January – December 2009 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.***

Fort Lewis Conservation Project

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.

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The cooperative program between Fort Lewis and The Nature Conservancy continues to be productive. Working with our Fort Lewis partners, we target landscape-scale restoration strategies that are informed and adapted by field trials and research. Fort Lewis Fish and Wildlife and TNC's approach to conservation on Fort Lewis continues to broaden through strategic participation in regional conservation efforts for rare species and habitat management.

In 2009, several programs on Fort Lewis that benefitted from regional integration. Primary examples of this include: prescribed fire, butterfly habitat enhancement, prairie quality monitoring and tall oatgrass control. We also initiated a study on Fort Lewis to evaluate a streaked horned lark nest predator protection technique that will be scaled-up to the rest the state by the Washington Department of Fish and Wildlife.

In summary, 2009 was a productive year on Fort. In spite of the usual set of set-backs such as weather and access restrictions, Fort Lewis and TNC were able to achieve all major shared goals. The summary table below presents highlights of the conservation activities accomplished during the year.

Highlights of 2009 conservation actions on Fort Lewis.

Habitat Enhancement and Invasive Plant Control

• Treated approximately 3257 acres of prairie, oak and pine habitat as management for invasives such as Scotch broom:
  ○ 2527 acres of prairie for rare butterfly, streaked horned lark, Mazama pocket gopher and general prairie enhancement.
  ○ 730 acres of oak and pine to enhance understory structure, remove encroaching Douglas-fir and enhance western gray squirrel habitat.
  ○ 1739 acres were treated through ecological burning.
• Initiated regional fire severity and effects monitoring program to guide fire management planning for restoration.
• Controlled about 17 acres of reed canarygrass along 3 miles of bank on Muck Creek.
• Completed survey of 13th Division Prairie to detect rare prairie plants and invasives.
Controlled all known priority weed infestations.

Rare Species Management
• Implemented Taylor's Checkerspot butterfly habitat enhancement experiment in three locations in conjunction with regional efforts. • Conducted butterfly and nectar surveys at Johnson Prairie. • Completed regional streaked horned lark predator nest exclosure experiment at Pacemaker. • Conducted first ever prairie pollinator survey and assessed pollination limitation of key prairie plant species. Completed surveys of marbled murrelet, and Townsend bats.

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.

2009 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-four 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*.

2009 FORT LEWIS ACTIVE TASK ORDERS	
Fort Lewis Burn 2009 (TNC#4928)	**Fort Lewis Noxious Weeds 2009 (TNC#4910)**
Fort Lewis Cavity Creation 2009 (TNC#4923)	**Fort Lewis Salmon 09 (TNC#4909)**
Fort Lewis Fauna Survey (TNC#4921)	**Fort Lewis Bald Eagle 09 (TNC#4908)**
Fort Lewis Murrelet 09 (TNC#4920)	**Fort Lewis Butterflies 2008 (TNC#4877)**
Ft Lewis Gophers – TNC#4918:	**Fort Lewis Muck Creek (TNC#4872)**
Fort Lewis Spotted Frog 09 (TNC#4917)	**Fort Lewis Oaks 2008 (TNC#4867)**
Fort Lewis Gray Squirrel 09 (TNC#4916)	**Fort Lewis Larks 2008 (TNC#4866)**
Fort Lewis Howellia (TNC#4915)	**Fort Lewis Invasives 2008 (TNC#4865)**
Fort Lewis Butterfly Habitat (TNC#4914)	**Fort Lewis Howellia 2008 (TNC#4864)**
Fort Lewis Flora Survey (TNC#4913)	**Fort Lewis Oak Woodland Restoration (TNC#3922)**
Fort Lewis Larks 2009 (TNC# 4912)	**Fort Lewis Prairies 2008 (TNC#3917)**
Fort Lewis Prairie Habitat (TNC# 4911)	**Williams Pipeline (TNC#3010)**

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 will largely be 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.

Fire is the preferred long-term, at-scale technique for broom control an prairie conservation. Over the past 10 years, ecological burning has been limited on base. Broom control during the past five years relied primarily on herbicide and mowing. After a few years of preparation, in 2009 Fort Lewis and TNC implemented a cooperative ecological burn program. In its first year, the program was able to achieve the desired level of implementation, making fire the current preferred treatment method. Fire is part of an integrated strategy that includes native plant establishment and other weed management. Fire is discussed in more detail in the fire section later in the Prairie section of this report.

SCOTCH BROOM SUMMARY TABLE

January-March

Fort Lewis Prairies 2009 (TNC# 3917)

- *Lower Weir Prairie.* Mowed 95 acres in southeast section of prairie using front mounted skid-steer mowers.
- *South Weir.* Skid-steer mowed 35 acres of broom in polygon north of pipeline.
- *Johnson Prairie.* Several small patches of broom was mowed along the perimeter to control dense patches of broom.

Fort Lewis Larks 2009 (TNC# 4866)

- *Lower Weir Prairie.* Mowed 25 acres of broom on east edge with conventional tractor.
- *South Weir.* Mowed 7 acres of dense broom western tip of the prairie
- *South Weir.* The highest quality 60 acres was brushcut to control sparse broom in the center of the prairie.
- *Upper Weir Prairie.* Mowed 68 acres of broom was southeast corner of the prairie in

preparation for prescribed burning during summer 2009. • *Upper Weir Prairie.* Brushcut 69 acres of sparse broom in two southwestern side polygons. • *Johnson Prairie.* Brushcut 163 acres of sparse broom throughout the prairie.
April-June Brushcut flowering broom at the following prairie sites (Fort Lewis Prairies 2009 - TNC# 4911): • Johnson Prairie - 163 acres. • South Weir Prairie – 60 acres. • Upper Weir Prairie – 68 acres. • Muck Creek Triangle – 43 Acres.
July-September • Spray treated 74 acres of Scotch broom at Upper Weir Prairie (TNC#4912)
October-December • Mowed 50 acres of broom in the NE corner of Upper Weir Prairie in preparation for fire (TNC#4912).

2009 Review

A total of 983 acres of broom were treated by mowing, brush cutting or spray treatment. Approximately 258 acres of Scotch broom were controlled through mowing during winter quarter on 10 polygons in the Rainier Training Area. In addition, 624 acres of broom was cut with brush cutters to control broom seed production on priority areas throughout the Rainier Training Area and 13th Division Prairie during winter and spring quarters. In addition to the prairie burning that took place in summer, we also spot treated 50 acres of broom at Upper Weir, and in the fall we mowed 50 acres of broom. All broom spray treatments were made with 2.0% Triclopyr ester 0.25% Nufilm as an adjuvant. See maps below for locations of activities.

Broom mowing is also used as site preparation for prescribed fire, and several polygons mowed by TNC and Ft Lewis Range Control were able to be burned this year as a result. Fire preparation mowing occurred in fall 2009 and will continue in 2010 for 2010 season burning.

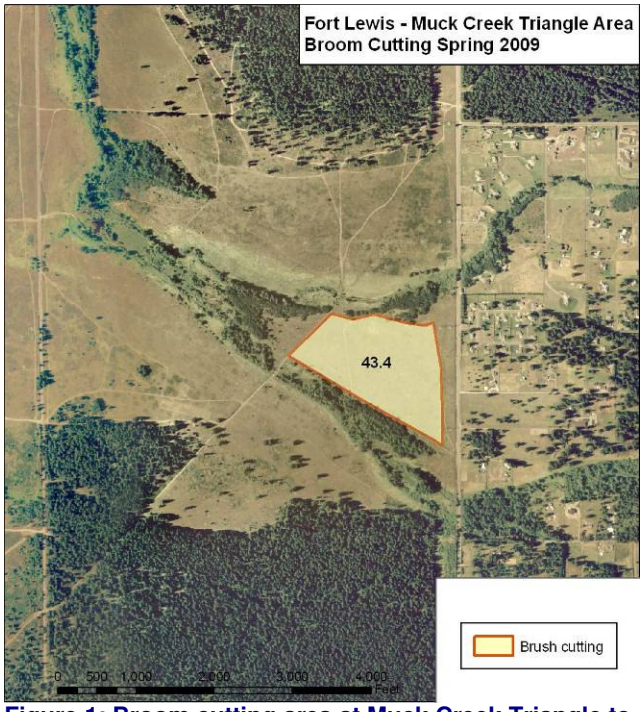


Figure 1: Broom cutting area at Muck Creek Triangle to control seed set.

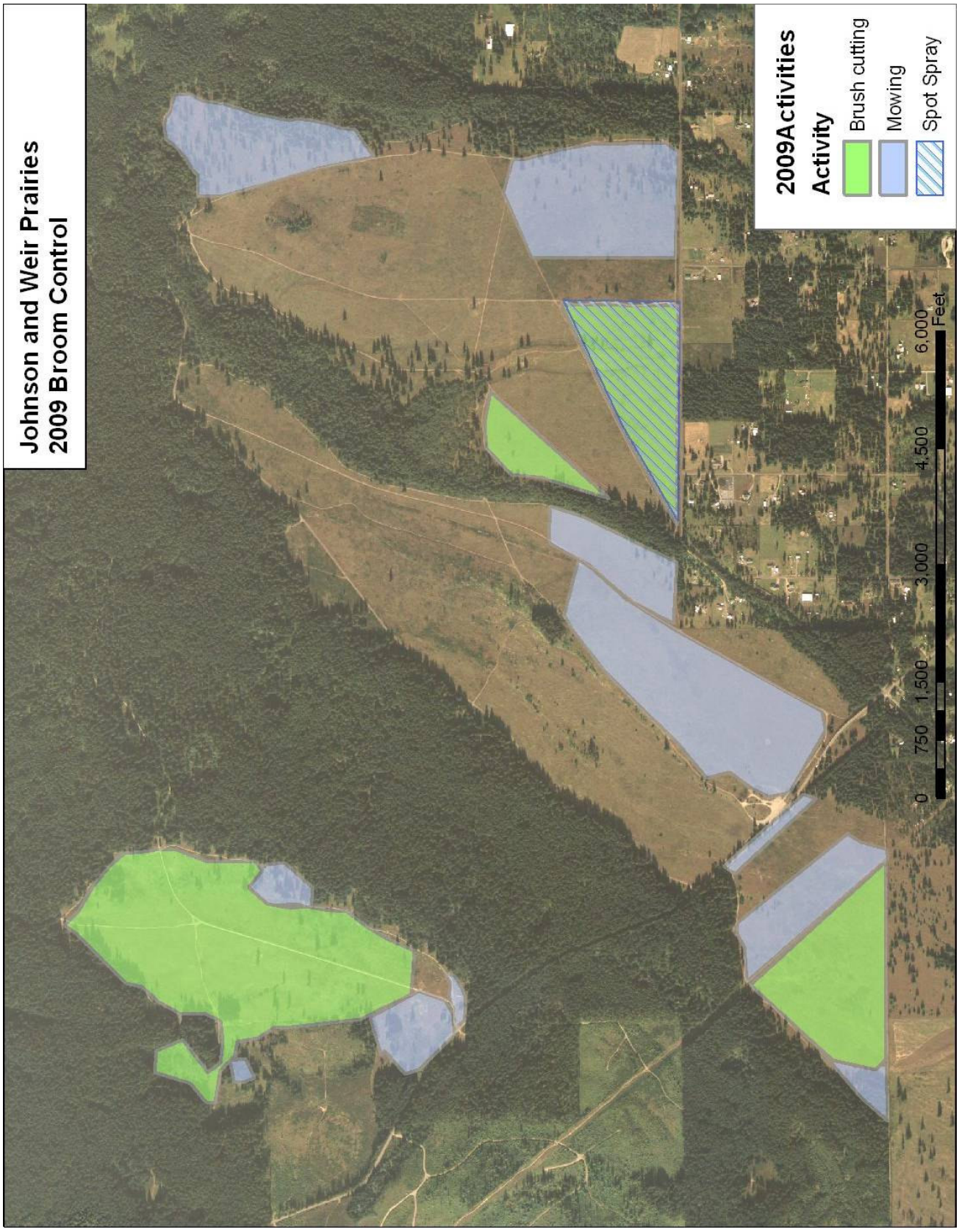


Figure 2:. Map of broom control activities at Fort Lewis Rainier Training Area.

PRESCRIBED FIRE PROGRAM

The South Puget Sound region of Washington was once largely dominated by a diverse mosaic of fire dependent grasslands that were interspersed with conifer and deciduous woodlands and wetlands. Lack of managed fire during the past 150 years has led to significant habitat loss and impact on species. Conservation Action Planning (CAP) for the region has identified the return of fire as a very important if not critical restoration strategy. Fort Lewis is particularly well suited to use of fire due to its large size and contiguous ownership.

While Fort Lewis has had a robust prescribed fire program, changes during the last decade have led to a dramatic reduction in acres burned for habitat enhancement. TNC has worked with Fort Lewis Fish and Wildlife during the past two years to develop the capacity for joint TNC/DoD implemented burns that can be bossed by TNC. This work has occurred in conjunction with regional efforts to step up prescribed prairie, oak and pine burns to benefit habitat and rare species throughout South Puget Sound. Funding from the Army Compatible Use Buffer program has been instrumental in providing staff training and equipment for use off-base. This investment in infrastructure has augmented efforts to build the Ft. Lewis prescribed fire program. A 2009 annual report for the regional fire program is available from TNC on request.

This was an exciting year for the Fort Lewis ecological burn program. After several seasons of effort, TNC received authorization and developed procedures with Fort Lewis to allow TNC to boss burns on Fort Lewis. As a result, we far exceeded our minimum goal of completing three burns on base. In total, we completed 25 ecological burn projects over 21 days of burning. The season started July 16 assisting Forestry with some grassland range burns. The burn season began in earnest on August 10, after which, every available burn day was utilized until September 28 when the rains began. In total, 1739 acres were burned during 21 operational shifts (including three no-go days due to weather). TNC along with DNR and volunteers supported Fort Lewis with burn bosses, experienced crew and equipment.

The season's success can be largely attributed to an unexpected opportunity that developed early in 2009. With the Fort's recent and rapid loss of two burn bosses and a transition towards increased use of Fort Lewis Fire Department on wildfires, TNC was able to bring two highly experienced burn bosses in staggered shifts from out-of-state programs. These burn bosses helped advise and evaluate Fort Lewis's wildland burn program as it worked to rebuild capacity and make transitions in management. They helped to incorporate resources advisor

Figure 3: Upper Weir oak understory burn at Ft Lewis

considerations from Ft Lewis Fish and Wildlife into fire planning. They also worked through institutional barriers limiting TNC's ability to lead burns and enhance credibility and trust among Ft Lewis partners. In addition, they lead ecological burns and provided classroom and live training opportunities for regional firefighters.

