancement plots (24 acres)
- *Pacemaker.* Conducted spot treatments on 121 acres of Scotch broom and boom treated an additional 40 acres.
- *Pacemaker.* Mowed 181 acres of broom around core STHL area.
- Planted 600 seedlings at Sequalitchew landfill prairie enhancement site as part of a preliminary pilot study.

Fort Lewis Butterflies (TNC#4831)

- Reviewed and summarized history butterfly habitat enhancement work 2003 – 2006.
- Developed Butterfly Habitat Evaluation to guide enhancement actions.
- Prepared Butterfly Habitat Enhancement Work Plan
- Collected 'pre-treatment' vegetation data to inform creation of checkerspot resource plots in the triangle portion of the 13th Division RNA between Muck and South Creeks.
- Worked with Cheryl Schultz of Washington State University in a study testing the effects of Poast herbicide on Puget Blue butterflies.
- *Upper Weir*. Spot treated Scotch broom on 76 acres of the highest quality polygons. Conducted a large-scale boom application test of crop oil to control broom.
- *South Weir.* Spot treated broom on 72 acres.
- *Butterfly Enhancement Plots.* Conducted site preparation on butterfly plots at 13th Division, TA 7S and Johnson.
- Planted 11,250 seedlings and broadcast seeded an equal area with native forb species as part of an experimental butterfly habitat enhancement project

Gophers 2007 (TNC#4833)

- *Muck Creek Triangle - A* total of 200 acres of the highest quality prairie were brushcut to control scattered flowering scotch broom plants.
- *Johnson* - All of the Johnson Prairie core area (170 acres) was brushcut to control scattered flowering scotch broom plants
- *Upper Weir* - About 75 acres of the highest quality polygons at Upper Weir were brushcut to control scattered flowering scotch broom plants.
- *South Weir* - About 65 acres of the highest quality polygons at Upper Weir were brushcut to control scattered flowering scotch broom plants.
- *South Weir* - About 65 acres of the highest quality polygons at Upper Weir were brushcut to control scattered flowering scotch broom plants.
- *Upper Weir Prairie.* Mowed 182 acres of Scotch broom along western edge.

Ft Lewis Muck Creek (TNC#4834)

- *Reed Canary Grass* – Followed up treatments of Nixon Spring and Johnson Creek. Cut and sprayed approximately 19 acres in four priority areas along Muck Creek and around Preacher Creek.
- Placed rock delivered in spring along spawning channel at MP13.
- Planted 500 bigleaf maples along Muck Creek in areas that were treated for reed canarygrass.
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