Our newly proven ability to burn over 1700 acres in a year puts us in reach of landscape-scale restoration with fire as a center-piece strategy on Fort Lewis. A 3-5 year rotation should greatly help maintain Scotch broom infestations. Use of fire is augmented with other restoration strategies, such as seeding and plugging native plants and highly targeted herbicide and mechanical treatments to control invasives.

PRESCRIBED FIRE SUMMARY TABLE
April-June Ft Lewis Burn 09 – TNC#4928: • Hosted G-131 Advanced Wildland Fire for Structural Fire Fighters (8 hrs 10 students) • Hosted S-290 Intermediate Wildland Fire Behavior: (24 hrs 18 students) • Hosted S-212 Wildland Fire Chain Saw Operations (24 hrs 18 students) • Hosted S-131 Advanced Fire Fighter (8 hrs 12 students) • Hosted S-133 Look Up, Look Down, Look Around (4 hrs 12 students)
July-September Ft Lewis Prairies – TNC#4911: • *Upper Weir Prairie.* Completed two oak woodland/prairie edge burns totaling 27 acres with focus on oak and snag protection. • *South Weir Prairie.* Completed one burn totaling 60 acres. Attempted interior burn exclusions and nest box protection. • *TA 15.* Completed one burn totaling 60 acres. Completed burn with hand crews and hose lay to minimize impact to prairie. • *TA 7S.* Completed one burn totaling 60 acres. • *TA 8*. Completed two burns totaling 120 acres. • *Marion Prairie*. Completed one burn totaling 120 acres. • *Ranges 86-93.* Completed three burn units totaling 248 acres. Ft Lewis Larks – TNC#4912: • *Lower Weir Prairie.* Completed two burns totaling 207 acres. Targeted torching of fir to enhance prairie. • TA 14. Completed two burns totaling 369 acres. Minimized impacts to butterfly resources and favored lark habitat by creating more complete burn. • *Upper Weir Prairie.* Completed two prairie burn projects totaling 171 acres. • *TA6.* Completed three burns totaling 219 acres. Ft Lewis Gophers – TNC#4918: • *Johnson Prairie*. Completed two burn projects totaling 70 acres. Excluded several interior habitat patches from fire using hand crews and ATV. • Provided burn boss expertise to assist with Fort Lewis burn program development;

conducted 1232 student hours of firefighter training in five different classes for local firefighters (TNC#4928)

October-December

- Conducted post-burn fire effects and severity monitoring at Upper Weir Prairie. TNC# 4912.
- Co-hosted fire ecology training course RX-310 with Fire Learning Network, which 11 Ft Lewis firefighters participated in 35 classroom hours. TNC# 4911.
- Developed implementation guidance document based on 2009 season observations #4928.

Of the 25 completed ecological burn projects, 1592 acres were on prairie, 120 acres were in pine woodland, and 27 acres were in oak woodland. Most of the burns were conducted in Training areas, but TNC assisted with three range burns totaling 248 acres. Following is a list of the acres burned at the various sites:

Table 1: List of units burned at Fort Lewis during 2009 season.

Cnt	Shift	Date	Unit	Acres	Boss
1	1	16-Jul	Range 86-9	136	Dan Leeper
2	2	20-Jul	Range 91	25	Dan Leeper
3	2	20-Jul	Range 92-3	87	Dan Leeper
4	3	22-Jul	Upper Weir Oaks	12	Bob Wilken
5	4	10-Aug	Upper Weir Oaks II	15	Eric Rosenquist
6	5	14-Aug	Johnson Prairie	46	Eric Rosenquist
7	6	17-Aug	TA 8 Pines	43	Eric Rosenquist
8	7	18-Aug	TA 8 Pines II	77	Eric Rosenquist
9	8	20-Aug	Johnson NE	24	Eric Rosenquist
10	8	20-Aug	Lower Weir SE	103	Eric Rosenquist
11	9	24-Aug	TA 7S I	0.24	Eric Rosenquist
12	10	25-Aug	TA 6 North	105	Eric Rosenquist
13	11	26-Aug	TA 7S II	60	Eric Rosenquist
14	12	27-Aug	South Weir	68	Eric Rosenquist
X	13	31-Aug	Pacemaker	0	Eric Rosenquist
X	14	1-Sep	Lower Weir SE	0	Eric Rosenquist
15	15	8-Sep	TA 6 Unit B	104	Eric Rosenquist
16	16	9-Sep	Upper Weir West	85	Eric Rosenquist
17	16	9-Sep	Upper Weir SE Blackline	20	Eric Rosenquist
18	17	10-Sep	Pacemaker North and Central	196	Eric Rosenquist
19	18	14-Sep	Upper Weir SE Finish	66	Eric Rosenquist
20	18	14-Sep	Lower Weir NE	104	Eric Rosenquist
21	19	15-Sep	Pacemaker South	173	Eric Rosenquist
22	20	16-Sep	TA 6 SE I	10	Eric Rosenquist
23	21	21-Sep	Muck Triangle	60	Eric Rosenquist
X	22	24-Sep	TA 8 North	0	Eric Rosenquist
24	23	28-Sep	TA 18 Marion Prairie	120	Eric Rosenquist
Total Acres				1739.2	

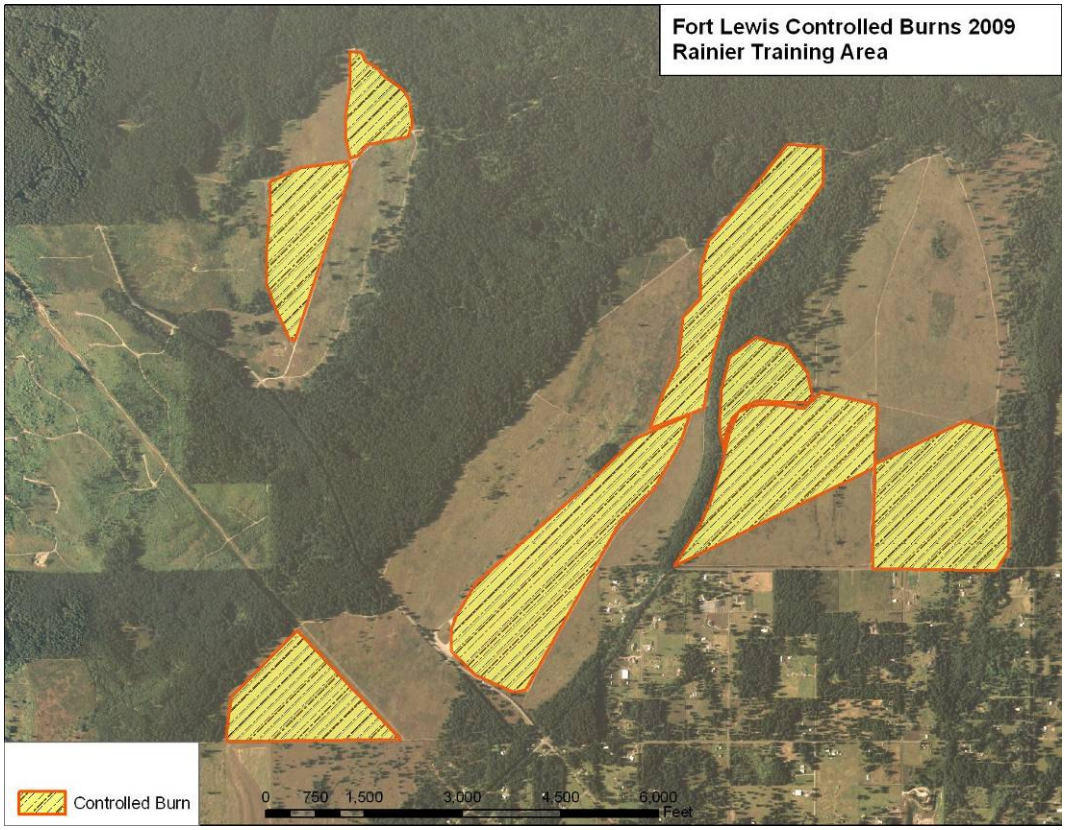


Figure 4: 2009 controlled burn locations at Johnson and Weir Prairies

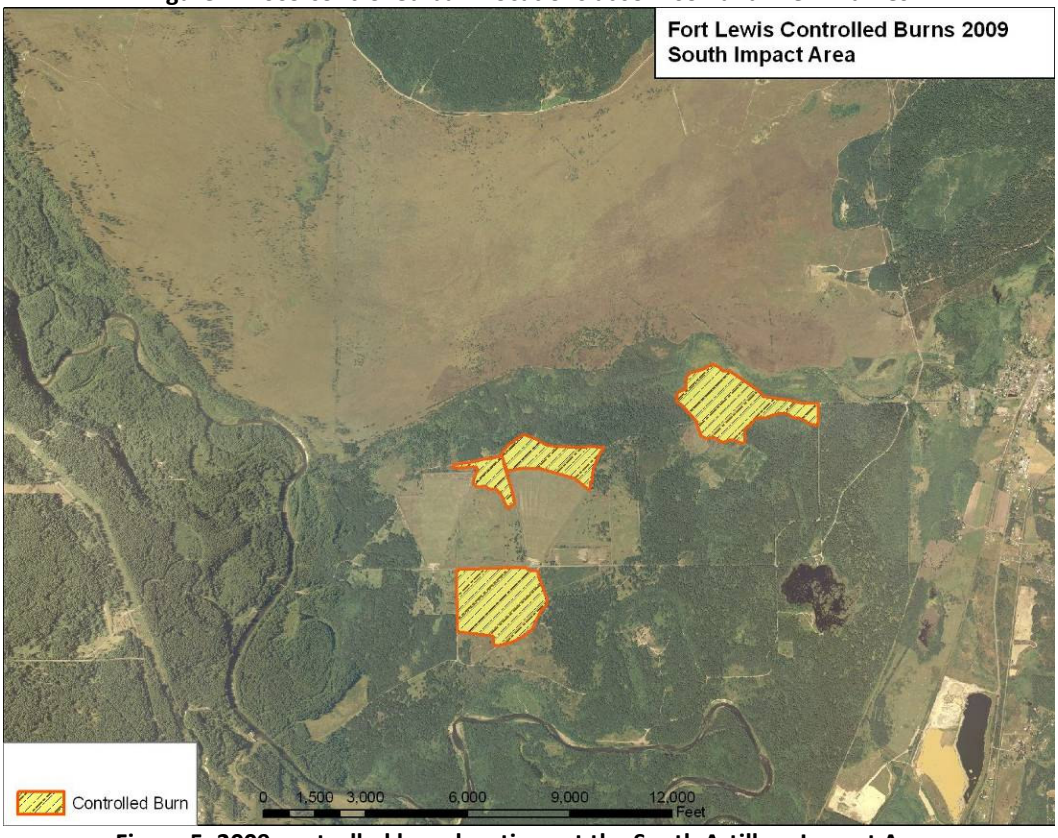


Figure 5: 2009 controlled burn locations at the South Artillery Impact Area.

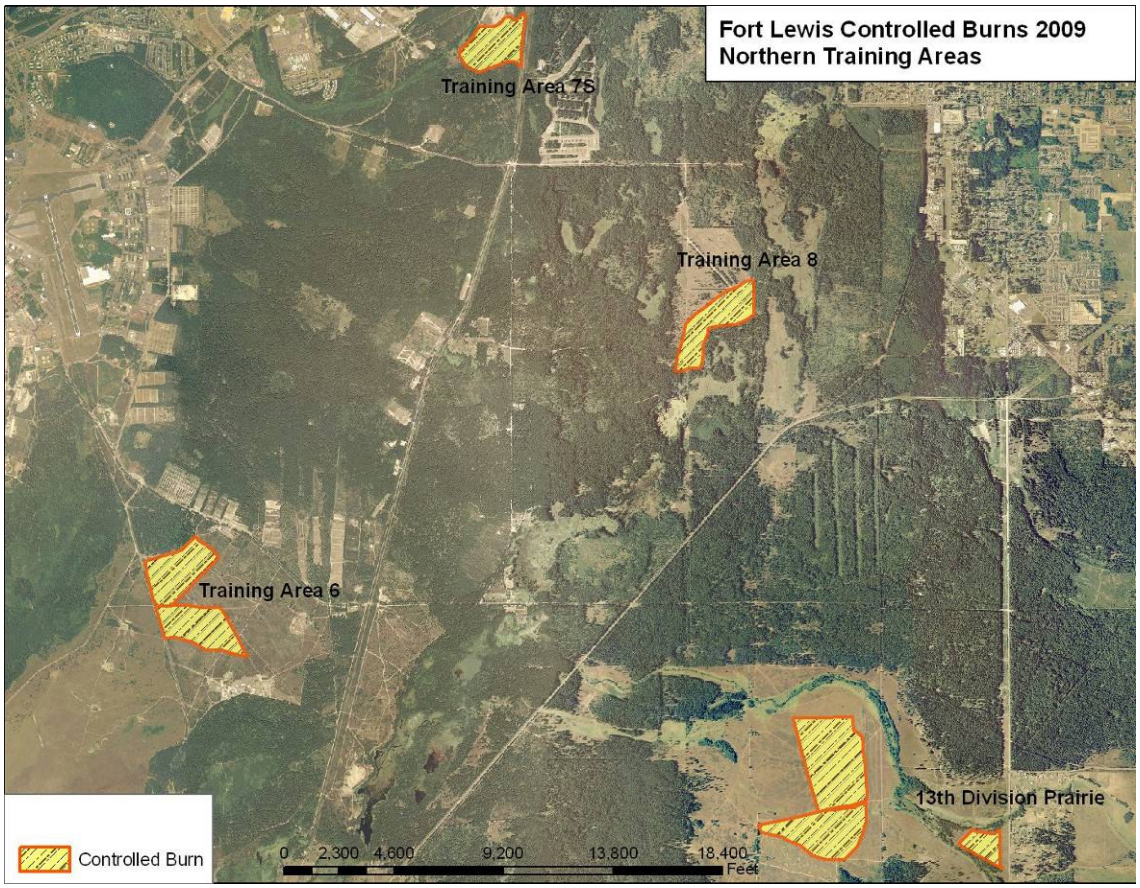


Figure 6: 2009 controlled burn locations at 13th Division and Training Areas 6, 8 and 7S.

Fire Effects and Severity Monitoring

In October 2009, we conducted post-burn fire severity monitoring on prescribed burn units at Tenalquot, Glacial Units 1 and 2, Wolf Haven, and Upper Weir prairies. At each site, we set up a permanent 100m baseline transect (split into two 50m transects for larger burns to cover greater diversity of sites within the burn perimeter), with ten perpendicular 50m transects set at 10m intervals. We collected the following data from ten $1m^2$ plots along each perpendicular transect (totaling 100 plots per site):

1) Fire severity index (assigned class 1-5)
2) Overall ground scorch
3) Scotch broom top kill
4) Litter consumption
5) Bare ground (as proxy for moss-removal)

Figure 7:Post-burn fire effects and severity monitoring plot at Tenalquot Preserve.

Once we collect fire effects data (native diversity, richness, non-native cover) from these

same plots in spring 2010 (and in subsequent years), we will be able to correlate fire severity variables to specific ecological effects. This information will help us better understand the connection between fire severity and resulting vegetative recovery trajectories. A regional monitoring program helps to link and improve information gathering and creates implementation efficiencies.

Firefighter Training

Though of significant size, South Sound still had an inexperienced crew of firefighters at the beginning of 2009, with significant needs for training. Increased training greatly increases both crew and resource safety, improves confidence among regulatory agencies, and increases operational efficiency, allowing reduced staff and equipment requirements during burns. Trainings are also valuable opportunities for fire programs from around the region and beyond to come together to network and learn from one another.

We were able to provide many more training opportunities than we originally hoped this year. Fort Lewis affiliated wildland firefighters participated in three off-site training exchanges to Texas and Arkansas for firefighter 1 trainees and sent an engine boss trainee to Florida's engine boss academy. Travel expenses were shared between Ft Lewis Prairies (TNC# 4911) and other non-Ft. Lewis funds (primarily ACUB). In addition, TNC was also able to provide close to 2000 student hours of training to local partners and other fire practitioners from around the northwest region and beyond, largely due to the availability of visiting burn bosses to Fort Lewis. Classes included the following and were supported by Ft Lewis Prairie (TNC#4911):

- Co-hosted Rx-310 Introduction to Fire Effects with FLN (35 hrs 25 students – 11 from Ft Lewis)
- G-131 Advanced Wildland Fire for Structural Fire Fighters (8 hrs 10 students)
- S-290 Intermediate Wildland Fire Behavior: (24 hrs 18 students)
- S-212 Wildland Fire Chain Saw Operations (24 hrs 18 students)
- S-131 Advanced Fire Fighter (8 hrs 12 students)
- S-133 Look Up, Look Down, Look Around (4 hrs 12 students)

Figure 8: Wekiwa Springs Engine Academy Mark III pump training.

With the benefit of the 2009 training and months of field experience, our network of South Sound firefighters has become noticeably more proficient. Trainings have provided a good education foundation, as well as expanding individual's experiences beyond normal operations. In addition, each of the regular season burns was treated as a learning opportunity. Firefighters were given opportunities to rotate through positions and leadership roles. After Action Reviews at the end of each burn were important learning opportunities, assessing what went right, what

to improve for the future. The reviews elevated the importance and risks of the work and re-emphasized the need to avoid complacency in routine activities. We now have a core of about 10 firefighters with advanced training and qualifications and experience functioning in multiple fire line roles.

GENERAL PRAIRIE RESTORATION

Propagation, Enhancement Plantings, Pollinators, Flora Surveys

Prairie plant propagation is an important component of the prairie program. Seed collected from the prairies is used to propagate seedlings and develop seed production beds, which are strategically used 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 further developed. The 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 seed increase project and several other regional efforts are facilitating this effort by funding development 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.

2009 Review

Most of the planting and seeding work in 2009 is reported in the Butterfly section of this report. In addition, the Dept of Defense Legacy seed project continues to be a major component of our regional seed development effort. The Legacy project is reported separately. Weed spraying is discussed in the weed management section of this report.

GENERAL PRAIRIE RESTORATION SUMMARY TABLE
January-March • *Pipeline* – Planted 30,000 Fescue plugs along north side of creek (TNC#3010).
April-June • *Pipeline* – Re-sprayed Muck Creek Triangle area pipeline restoration area (TNC#4911). • *Sequalitchew Earthworks* – re-sprayed project area (TNC#4911).
July-September • Completed field surveys for native and invasive plants on 13th Division Prairie (TNC#4913). • Collected seed from 40 species of prairie plants (TNC#4918). • *Spurgeon Creek Seed Plots* - Sprayed 8 acres as site preparation for fescue seed production (TNC#4911)
October-December • *Sequalitchew Earthworks* -- Retreated project site to control summer weed germinants (TNC#4911). • *Muck Creek Seed Plots* - Tilled 5 acres as site preparation for future plug seed production (TNC#4911) • *Pipeline* – Re-sprayed Muck Creek Triangle area pipeline restoration area (TNC#4911).

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.

In January 2009, approximately 30,000 fescue plugs were planted along the northern stretch of the project area, totaling about 1600 linear feet. This area has had topsoil delivered and spread, where native topsoil was lacking. It received subsequent spray treatments 2-3 times per year to control weeds. In spring and fall of this year, we made the regularly scheduled spray treatments to control invasive grasses and forbs. A 2% solution of Aquamaster (Glyphosate) 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.

Spurgeon Creek Seed Plots

Site preparation for 8 acres just off Spurgeon Creek Road near the Rainier Road intersection was conducted this summer using a 2% solution of Round-Up Pro(TNC#3917).

Sequalitchew 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.

The Earthworks habitat enhancement area was expanded to a total of 18 acres in 2008. Treatments continued through 2009, and weed seed bank continues to be robust. Round-up Pro concentrate was used at maximum label rate in the spring.

Plots were seeded again in winter 2008. Seed rates were doubled and sown in November instead of January, which should give the seed more time for establishment and cold stratification. Monitoring for plug and seed survival will be performed in spring 2010.

Table 2: Fall 2008 plot sowing at Sequalitchew Earthworks enhancement project.

Species	Plug mix (grams per plot)	Cocktail mix (grams per plot)	Fescue (grams per plot)	Total grams sown
Aquilegia formosa	0.000	6.160	0.000	30.800
Camassia quamash	9.000	0.000	0.000	45.000
Castilleja hispida	0.000	0.480	0.000	2.400
Erigeron speciosus	0.750	0.000	0.000	3.750
Eriophyllum lanatum	0.000	2.880	0.000	14.400
Lomatium utriculatum	3.660	0.000	0.000	18.300
Lupinus lepidus	8.147	0.000	0.000	40.733
Microseris laciniata	5.176	0.000	0.000	25.882
Potentilla gracilis	0.000	1.000	0.000	5.000
Ranunculus occidentalis	4.640	0.000	0.000	23.200
Danthonia californica	0.000	20.117	0.000	100.583
Festuca roemeri	0.000	0.000	10.550	105.500

The below table depicts the spring 2008 survivorship of plugs planted in winter 2007. Ranunculus, Microserous, and Erigeron plugs appear to do quite well after one year. They will be monitored again in 2010 to see if they continue to thrive after two winters.

Table 3: Species planted at Sequalitchew as plugs in winter 2008 with spring 2008 survival.
(10 of each species planted at each plot)

	Planting tool	ROAC	LOUT	MILA	LULE	ERSP	CAQU
Plot 1	Dibble	10	6	10	6	10	3
	Shovel	10	5	10	7	10	2
Plot 2	Dibble	10	7	9	3	10	0
	Shovel	10	6	10	7	10	1
Plot 3	Dibble	10	5	10	1	10	0
	Shovel	10	2	10	2	10	0
Plot 4	Dibble	2	0	9	4	10	0
	Shovel	3	0	7	4	9	0
Plot 5	Dibble	10	1	10	4	6	0
	Shovel	6	1	7	6	7	0
Total survival		81	33	92	44	92	6
% survival		81	33	92	44	92	6
Dibble survival		42	19	48	18	46	3
% plug survival		84	38	96	36	92	6
Shovel survival		39	14	44	26	46	3
%Shovel survival		78	28	88	52	92	6

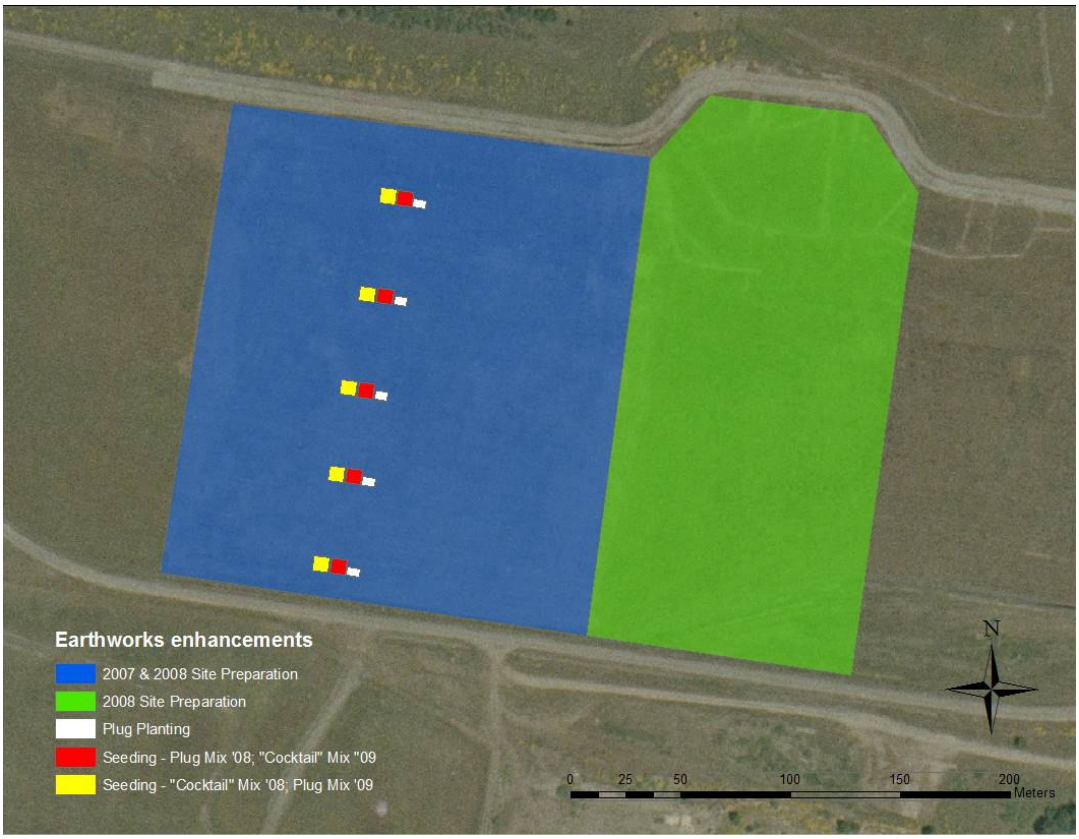


Figure 9: Treatment area and plant establishment plots at Sequalitchew.

Seed Collection

Seed from 40 species of prairie plants was collected and cleaned by Fort Lewis and TNC staff and volunteer crews during the late spring and early summer months. Seed was collected from numerous sites, on and off Ft. Lewis and from Shotwell's Legacy seed beds. Some seed has been and will be used for plug production, direct seed trials, and for large-scale seed production.

TABLE 4: List of seed collected in 2009 by TNC staff and volunteers and Fort Lewis staff and processed at Shotwell's Landing.

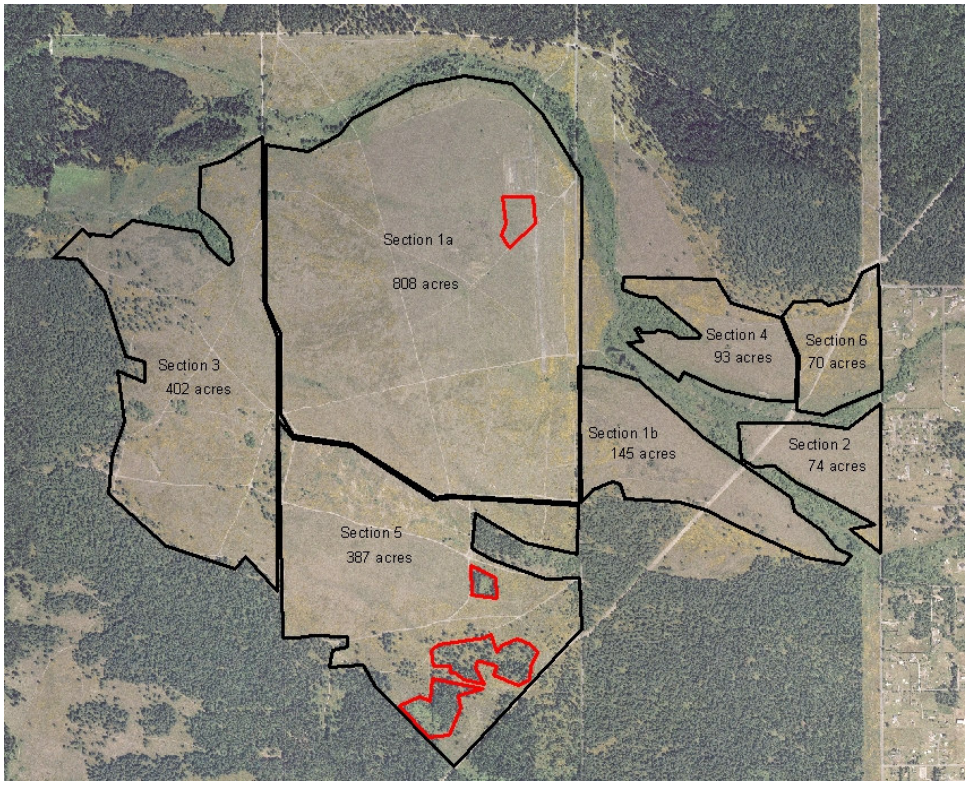
Species	Spp	Grams (A)		Species	Spp	Grams (A)
Antennaria neglecta	ANNE	6.565		Gaillardia aristata	GAAR	226.870
Apocynum androsaemifolium	APAN	26.667		Gilia capitata	GICA	18.235
Arctostaphylos uva-ursi	ARUV	3.989		Hieracium cynoglossoides	HICY	37.517
Armeria maritima	ARMA	113.081		Koeleria cristata	KOMA	3.124
Aster hallii	ASHA	0.546		Lomatium nudicaule	LONU	1,348.492
Balsamorhiza deltoidea	BADE	2.732		Lomatium triternatum	LOTR	117.627
Brodiaea coronaria	BRCO	5.955		Lupinus albicaulis	LUAL	57.433
Calandrinia ciliata	CACI	10.385		Lupinus lepidus	LULE	1.300
Camassia quamash	CAQU	60.898		Microseris laciniata	MILA	471.450
Castilleja hispida	CAHI	81.440		Panicum occidentale	PAOC	6.008
Collinsia grandiflora	COGR	36.213		Panicum scribnerianum	PASC	6.095
Danthonia californica	DACA	119.190		Plantago Lanceolata	PLLA	220.022
Danthonia spicata v. pinetorum	DASP	303.000		Potentilla glandulosa	POGL	102.460
Dodecatheon hendersonii	DOHE	6.690		Potentilla gracilis	POGR	238.379
Dodecatheon pulchellum	DOPU	3.366		Ranunculus occidentalis	RAOC	18.386
Erigeron philadelphicus	ERPH	32.439		Senecio macounii	SEMA	4.219
Erigeron speciosus	ERSP	1,013.152		Silene scouleri	SISC	16.120
Eriophyllum lanatum	ERLA	354.871		Sisyrinchium angustifolium	SIAN	657.457
Festuca romerii	FERO	204.539		Solidago spathulata	SOSP	379.718
Fritillaria lanceolata	FRLA	5.274		Zigadenus venenosus	ZIVE	8.617

Prairie Flora Surveys

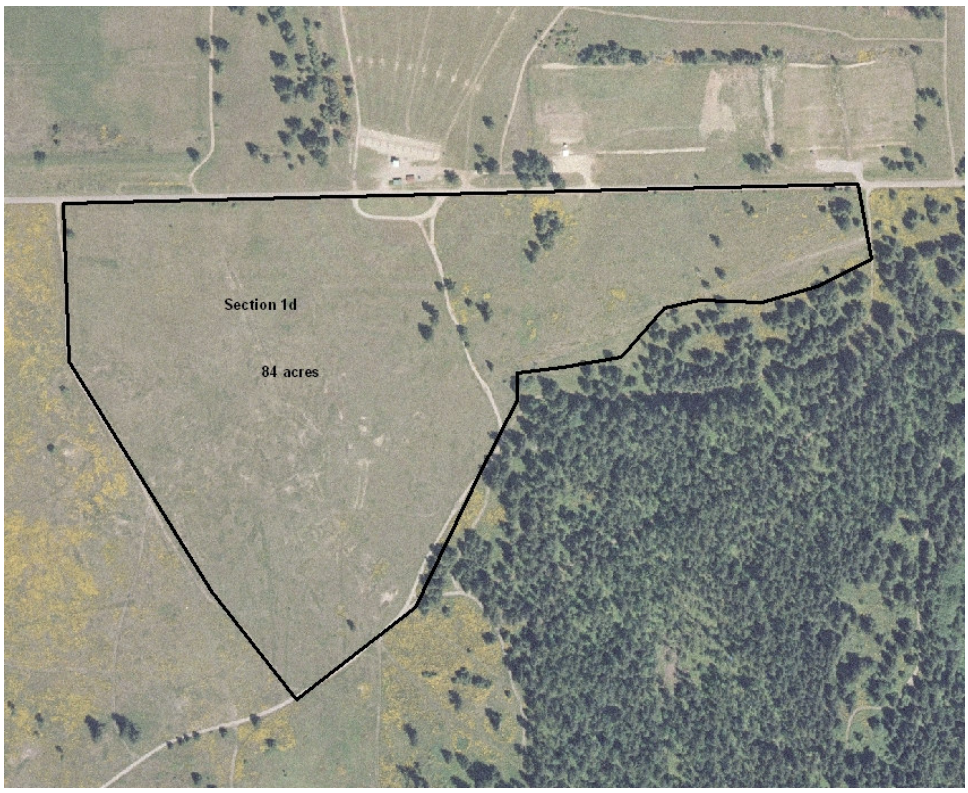
Starting in June, we contracted with SEE Botanical Consulting to survey selected prairies on Fort Lewis for forty six target species that are either considered to be rare on the installation or are noxious weeds. The primary target species for the survey was Senecio [Packera] macounii, Puget groundsel which, prior to this survey, was only known from three sites on the fort. In addition, the species was known historically from three general areas in which it had not been recently relocated (Gilbert, personal communication). A final report titled 2009 Plant Surveys: Fort Lewis Prairies was submitted to Fort Lewis Fish and Wildlife and is available from TNC.

Table 5. Species for which information was gathered during this inventory. Taxa found during this survey are indicated with an asterisk (*);Training Area(s) in which they were found are shown. Occurrence details are found in Appendix 1.

Native Species	1a	1b	1c	1d	2
Agoseris grandiflora					
Agoseris heterophylla					
**Antennaria neglecta*	X	X	X		X
**Armeria maritima*			X		X
**Brodiaea congesta*				X	
**Brodiaea howellii*					X
Camassia leichtlini					
Carex tumulicola					
Carex unilateralis					
**Castilleja hispida*	X				X
Collinsia parviflora					
Collinsia grandiflora					
**Delphinium nuttallii*		X			X
Deschampsia cespitosa					
Deschampsia elongata					
**Dodecatheon pulchellum*	X				
**Erigeron philadelphicus*					X
**Gaillardia aristata*	X		X	X	
Geranium bicknellii					
Linaria canadensis					
**Lomatium nudicaule*	X				X
**Lotus nevadensis*			X	X	
Minuartia tenella (Arenaria stricta)					
Montia linearis					
**Navarretia intertexta*	X				X
**Navarretia squarrosa*	X				X
**Perideridia gairdneri*	X	X			X
Plagiobothrys figuratus					
**Plagiobothrys scouleri*	X				X
Plectritis congesta					
Potentilla glandulosa					
**Psoralea (Rupertia) physodes*				X	
Ranunculus orthorhynchus					
**Rhinanthus crista-galli*	X	X			
Sanicula graveolens					
**Senecio macounii*	X	X	X	X	
Silene douglasii					
Symphyotrichum (Aster) hallii					
Trifolium microcephalum					
Trifolium tridentatum					
**Viola nuttallii*	X	X	X	X	X
Noxious Weeds					
**Centaurea* spp. (*C. diffusa* and/or *C. maculosa*)	X	X	X	X	
**Potentilla recta*	X	X	X	X	
**Hieracium pilosella*			X		
**Euphorbia esula*				X	
**Echium vulgare*				X	


Section 1a
808 acres
Section 3
402 acres
Section 4
93 acres
Section 6
70 acres
Section 1b
145 acres
Section 2
74 acres
Section 5
387 acres

b.


Section 1d
84 acres

c.

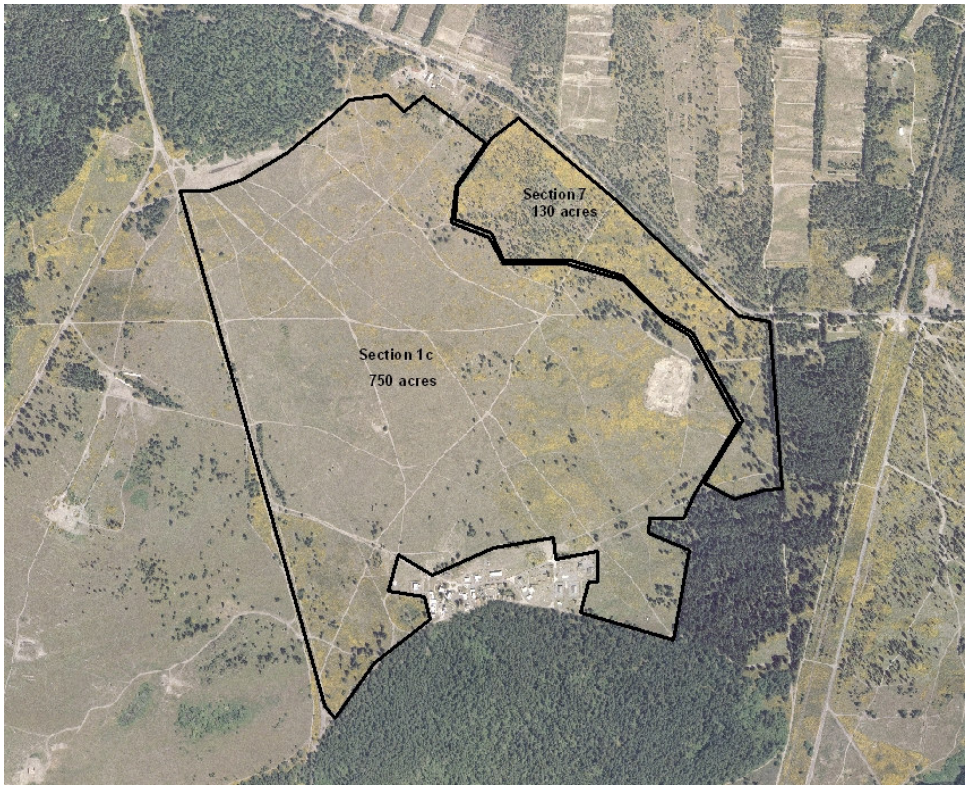


Figure 10 a-c: Maps including prairies surveyed during this inventory. Areas 1a, 1b, 2, 1c and 1d were surveyed.

Pollinators

Prairie restoration efforts are likely to be most successful if they incorporate considerations for the historical functional components of the prairie - oak ecosystem, including pollination services. Current restoration practices on South Puget Sound prairies emphasize actions to promote native forbs, but meet with mixed success. Native forbs provide resources for many prairie fauna, but they often decline as habitat condition degrades. Pollination studies in western oak savannas have revealed the importance of the rich bee fauna in the reproductive success of many understory species. Bees are generally considered the most effective pollinators because they are morphologically and behaviorally adapted to visit multiple flowers to gather pollen and nectar to provision young, thereby transporting pollen among flowers. Despite their importance in providing pollination services for many plant species, and the global concern for loss of native pollinating insects, little is known about the bee fauna or other pollinators of western Washington flora. At present, there is no curator for arthropods at the Burke Museum at the University of Washington in Seattle, and many insects from western Washington are housed at the Oregon State University Arthropod Collection in Corvalis, Oregon.

A new pollinator project was initiated by TNC and Ft Lewis Fish and Wildlife in 2009. This study represents a first step in a standardized approach to characterizing the community of flower-visiting insects that may be pollinating flowers on Puget prairies to better inform restoration and land management planning in the region. A valuable final product will include a reference collection of bees and other insects of western Washington identified by experts and housed at Evergreen State University and Washington State University where they will be available to other interested parties within the state. A detailed report on the pollinator project, *Enhancing Pollination Function on South Sound Prairies, 2009,* by Cheryl Fimbel is available from TNC. Highlights of the report are provided below. Funding for this project was provided from Ft Lewis Fauna Survey (TNC# 4921).

Pollinator Survey

- Bee capture rates in passive pan traps (3.64 bees/pan/day) on Fort Lewis exceeded norms for the western U.S. (range: 2.3 – 3.2) and the eastern U.S. (range: 0.5 – 1), suggesting relatively abundant bee populations on these prairie sites compared to other sites investigated. Identifications of pollinator specimens are still underway, and will allow further analyses to inform our understanding of the resiliency of our pollinator and plant communities.
- Preliminary results show that the abundance of bees captured in pan traps was most closely correlated ($r^2 = 0.43$, $p = 0.05$) to the abundance of flowering forbs at nine prairie sites on Fort Lewis, when compared to other vegetation parameters measured, followed by weaker non-significant correlations with % cover of bareground and non-native grasses (negative

Figure 11: Bee nest block on oak tree.

correlation), reinforcing the need to continue restoration efforts that increase forb resources while reducing cover of non-native grasses and open up bare ground.
- Long-blooming flowers of native and invasive shrubs, including Oregon grape, snowberry, trailing blackberry and Himalayan blackberry in open and edge habitats are heavily used by native bees and are likely important for sustaining pollinator communities, especially as the summer season progresses and many of the prairie forbs senesce.
- Under conditions of drought-stress on the prairies, micro-climates, such as shady areas, deep swales, and pockets of deep soil occurring on mounds or in swales appear to be important for providing 'fresh' nectar resources of some forb species when the majority of conspecifics in adjacent drier habitats have either senesced or appear to be otherwise undesirable to the pollinators.
- *Solidago Canadensis* likely serves an important role by being one of the latest blooming native forbs on the prairie and attracting a variety of pollinators, and should be considered for inclusion in restoration plantings where late season floral resources are limited.

Balsamorhiza deltoidea pollination study
- Outcrossed seeds of *B. deltoidea* yielded higher rates of larger (plump) seeds with higher rates of germination within 16 days compared to selfed seeds, confirming the importance of assisted pollination in producing viable seeds for this important forb.
- Hand pollinated flowers of *B. deltoidea* yielded significantly ($p=0.05$) higher numbers of plump seeds compared to open (natural) pollinated flowers at the 7S prairie. There was a trend for more plump seeds in hand pollinated flowers at the other two prairie sites in this study, but the differences were not significant ($p=0.05$). These preliminary results suggest there is potential for some pollinator limitation for some forbs at select sites, but the evidence is not suggestive of severe pollinator limitation as a general issue at Fort Lewis at this time. Anecdotally, the prairie with the most abundant bees (7S) produced the highest percentage of plump seeds per *B. deltoidea*, suggesting that some populations of forbs may produce more viable seeds compared to others. Thus, increasing populations of bees may support restoration efforts to promote native forbs with higher percentages of viable seeds. This would be especially important in the vicinity of seed beds for native forb seed production.

Bee nesting blocks/trap nests
- The majority (29 of 37, 78%) of nesting blocks recovered contained larvae or pupae of solitary bees, but varied considerably by prairie.
- Many occupied galleries contained small mites and wasps, potential parasites and predators, respectively. Parasites and predators are commonly associated with artificial bee nesting structures elsewhere, so that caution is warranted in continued use of these devices where the goal is to promote, rather than harm, solitary bee populations.

RARE BUTTERFLIES

The Fort Lewis Military Installation is regionally important because it holds 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 current recovery effort for Taylor's checkerspot (*Euphydras editha taylori*) butterflies includes captive rearing and translocation onto Puget prairies. Potential receiving sites appear to be deficient in important resources for this species. Many of our prairie restoration efforts therefore, emphasize habitat enhancement activities designed to increase checkerspot resources in these sites. Some of the restoration actions are implemented in an experimental fashion to allow comparison of site preparation and planting techniques (plugs of nursery-grown seedlings vs. direct seeding). We also participate in the ACUB Butterfly Habitat Enhancement Team to ensure two-way transfer of information and techniques between Fort Lewis and other Puget prairies. Although butterfly habitat enhancement activities are designed to provide specific benefits to target butterflies, most prairie fauna from invertebrates such as pollinators, to mammals such as gophers, are expected to benefit from restoration activities that reduce non-native plants while increasing natives, especially forbs, and restoring historical prairie structural components to the vegetative community.

To further support science-based habitat enhancement, we undertook a series of pilot projects to identify characteristics of habitat used by Taylor's checkerspot butterflies in diapause phase to aid restoration planning for all life stages of this rare butterfly. Finally, Johnson prairie has historically supported the most abundant and diverse butterfly community on Fort Lewis, and we continue to map important resource patches for adult and larval stages of rare and other butterfly species to provide site-based information for management planning on this exceptional prairie.

BUTTERFLY SUMMARY TABLE **January-March**
Fort Lewis Butterflies (TNC#4877) • Contacted national pollination experts in preparation for prairie pollinator research on Ft Lewis. • Obtained scientific collection permit for pollinators. • Constructed and installed 13 bee nesting blocks. • Developed 2009 butterfly habitat enhancement workplan. • Cooperated on fir removal project at Johnson Prairie. • Mapped kinnikinik patches on Johnson Prairie. • Presented summary of Ft Lewis and ACUB butterfly enhancement work to Washington Wildlife Society annual conference.

• Conducted tree removal and girdling to promote butterfly microhabitats at Johnson Prairie.
April- June Fort Lewis Butterflies 2009 (TNC#4914) • Mapped important larval resources for silverspot fritillaries on Johnson prairie to aid management planning. • Mapped locations of hoary elfins, a state monitor species, on Johnson prairie to aid management planning. • Released 61 Taylor's checkerspot larvae into three prairie habitat structures for future documentation of diapause habitat characteristics to aid restoration planning. • Monitored survival of forbs planted in butterfly habitat enhancement plots on TA's 7S, 15, 22 and 23 to better inform best management practices for prairie restoration.
July-September Fort Lewis Butterflies 2009 (TNC#4914) • Completed butterfly habitat mapping at Johnson Prairie • Conducted Taylor's Checkerspot Diapause Habitat Characteristics
October-December Fort Lewis Butterflies 2009 (TNC#4914) • Planted 18,600 native forb plugs at TAs 7S, Pacemaker, Muck Creek Triangle prairie and Johnson Prairie for butterfly habitat enhancement.

2009 Review

With the aid of the WCC crew, we planted 18,600 native forb and butterfly resource seedlings at various sites on Ft Lewis. TNC presented a talk, co-authored by all members of the ACUB Butterfly Habitat Enhancement Team, entitled *Butterfly Habitat Enhancement in Puget Prairies, Western Washington*, at the Washington Wildlife Society/Society for Northwestern Vertebrate Biologists conference in Skamania, WA February 19, 2009, featuring the combined work of the ACUB Butterfly Habitat Enhancement Team and parallel efforts on Fort Lewis.

Plant Establishment Trials

- Second year survivorship means of planted seedlings as plugs yielded a high of 151% survival for *Fragaria Virginia* (considerable recruitment), but other species' means were considerably lower than first year results, ranging from 21 – 50%.
- Mean second year seedling survivorship of *Armeria maritima* and *Fragaria virginiana* were significantly higher in de-thatched treated sites compared to the same species planted in control (do nothing) sites at the Triangle butterfly enhancement test site. Thus, it appears prudent to employ de-thatching at a planting site in semi-native prairie as a site-preparation treatment to promote seedling survivorship if burning or a combination of burning and spraying are not viable options.

Taylor's Checkerspot Diapause Habitat

- A trial to investigate habitat characteristics of Taylor's checkerspot caterpillars in diapause phase revealed use of the duff layer, especially at the base of plants, and use of small protected sub-surface habitats such as tunnels and holes in the soil

- Taylor's checkerspot caterpillars in diapause in the duff layer on the surface of the soil are at risk from burning and other high impact land management actions in late summer and fall. At the same time, it is likely that some diapausing larvae will be buffered from land management activities by occupying below ground habitat structures.

Johnson Prairie Butterfly Mapping

- Building on the survey work of Bob Hardwick reported in TNC's 2009 annual report, we continued to monitor rare butterfly species: hoary elfin, valley silverspot, and the Puget silverspot, and map the locations of their resources on Johnson prairie. A new habitat patch in the western extension of the prairie supporting relatively large numbers of Puget silverspots was identified during 2009 efforts.
- We identified high-use habitat patches for the rare butterfly species mentioned above, and will work with land managers on the ground to minimize impacts and safeguard these resources and the butterflies in residence.

Butterfly Habitat Enhancements

In collaboration with Fort Lewis Fish and Wildlife personnel, we identified priority actions for enhancing habitat to support planned reintroductions of Taylor's checkerspot butterflies at three prairie sites, TA 14, 15, and 7S and enhancements for the butterfly community, emphasizing two species of silverspots at TA 22. We also participated with the ACUB Butterfly Habitat Enhancement Team to incorporate strategies for butterfly habitat enhancement defined by this group.

Enhancement planting sites are selected based on site histories and target species, and are located within prairies to provide a variety of micro-climatic conditions for multiple life stages of the butterflies. Plantings are concentrated in enhancement 'patches' or islands to promote discovery by butterflies and other pollinators. I am planting seeds of the non-native forb, English plantain (*Plantago lanceolata*) in small patches at select Taylor's checkerspot reintroduction sites to provide larval foods where this plant is limited. Fort Lewis and The Nature Conservancy weed control specialists applied herbicide to control invasive grasses and forbs at enhancement sites in preparation for fall planting. Portions of the prairies were also burned in late summer 2009 to promote conditions for prairie restoration and general prairie function. From October – December, 2009, with the aid of the WCC crew, we planted 18,600 native forb seedlings as plugs and are planting ~ 300,000 native forb seeds during January 2010 into four priority prairie sites (Table 6).

In May, 2009, we evaluated second year survivorship of seedlings and seeds planted in the fall of 2007. Second year survivorship of seedlings planted as nursery-grown 'plugs' at the TA 15 'triangle' monitoring site were generally below 50%, except for strawberries *(Fragaria virginiana*), which yielded the highest survivorship and apparent reproduction (Figure 12). Spring gold (*Lomatium utriculatum*) had the lowest survivorship and the plants continue to exhibit relatively low stature (<5 cm) and vigor. All species except *F. virginiana*, exhibited

considerable reduced survivorship in their second year compared to the first year (Figure 13a and 13b). It is also important to note that the surviving plants of the tap-rooted species *Balsamorhiza deltoidea* and *Lomatium utriculatum* tend to be very small, generally <5 cm tall.

Table 6. Summary of native forb plug plantings on four prairies on Fort Lewis, WA, 2007 – 2009.

	year	ARMA	BADE	CAHI	ERLA	LOUT	LOTR	FRVI	VIAD	ERSP	SOSP
TA 14	2007	325	12								
	2009	1,000	300				500 baroot				
	2009	400	200	3,000	500	700	200				
	TOTALS	1,725	512	3,000	500	700	200				
TA 15	2007	1,080	780	4,440	1,260	1,890		1,800			
	2009	500									
	2009			2,100	350						
	TOTALS	1,580	780	6,540	1,610	1,890		1,800			
TA 7S	2007	300	40								
	2009			3,000	500						
	2009			3,000	500	300	200				
	TOTALS	300	40	6,000	1,000	300	200				
TA 22	2009								3,200	100	
	2009			2,400	400				3,000	1,000	200
	TOTALS			2,400	400				6,200	1,100	200

The contribution of de-thatching as a site treatment yielded mixed results. Some species exhibited slightly higher survivorship their first year in de-thatched sites, other species were slightly higher in the control (no treatment) sites although no means were statistically different at the $p \leq 0.05$ level. By their second year, *Armeria maritima* and *Frageria virginiana* exhibited significantly ($p \leq 0.05$) higher survivorship in de-thatched plots compared to control sites. At the same time, *Balsamorhiza deltoidea* and *Castilleja hispida* survivorship was higher in control sites, although the mean differences were not statistically significant. In the absence of burning, it appears prudent to implement de-thatching as a site treatment in preference to doing nothing at a semi-native site like the triangle. In addition, casual observations suggest that de-thatching may promote growth of lupines that are naturally occurring on site, and fescue plants remained noticeably smaller by year 2 than adjacent plants beyond de-thatched plots, suggesting reduced competition to forbs from fescue.

A prescribed burn was implemented at this site in late summer 2009, which is expected to promote growth of the forbs. These plots will be measured again in May 2010 to provide year 3 survivorship data. Results from the direct seeding plot have not yet been analyzed, and will be reported in the first quarter of 2010. Casual observations of direct seeding plots during their first and second growing seasons suggest very low establishment rates for the species planted, and very small-statured plants, as with outplanting of seedling plugs mentioned above. The tap-rooted species *L.utriculatum* and *B. deltoidea* also have the largest seeds of the species

planted, and were the most successful in establishing seedlings from direct seeding during their first year. Although their above-ground portions are remaining very small (< 5 cm), they may be investing in root structure at this time which will position them to add shoot growth in a later year.

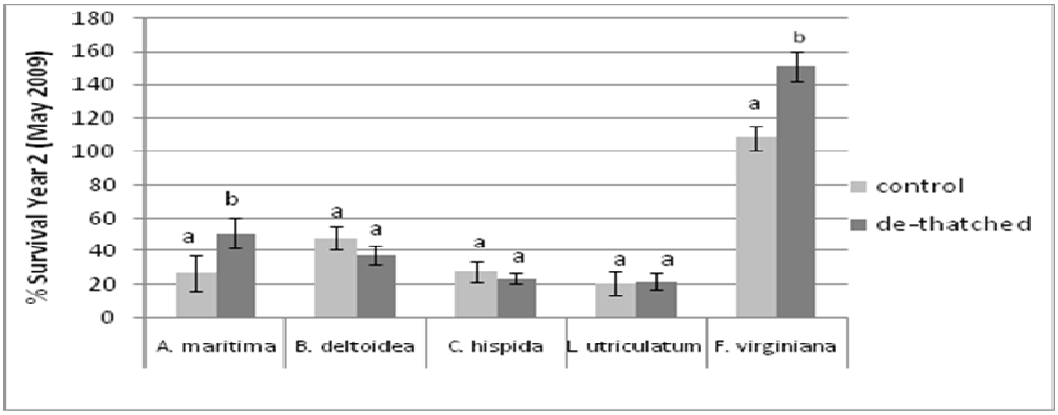
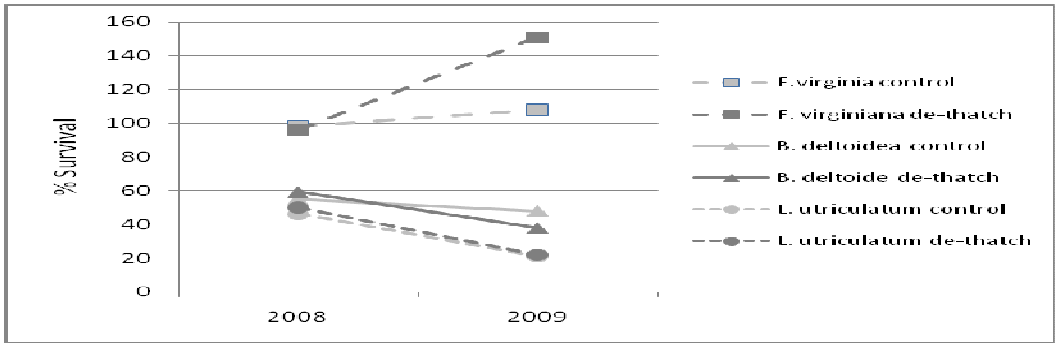
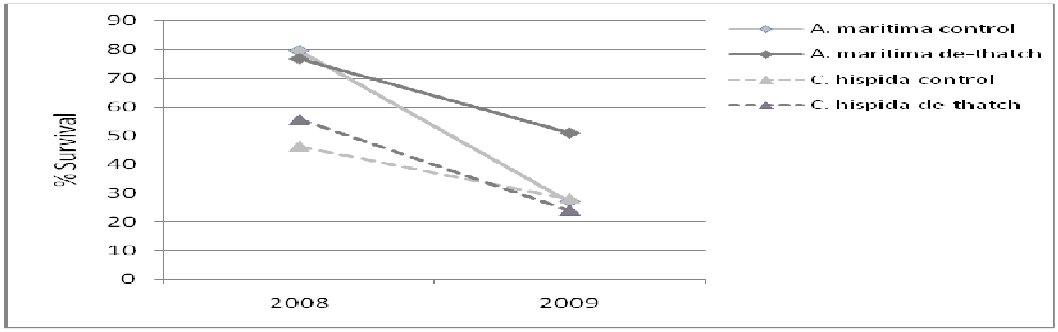


Figure 12. Second year survivorship of planted seedlings at TA 15, the 'triangle' enhancement site on Fort Lewis, WA, measured May 2009. Error bars are one standard error. Like letters above columns indicate within species' treatment (control vs. de-thatched) means are not statistically different (at $p \leq 0.05$). Sample sizes: A. maritima n=1,080; B. deltoidea n=780; C. hispida n= 4,440; L. utriculatum n=1,890; F. virginiana n=1,800.



a



b

Figure 13 a and b. First (2009) and second (2009) year survival rates for five species of native forbs planted at TA 15, the 'triangle' enhancement site on Fort Lewis, WA.

Presentation

TNC presented at the Washington Wildlife Society/Society for Northwestern Vertebrate Biologists conference in Skamania, WA February 19, 2009. The presentation, co-authored by all members of the ACUB Butterfly Habitat Enhancement Team, was entitled *Butterfly Habitat Enhancement in Puget Prairies, Western Washington*. It featured the combined work of the ACUB Butterfly Habitat Enhancement Team and parallel efforts on Fort Lewis.

Diapause Habitat Characteristics for Taylor's Checkerspot Larvae

We conducted a series of trials in 2009 and 2009 to investigate characteristics of Puget prairie habitat used by *Euphydryas editha taylori* larvae during early stages of diapause. We released a total of 83 captive-reared larvae into study plots or containers during the two years, and then conducted searches to re-locate diapausing larvae. Although less than half of all larvae were re-located, the majority (56%) of re-located larvae were found above ground amongst duff and plant detritus, often between or at the base of desiccated stems of prairie forbs. The remaining larvae were found below the soil surface, in soil crevices, a tunnel, or other below ground space. In summary, it appears that some *E. e. taylori* larvae seek out below ground structures when entering diapause, and those individuals may be partially buffered or protected from land management activities occurring on the prairies between July and February, including prescribed fires. Depending on the availability of below ground crevices and structures, a portion of the *E. e. taylori* larval population likely remains on the surface, leaving them vulnerable to land management activities.

Figure 14. Scent dog training, Pierce Co., WA 2009.

Commencing February 2009, we piloted three approaches to investigating habitat used by Taylor's checkerspot larvae in diapause phase.

1. We collaborated with Packleader Dog Training to train a conservation scent dog to locate *E. e. taylori* larvae in trial and wild/natural conditions during February and March 2009 (Figure 1).
2. We released 22 captive-reared *E. e. taylori* larvae provided by the Oregon Zoo in the 4th or 5th instar phase onto *Plantago lanceolata* host plants in netted 0.5-m^2 mesh-framed enclosures (Figure 2) on prairie habitat at Glacial Heritage Preserve on 11 July, 2009, and observed larvae in diapause in July and September, 2009.
3. We released 61 captive-reared *E. e. taylori* larvae provided by the Oregon Zoo in the 4th or 5th instar phase on 21 June, 2009 onto *P. lanceolata* host plants in three plastic tubs (55 cm x 40cm x 15cm, 20 – 21 larvae per tub) containing blocks of native prairie habitat removed from south Weir prairie in January 2009 (Figure 3). Each of the prairie habitat blocks was entirely enclosed by a white synthetic mesh netting to prevent escape

Figure 15. Prairie enclosure on the prairie, Thurston Co., WA, 2009

Figure 16. Prairie container enclosed in mesh, Thurston Co., WA, 2009.

by the larvae. Some larvae foraged on *P. lanceolata* for several days, but within 5 days, larvae were no longer observed feeding within the containers. We searched the three containers for a total of 16.5 hours between 4 – 27 September 2009 to record observations of larvae. Larvae were removed from the container upon detection.

The first effort proved successful in teaching the conservation dog to locate checkerspot larvae under controlled conditions, but was less successful on wild populations where the dog frequently missed larvae on the ground surface. We suspended on-site training in wild checkerspot habitat because the dog's impact was deemed too risky for this vulnerable population that was also being affected by unusually severe spring weather combined with unanticipated elevated use of the site for military training exercises and other research activities. This technique holds promise for the future, but would likely be improved by the use of a small delicate dog, and initial training on a surrogate species that is not of conservation concern.

The second trial yielded 8 observations of Taylor's checkerspot in diapause in July and September 2009. The majority of larvae observed (75%) were in the duff layer, generally at the base of a desiccated plant, one under a small ~1" diameter rock, and one in a small tunnel in the soil. Despite extensive searching, no other larvae were found and were presumed to have escaped from the enclosures.

The third trial yielded 25 observations of larvae in diapause in September 2009. Thirty-six larvae were not located, despite clearing soil contents from the boxes. Table 1 presents the results of observations from this effort, combined with observations from the 2009 trial using the mesh cages at Glacial Heritage Preserve.

Table 7. Observations of Taylor's checkerspot larvae in diapause on Puget prairie habitat, July and September 2009 and September 2009, WA.

Year	**2009**	**2009**
Total # larvae released	**22**	**61**
larvae under duff and litter on ground surface	5	13 (2 larvae together 1 time)
larva under rock	1	
larvae < 2" below surface (soil fissure or narrow hole)	1	2 (~1" deep) 1 (~2" deep)
larvae in the bottom of one container at a corner, 6" deep.		9
Total # larvae relocated	**7**	**25**

We located about 40% of Taylor's checkerspot larvae that were released into study plots over the two years. This value was lower than expected, but highlights the difficulty in locating larvae in diapause. The majority (56%) of observations came from larvae that were above ground, but generally amongst duff, detritus and moss. The next largest (28% of observations)

category was an anomalous habitat type that was an artifact of one of the prairie habitat containers in 2009. There was a narrow gap in the corner of one prairie habitat container between the container wall and the prairie soil. This gap extended to the bottom of the container, where we observed 9 larvae. Also of interest is that no larvae were observed in a webbing structure, and most larvae were found as singles, rather than colonial groupings. There was only one site where 2 larvae were found together amongst the duff, and also the 9 larvae together in the corner of the container mentioned above.

We observed that the majority of Taylor's checkerspot larvae spend at least the early phase of their diapause on the ground surface amongst plant litter and duff, often at the base of forb stems. Some *E. e. taylori* larvae appear to seek out relatively protected below ground microhabitats in their early phase of diapause, and take advantage of soil cracks and tunnels when these habitat types are available. There was no evidence that *E. e. taylori* larvae dig burrows or modify habitat themselves. In California, diapausing larvae of a sister sub-species, the Quino checkerspot (*Euphydryas editha quino*), were primarily observed congregating within shelters consisting of shaded cavities along the stems of the California buckwheat (*Eriogonum fasciculatum*) shrub (Pratt and Emmel 2009). The authors posit that shade is the primary benefit of the California buckwheat shelters during their hot California summers. These combined observations suggest that *E. editha* has a proclivity for seeking sheltered locations during diapause.

Our findings have implications for prairie management and restoration planning. Observations were conducted during a season when prescribed burns are implemented in prairie habitat, and reveal that a portion of *E. e. taylori* larvae are likely at risk from burning and other high impact land management actions in late summer and fall. At the same time, it is likely that some diapausing larvae will be buffered from land management activities by occupying below ground habitat structures. Research conducted in Puget prairies yielded peak temperatures of 246^{o} C+ at the majority of test plates measuring temperatures on the soil surface during spring and fall prescribed burns in Fescue grassland (Tveten and Fonda 1999). Mean temperatures measured 2cm and 5cm below the soil surface during prescribed burns at several dry forest and grassland sites elsewhere ranged from 40 ^{o}C - 54^{o}C and 25 ^{o}C – 42 ^{o}C, respectively (Penman and Towerton 2009). These subsurface temperatures are considerably below the temperatures reached on the surface, and would be expected to be less harmful to soil fauna compared to surface temperatures, as long as there is not a threshold effect that negatively impacts animals within the sub-surface temperature range during prescribed fires on Puget prairies.

Finally, a diverse insect community that promotes soil burrows (e. g. ground nesting bees and ants) and other microhabitats within the prairie soil may be beneficial to the Taylor's checkerspot population by creating microhabitat structures that potentially afford larvae better protection from disturbance and inclement weather.

Johnson Prairie Butterflies

Johnson prairie has historically supported one of the more diverse and abundant butterfly communities on Fort Lewis. Despite weed control efforts, invasive grasses flourish in some areas, and some species of butterflies appear to be declining, especially the valley silverspot. Land management activities to control invasive plants and favor native forbs are expected to increase on Johnson prairie in the upcoming years to improve conditions for military training exercises and native wildlife, including butterflies. In an effort to inform management planning, and minimize impacts on the butterfly community, we developed a baseline map of adult butterfly habitat use in 2009 with the help of Robert Hardwick of the WA Butterfly Association,

In the spring and summer of 2009, we added to this mapping effort by recording locations of hoary elfins and two species of silverspot butterflies and their larval and nectar resources (Figure 1). On July 14, 2009 we observed 34 (23 male, 2 female) Puget silverspot and 2 valley silverspot butterflies in a 1.4 hour survey effort along the eastern edge of the prairie. In mid-July, silverspot butterflies were concentrated on the abundant floral resources of dogbane largely restricted to the SE edge of the prairie. By mid-August, silverspot butterflies were most commonly observed on the non-native plants, bull thistle and tansy. We observed a large concentration of bull thistle in a western extension of the prairie that was being used by Puget silverspots. This habitat patch has not received attention in previous surveys, but holds promise for habitat improvements. As with previous surveys, these observations confirmed that silverspot butterflies are often associated with forest pockets or small extensions of the prairie into the forest edge. In addition, silverspots are generally associated with concentrated nectar resource patches that should receive special consideration in land management planning.

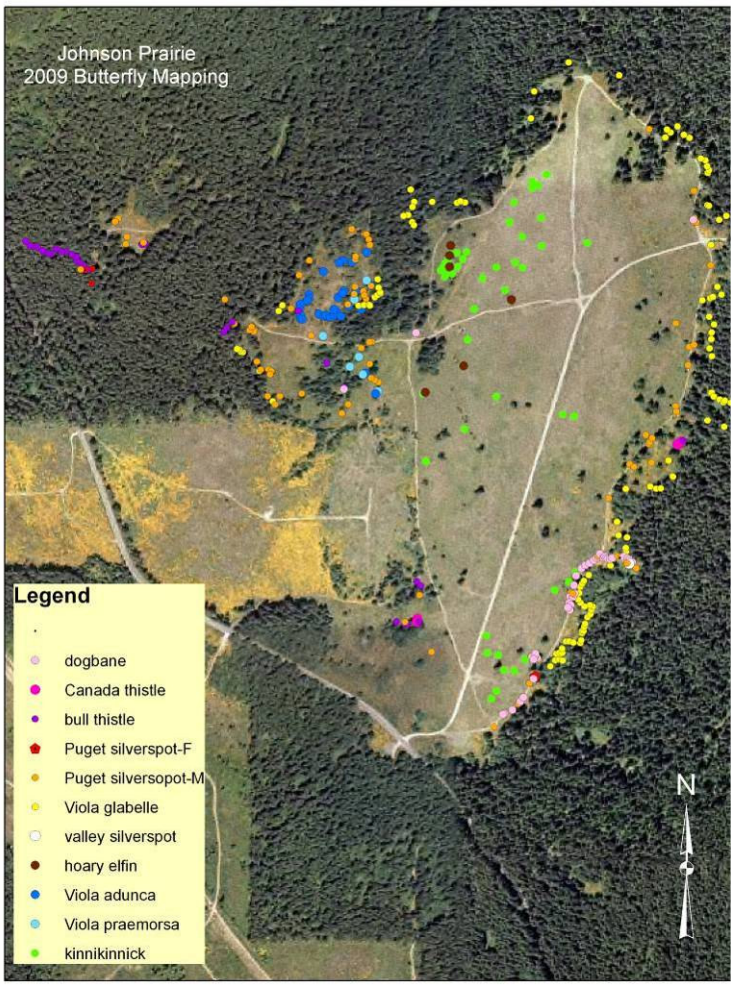


Figure 17. Map of Johnson prairie showing observations of hoary elfins and silverspot butterflies and their resources on Fort Lewis, WA, 2009.

These observations of rare butterflies and their resources allow for more careful planning of land management actions such as burning and spraying, and siting butterfly resource enhancement patches to increase potential for use by the butterflies. This approach of mapping adult habitat use and larval resources serves as a

model for site-based grassland restoration efforts targeting butterflies or other invertebrates with multiple life stages.

Johnson Prairie
During winter quarter, tree removal and girdling at three prairie edge locales to create 'forest nooks' for silverspots on Johnson prairie was undertaken as a joint effort by Fort Lewis Fish and Wildlife, Fort Lewis Forestry, and The Nature Conservancy during this quarter.

To increase our knowledge of important butterfly resources to aid management planning, locations of kinnikinik patches were mapped on Johnson prairie because this plant serves as a larval host and nectar resource for hoary elfins, a state monitor species. This information proved very useful for burn planning, and several key kinnikinik patches were excluded from fire by hand crews.

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).

2009 Review

TNC, in cooperation with Fort Lewis and WDFW, initiated a pilot study aimed at reducing streaked horned lark nest failure due to predation. The study is designed as a pilot study to test the use of nest exlosures as a predator deterrent on streaked horned lark nests. This pilot study is being used to develop a region-wide study of the technique to be applied in the Puget Lowlands and the WA Coast

Lark habitat enhancement is reported in the Prairies Broom section.

STREAKED HORNED LARK SUMMARY TABLE
April-June Initiated nest exclosure pilot project in conjunction with WDFW to evaluate methods for reducing nest predation throughout home range of larks (TNC#4912)
July-September • Completed streaked horned lark nest predation study at 13th Division Prairie: surveyed lark nests, installed nest exclosures, banded nestlings and surveyed nest predation of other adjacent ground nesting birds (TNC#4912).

As part of a range-wide experiment to reduce nest predation on streaked horned larks, 13th Division streaked horned larks along with their Washington Coast and Willamette Valley brethren received a reproductive boost from TNC, WDFW, & OSU researchers during spring and summer this year. Because nest predation is the primary cause of reproductive failure in larks, nests discovered on these sites were fitted with wire exclosures designed to keep out predators. The work was conducted in an experimental fashion, exclosing every other nest discovered. Additionally, lark nestlings were color banded to enable estimates of survivorship using mark-recapture methodology. Funding from USFWS was secured to conduct the work along the WA Coast and Willamette Valley and matching Fort Lewis funds will support a

researcher to focus solely on the 13th Division prairie during the lark breeding season April 15 - August 15. A final report will be prepared during summer 2009. (Ft Lewis Lark TNC#4912)

Eleven nests from 5 Streaked Horned Lark (STHL) pairs were found. An additional breeding pair was likely, but no nests were ever found. Fourteen STHL were banded and fledged from the 11 known nests with an additional 3-7 unbanded fledglings from undiscovered nests. Three of the pairs' territories were along the Pacemaker airstrip, one was in the recently burned southwest corner of the site, and one was west of the apron between Pacemaker and the western site boundary road. The undiscovered nesting location was hypothesized to be somewhere between these last two territories. See Tables 2 and 3 below for an overview of of data results. A more detailed report will be prepared in conjunction with the range-wide project.

Nest Exclosures

Six of the 11 nests found in the 2009 breeding season were exclosed. Although the experimental design called for exclosure of every other nest, this was not always possible. Nests that were built adjacent to roads or discovered in an advanced stage of brooding were not exclosed. Consequently, one pair (North Apron Pair) had three nests exclosed, while three other pairs had one nest apiece exclosed.

Out of the two STHL nests predated, one of these was under an exclosure. Western Meadowlarks appeared to be the predators in both cases of depredated nests: eggs with 0.5cm holes were found and one small chick was killed but not eaten. Although full statistical analyses have not yet been performed, STHL predation rates for the 2009 breeding season are much lower when compared to other ground nesting species on the 13th Division Prairie. An even 50% (11 out of 22) nests of Savannah Sparrows, Common Nighthawks, Western Meadowlarks, and Killdeer were depredated, compared to just 2 out of 11 depredated STHL nests (18%).

Table 8: Nest survey data for streaked horned lark at 13th Division Prairie, spring and summer 2009.

Nest ID	Exclosed	Successful	Predated	Abandoned	Eggs Laid	Eggs not predated	Eggs Hatched	Fledglings
01A NAP1	1	0	0	0	2	2	1	0
02A SAP1	0	1	0		3	3	2	2
03A SSP1	0	1	0		3	3	1	1
04A SWP1	1	1	0		2	2	2	2
05A NAP2	1	1	0		4	4	2	2
06A SWP2	0	1	0		4	4	3	2
07A SAP2	1	0	1		4	4	1	0
08A SSP2	0	1	0		3	3	3	2
09A YWP2	1	1	0		3	3	3	3
10A SSP3	0	0	1		3	0	0	0
11A NAP3	1						0	
Totals (11)	6	7	2	0	31	28	18	14

Egg Hatchability

Of the 28 STHL eggs that were not predated during incubation, only 18 hatched (64%). When compared to a hatch rate of 88% (38 of 43) for the other 4 species, it would appear that STHL egg hatchability is a serious concern at 13th Division Prairie.

Table 9: Nest survey data for Savannah Sparrows, Common Nighthawk, Western Meadowlark and Killdeer at 13th Division Prairie during spring and summer 2009.

Nest ID	Successful	Predated	Eggs Laid	Eggs not predated	Eggs Hatched	Fledglings
SAVS 01	1		3	3	3	3
SAVS02	1		4	4	3	3
SAVS03	1		4	4	4	3
SAVS04	1		3	3	3	3
SAVS05	1		3	3	3	3
SAVS06		1	3	0	0	0
SAVS08	1		5	5	4	4
SAVS09	1		5	5	4	4
SAVS10		1	2	0	0	0
SAVS11		1	5	0	0	0
SAVS15		1	4	0	0	0
SAVS17		1	4	0	0	0
SAVS18		1	4	0	0	0
SAVS21		1	4	0	0	0
SAVS22	1		2	2	2	2
TOTAL	8	7	55	29	26	25
CONI12	1		2	2	2	2
CONI14		1	2	2	1	0
CONI16	1		2	2	2	2
CONI20		1	2	0	0	0
TOTAL	2	2	8	6	5	4
WEME 07		1	4	4	4	0
WEME19		1	4	0	0	0
TOTAL	0	2	8	4	4	0
KILL13	1		4	4	3	3
TOTAL	1	0	4	4	3	3
TOTALS(22)	11	11	75	43	38	32

WOODLAND 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, and are listed as a 'critical habitat' by the Washington Department of Fish and Wildlife. They provided necessary habitat for numerous species, including the state 'threatened' western gray squirrel. In addition, a unique population of native western Washington ponderosa pine persists on 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, releasing oaks from Douglas-fir competition, and improving habitat structure through control of invasive woody species. Past efforts included the reduction of colonizing eastern gray squirrels, a potential competitor for limited resources, and population monitoring utilizing baited hair-snag tubes. Recently, WDFW has implemented a program to research the population and improve genetic viability through 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.

2009 Review

The oak woodlands of Training Areas 8, 9, 10, 12 and the Ammo Depot have received consistent and expanded management in recent years. As a result, more acres are in better condition and can be managed with less effort, including prescribed fire. Scotch broom, Douglas-fir and other woody invasive species have been greatly reduced and recent radio telemetry of western gray squirrel activity indicates heavy usage of the managed areas. In total, 535 acres of treatments were conducted, improving on totals from 2009. Of this, 365 acres received herbicide

treatments, doubling the efforts of 2009. 170 acres were mowed, including several sites that had never received treatment.

FORESTRY AND WGS HABITAT ENHANCEMENT
January-March
• Mowed 48.3 acres at Sequalitchew Ecopark on North Fort- (TNC#3922) • Mowed 10.4 acres at Bauman Oak in Training Area 4- (TNC#3922) • Mowed 65 acres in Training Area 6- (TNC#4867) • Published squirrel monitoring article in Northwest Science- (TNC#4867)
April-June
• Completed follow-up brush cutting of Scotch broom after mowing in winter at Bauman Oak and Sequalitchew Ecopark (TNC#3922) • Mowed 7.9 acres to control Scotch broom at Bunker Oak (TNC# 3922)
July-September
• Mowed 54 acres in the Ponderosa Pine Savannah of TA12 (TNC#3922) • Spot treated Scotch Broom over 44 acres at the Gravel pit in TA10 (TNC#3922) • Brush cut 3 acres at the Prairie Oak Preserve (POP) (TNC#3922) • Applied herbicides to a *Vinca sp.* Infestation at Bunker Oak (TNC#3922) • Spot treated Scotch Broom over 241 acres in core WGS sites (TNC#4916)
October- December
• Mowed 12 acre Oak stand east of Bill Lake (TNC#4916) • Mowed 10 acre Oak savannah in TA8 near Spanaway Marsh (TNC#4916)

Accomplishments

Restoration

During the 2009 work year, approximately 170 acres of western gray squirrel habitat was treated by mechanical means (mowing and brushcutting), while an additional 365 acres were treated with an herbicide application of 2% Garlon 4 (Figure 18). Work focused primarily around oak stands of known significance to WGS, as determined by telemetry efforts by the Washington Department of Fish and Wildlife as part of their western gray squirrel research. Scotch broom, small Douglas-fir and other invasive brush species were mowed and brushcut to create a more open understory that is preferred by the WGS. Efforts in 2010 will focus on expanding mowing efforts outside of the 'squirrel triangle', while continuing control efforts within the triangle with herbicide applications and prescribed fire where appropriate. This work occurred over the entire year and utilized three task orders: TNC#'s 4867, 3922 and 4916.

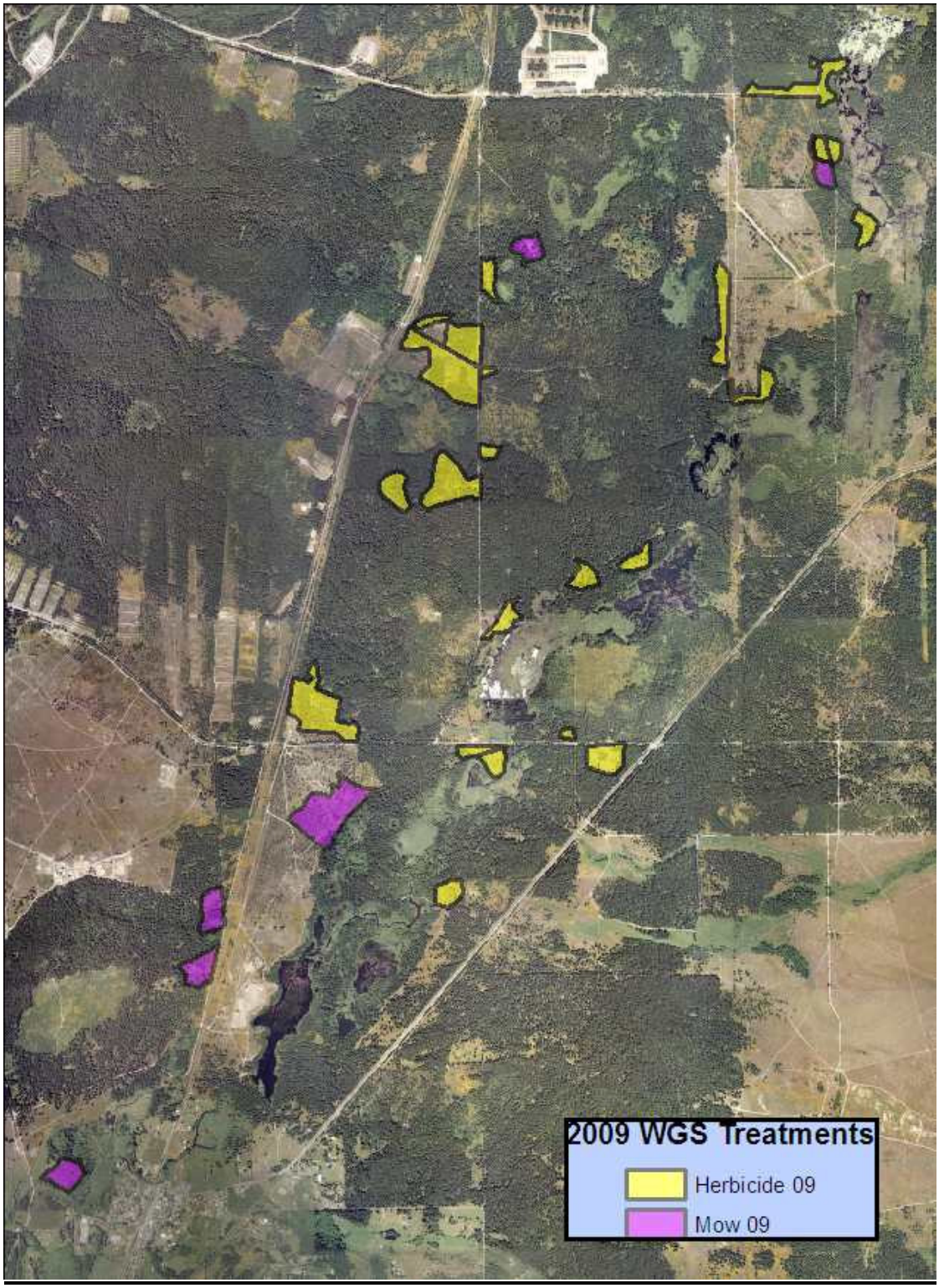


Figure 18: Oak and WGS treatment areas in Training Areas 8, 9, 10, 12 and 6.

In addition to the sites treated in figure 18, several additional sites were treated with mowing or brush cutting including Sequalitchew Ecopark, Bunker and Bauman Oak north of the AIA, and the POP (Figure X and X). These tasks were all completed under TNC#3922.

Figure 19 a and b: Bunker Hill and Bauman Oaks(left) and Sequalitchew (right) treatment areas.

Squirrel Monitoring Publication

Two publications received effort under task order 4867 in the first quarter of 2009. The completion and publication of 'Monitoring Western Gray Squirrels for Landscape Management in Western Washington' by Cheryl Fimbel and Sanders Freed, was published in Northwest Science, Vol. 82, No. 4, 2009. The paper discusses the use of hair-snag tubes to determine presence of western gray squirrels and the implications for management. Additionally, 'Invasive Squirrel Control: A Trial on Fort Lewis, Washington' by Sanders Freed, Cheryl Fimbel, and Aaron Johnston, is undergoing further edits to improve the manuscript. This paper documents the Eastern gray squirrel control project on Fort Lewis and should aid in efforts for invasive species control in other regions and is planned for resubmission in early 2010.

CAVITY CREATION AND BATS

Cavity creation tasks were aimed at improving habitat for numerous species that require cavities for nesting, roosting, or shelter. The decay class for these types of cavities, where heart wood is rotten, is a component often lost in typical managed landscapes. Snags, dying, and decadent trees are often removed from stands to make room for economically more valuable trees. Thus, species that rely on cavities for some aspect of their life cycle are often quickly lost from intensively managed forests. The history of management on Fort Lewis tended toward this type of intensive management. In 1995, a new management guideline was established 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 task order was 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*). Western gray squirrels (*Sciurus griseus*) and blue birds (*Sialia mexicana*) were also included as a target given the treatments and habitats were similar. Another unique species to the area, the Vaux's swift (*Chaetura vauxi*), was included in habitat enhancements. In addition, in combination with our summer 2009 bat survey, a bat box experiment was conducted to determine what design is most useful in western Washington. There are nine species of bats present in the region, while 4 have federal or state conservation listings. The Townsend's big-eared bat (*Corynorhinus townsendii*) was subject of an intensive study during the summer of 2009- aimed at determining foraging and roosting preferences.

In Washington, cavity-nesting ducks nest primarily in late successional forests and riparian areas adjacent to low gradient rivers, sloughs, lakes, and beaver ponds. Wood ducks, a Washington State 'priority species', nest almost exclusively in tree cavities, which offer protection from weather and predators. They are secondary cavity nesters, using cavities created by large woodpeckers or by decay or damage to the tree. Destruction of cavity trees can eliminate this species from an area. An adequate supply of nest cavities is the key to supporting populations of cavity-nesting ducks in Washington. A nest box program on Fort Lewis has been in operation since the 1990's, and has successfully maintained breeding populations of this species, although the long term goal of the program is to maintain breeding populations until enough natural cavities are available to replace artificial cavities.

Purple martins, a Washington State 'candidate' species, are insectivorous, colonial nesting swallows that nest in cavities. In Washington, most martins have been reported nesting in artificial structures near cities and towns in the lowlands of western Washington. Historically, they probably bred in old woodpecker cavities in large dead trees, but only a few such nests are known to exist in Washington today. The nest site preferences of the purple martin have been studied at Fort Lewis in Pierce County. Martins nested in a variety of artificial nesting structures, including wood duck boxes. No purple martin nesting activity was detected in artificial nesting structures on land; all artificial cavities were over freshwater wetlands, ponds or saltwater. Several sites on Fort Lewis are known to currently contain nesting cavities in

snags, such as Lower Weir prairie. The decline of the purple martin is attributed to the lack of snags containing nest cavities as well as competition for nesting cavities with more aggressive European starlings (*Sturnus vulgaris*) and house sparrows (*Passer domesticus*).

Fort Lewis and McChord Air Force Base contain the only known population of western gray squirrels (*Sciurus griseus*) west of the Cascades. Several studies have documented significant declines of the population on Fort Lewis, resulting in current efforts on Fort Lewis to study and augment the population. Efforts have been directed toward the enhancement of western gray squirrel habitat, including the removal of invasive plants and the release of oaks. Western gray squirrels use cavities for parturition and rearing of young. Given the history of forest management on Fort Lewis, few trees are large enough to provide cavity opportunities for larger mammals. Eleven cavities, similar to wood duck cavities, were created and have been monitored over the past two years.

The western bluebird (*Sailia mexicana*) is rare in western Washington, but fairly common on Fort Lewis. A secondary cavity nester, the western bluebird has persisted on Fort Lewis with an extensive box program, and numerous, small diameter snags in prime bluebird habitat. Bluebird cavities were placed in Douglas-fir trees located on the periphery of prairie habitat to increase nesting opportunities. These cavities will provide immediate nesting opportunities for bluebirds and other cavity nesting species, while also contributing to the long term creation of standing dead and decaying trees, improving habitat for numerous species. Over 50 cavities have been created throughout Fort Lewis, including the AIA, CIA, and RTA.

The Vaux's swift (*Chaetura vauxi*) is a colony nesting neo-tropical migrant species. Swifts nest in several varieties of man-made towers, including chimneys, bell towers, and other upright open towers. Due to the removal of chimneys from modern architecture and the reduction of large diameter snags in forests, swift populations have been declining. Two swift towers were constructed, one at Sequalitchew Ecopark, and one on Upper Weir prairie. No use was documented in 2009, although a population was located in an old chimney on main base of Fort Lewis

In combination with our summer Townsend's big-eared bat study, our 2009 bat box preference study was monitored to determine the best of three designs for bat use in the region. Our three designs were the mammoth box, the dual chambered rocket box, and a design created by our contracted bat expert- Greg Falxa, of Cascadia Research Collective. All bat species use cavities for night and day roosts, and several of our boxes received use in the first season. Our two most successful designs included the dual chambered rocket box, and the Falxa model. The results of the second year of monitoring were compiled and a presentation of the results is planned for the SERNW conference in the upcoming year.

CAVITY CREATION SUMMARY TABLE
April-June • Began Townsend's big-eared bat survey 09 (TNC# 4921) • Replaced and maintained guano trays for bat box experiment (TNC# 4923) • Stained Sequalitchew Ecopark swift tower (TNC# 4923)
July-September • Completed the 2009 study of Townsend's big-eared bat (TNC#4921) • Began the retrofitting of the bat steeple at Seqalitchew Ecopark (TNC#4923)
October- December • Completed construction of bat steeple at Sequalitchew Ecopark (TNC#4923) • Compiled results of bat box preference study and submitted abstract for presentation at SERNW conference (TNC#4923) • Monitored cavities and compiled results for publication (TNC#4923)

Accomplishments

Swift Towers-

Two swift towers were completed during 2008, one at Sequalitchew Ecopark and one on Upper Weir. No use has been detected since construction although future monitoring will be conducted to identify use and determine rate of colonization. An unknown colony of swifts was located on the main base of Fort Lewis during the summer migration- in close proximity to the Ecopark tower. The Upper Weir swift tower was of special note, given the method of placement. With the aid of a lift truck, this swift tower was placed on a topped tree, approximately 35 feet high. In addition to the swift tower, 5 purple martin boxes were placed on the topped tree bole. During the spring of 2009, the tower at Sequalitchew was stained to prolong structure longevity (Figure X).

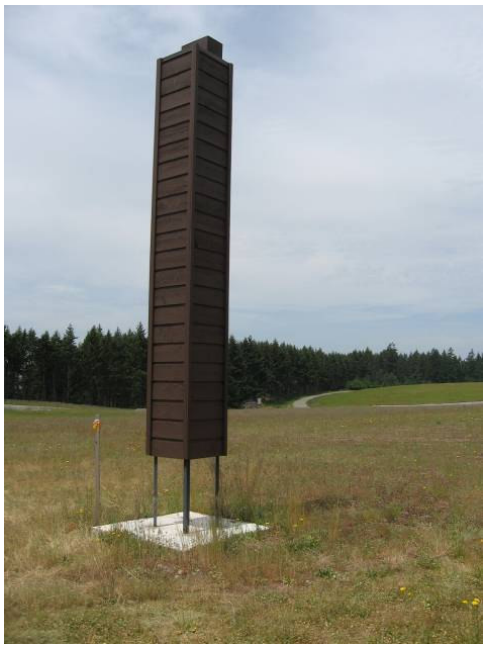


Figure 20: Swift Tower at Sequalitchew Ecopark.

Artificial Cavity Monitoring

Monitoring of all 50 created cavities was conducted for second and third years, finding high rates of use. Of cavities created in 2007, third year cavities, rates of use reached 96%, while cavities created in 2009, second year cavities, had 80% use (21 of 26). Overall, averaging both second and third year cavities, use rates were approaching 90% (88%). These high rates of use suggest a dearth of cavities for wildlife in the woodlands of Fort Lewis. Second year cavities began seeing high rates of use as was the case previously, yet many of these cavities were located in interior woodlands, and use was by species other than wood ducks. A confirmed use by western gray squirrel was made in the AIA. In addition to our target species, numerous other species were found to use the cavities,

including other species of birds, several mammals including bats, and honey bees (Figure X - X). Compilation of these results is being prepared as a manuscript for publication in 2010.


a.

b.

c.

d.

Figures 21 a-d: comparisons of nesting material found in cavities.

Bat Box Experiment

Nine bat species are found in the Puget Trough of western Washington, four of which have federal or state conservation status. Recent research on Fort Lewis has documented all nine species present, providing impetus for conservation action. The loss of historical roosting habitat (old growth snags), has forced numerous bat species to adapt to human structures and artificial roosts as primary roosting habitat. Over the past two years, we tested three bat box designs (Figure X) to determine which was most preferred by resident bats. Ten boxes of each design were built and placed in arrays at ten sites across Fort Lewis (Figure X). In 2009, the Uncle George (UG) design had the most use (50%) as assessed by guano traps and bat observations, followed by the dual chambered rocket box (DCR) (40%), and lastly the mammoth box (10%). In 2009, the UG received the most use (80%), followed by the DCR (50%), and lastly the mammoth (10%). Although the UG had the most use, the DCR received more extensive use at several sites (large amounts of guano), indicating numerous bats residing in the structure. Cost breakdown is as follows, DCR- 63$; UG-50$; Mammoth- 25$, not including mounting hardware and post. The most labor intensive box was the DCR, followed by the UG and the Mammoth. This research suggests the UG may receive the most use by area bats and is reasonable in cost and construction time, although the DCR showed promise for use by aggregations of bats and may provide maternity roosting habitat. This information will be presented at the upcoming SERNW conference in February of 2010.

Figure 22. Bat box designs (Uncle George, Dual-chambered Rocket, Mammoth).

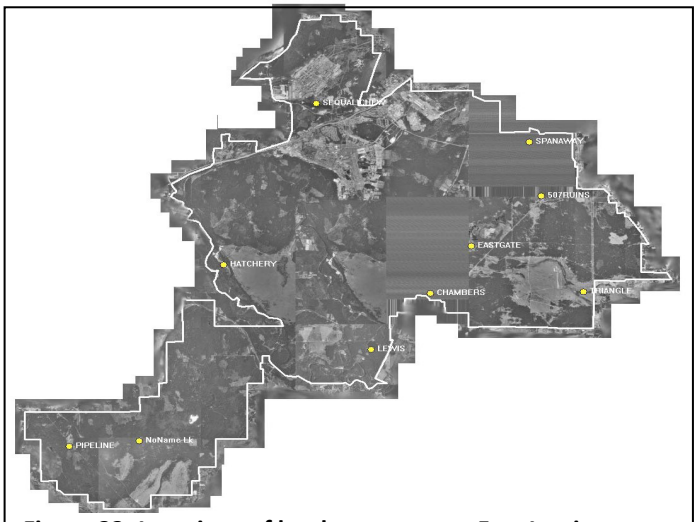


Figure 23: Locations of bat box arrays on Fort Lewis.

BAT STEEPLE

In the winter of 2009, a church steeple that was removed from a church was retrofitted to house bats at Sequalitchew Ecopark. With the help of volunteers and several days of labor, the steeple was reroofed and bat friendly entrances were created (Figure X and X). It was then placed on a stem wall located on the back side of Sequalitchew Ecopark along Sequalitchew Creek. Monitoring of the steeple will begin in the summer of 2010.

Figure 24: Steeple construction

Figure 25: Completed steeple

Townsend's Big-eared Bat Survey

The Townsend's big-eared bat (*Corynorhinus townsendii*) is a federal *species of concern*, and a Washington state candidate for listing as *threatened* or *endangered*. Although found across Washington state, the number of known nursery colonies is limited to approximately 20, each with 20 – 200 bats. This species is the only Washington bat known to form nursery colonies in caves; however half of the known colonies utilize buildings. Compared to other species, these bats are particularly sensitive to human disturbance at day roost sites. A thorough review of Townsend's big-eared bat colony structure and their susceptibility to disturbance is found in a 1998 status review of Townsend's in California, by Pierson and Rainey.

A 1990 report by Perkins estimated the known population of Townsend's big-eared bats in Washington State as 600 (not all colonies are known and documented), indicating Townsend's numbers are in decline in the Pacific Northwest. Forest management practices are likely responsible for some of these declines, as is loss of roosting habitat. Disturbance from human activity (research, mineral extraction, and recreational activities), removal of old buildings, and bat exclusion efforts are responsible for the extirpation of many historic Townsend's colonies. Removal of older trees and snags, the dominance of even age forests, and use of chemical treatments in forests are likely impacting the foraging habitat.

Bats in the genus *Corynorhinus* are difficult to detect during surveys. They have very quiet echolocation calls that are seldom documented in recordings made during acoustical bat surveys, even in areas they are known to occupy. They are also adept at avoiding mist nets used in bat surveys.

Townsend's big-eared bats prey primarily on medium size moths (average 5 cm wingspan) but will take larger prey, such as Sphinx moths. Their distribution appears to be associated with mature conifer stands, like those found on the Fort Lewis Military Reservation. The flight and echolocation style of this species is well adapted for foraging along mature forest canopy. Their strategy of feeding on moths in the forest canopy likely contributes to healthy forests. Studies

indicate that their diet includes forest pests such as the tussock moth. Prey studies for Townsend's bats in the western states have not been conducted, and their contribution to Northwest ecology may be undervalued.

Documentation of Townsend's big-eared bats on Fort Lewis is spotty. During a 1992 Fort Lewis bat survey, a single adult female Townsend's was captured, radio-tagged, and subsequently tracked to two sites in the nearby town of Roy. This effort did not document a maternity colony, but a small number of Townsend's bats were found roosting in a building in the town of Roy. After a few days, the bats moved to nearby shed, and then disappeared. Follow-up inspections at one of the roost sites indicated the presence of a colony for a period during the 1990s, but monitoring has been intermittent. The building manger made repeated attempts to eradicate the bats in the building's attic, which may have been successful; in 2005, the WDFW district biologist reported that the colony had not been at the site for some years, and its fate was unknown.

In the mid-1990s, there was also a report of a single Townsend's big-eared bat found in a construction office trailer in the Rainier Training Area (RTA), but no details on this animal are in the records. A targeted study was conducted in 1996 to determine if these bats of federal and state concern were present on Fort Lewis, but none were found. Until the 2009 Fort Lewis bat survey, no known documentation of Townsend's bats has occurred on or nearby Fort Lewis for a number of years. In September, 2009, on the final day of a comprehensive bat inventory conducted on Fort Lewis by Cascadia Research, the first Townsend's big-eared bat was encountered (Figure X), day-roosting in a concrete culvert adjacent to Bower Woods.

The bat was radio-tagged and tracked during evening foraging for 6 nights, and a search image for the type of preferred night-roosting structure was developed. Using this information we were able to document 2 more Townsend's bats by the end of September--a post-lactating adult female, and a juvenile male (a 'young of the year'). The adult female was tagged and tracked for 7 days, documenting that both of the tagged bats foraged in forests on the military installation during the early autumn season.

Given these encounters, Fort Lewis Fish and Wildlife, The Nature Conservancy, and Cascadia Research all realized that this elusive species may actually be present in the Fort's diverse lowland wooded areas, and that these recent encounters might indicate a maternity colony was located nearby. However, since many bats disperse away from maternity colonies after the reproductive season, occurrences in late September did not necessarily indicate that a maternity colony resided in the area.

Between 17 June and 29 September, 2009, 22 Townsend's big-eared bats were visually sighted or captured. Six of these were fitted with radio-tags and tracked. Additionally, 2 reproductive female Long-eared myotis bats (*Myotis evotis*) were tagged and tracked, which were found to use similar habitat as the Townsend's bats. This report contains a discussion of what we learned

during this follow-up study targeting Townsend's big-eared bats, performed during the summer of 2009.

An important conclusion from the tracking effort is that the Townsend's bats forage in stands of large conifers, typically with open and complex canopy structure, and they would travel between isolated stands of this type. Most of the tracked bats would travel up to several miles between stands, revisiting some of the same locations each night. Although much of the foraging occurred deep within Fort Lewis, such as in the Central Impact Area (CIA), no maternity roosts were located within the boundaries of the installation. A small complex of Townsend's nursery roost sites were located 0.5 km (0.36 mile) off the Fort, in the town of Roy, which appeared to collectively house one maternity colony.

In addition to the Townsend's discoveries, two radio-tagged long-eared myotis bats were tracked to roost trees, including a snag in Training Area 5, which housed over 40 bats in June, a positive indication of a maternity colony roost. Genetic test results from long-eared myotis bats sampled in this same area during 2009 indicated that some of these bats are the cryptic Myotis keenii, a 'species of concern'. During this field work, several other bat nursery colonies were discovered in undeveloped areas of the Fort, boosting the opportunities for bat conservation on the installation. The final report was submitted to Fort Lewis and is also available from TNC.

Figure 26: Townsend's big-eared bat captured, Range 26.

Table 10. Bat species documented on Fort Lewis summer, 2009.

Scientific Name	Common Name	Federal Status	State Status	Natureserv
Corynorhinus townsendii	Townsend's Big-eared Bat	Species of Concern	Species of Concern	S3
Lasionycteris noctivagans	Silver-haired Bat	-	-	S3S4
Lasiurus cinereus	Hoary Bat	-	-	S4
Eptesicus fuscus	Big Brown Bat	-	-	S5
Myotis californicus	California Myotis	-	-	S5
Myotis evotis	Long-eared Myotis	Species of Concern	-	S4
Myotis lucifugus	Little Brown Myotis	-	-	S5
Myotis volans	Long-legged Myotis	Species of Concern	-	S3S4
Myotis yumanensis	Yuma Myotis	Species of Concern	-	S5

NOXIOUS WEEDS

One of the most significant threats to the natural ecosystem of Fort Lewis comes by way of invasion of exotic pest plants. These pest plants degrade training areas, displace native plant and animal communities, and modify existing habitats across the base. Additionally, it is a top priority to contain these infestations so that nearby land owners and natural areas are not impacted. Once established, many of these species can be nearly impossible to eradicate using practical control measures.

There are numerous pest plants that occur on Fort Lewis. The well known regional pest Scot's broom has negatively impacted most training areas across the base. Other species such as the knapweeds and sulfur cinquefoil are currently found in much more limited distributions across the base but have the potential to seriously degrade habitat and training land function. Tall oatgrass is an invasive grass that displaces native vegetation, degrades habitat and, much like Scot's broom, it significantly alters the physical structure of the native ecosystem, outcompetes native plants and creates an undesirable habitat for fauna such as rare butterflies. For this reason, tall oatgrass has become a priority for control in natural areas across the region.

This section focuses on noxious weed species other than Scot's broom; 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. Last year, data was collected and entered in WIMS (Weed Information Management System), a MS Access based database. After a one year trial it was decided that WIMS was too cumbersome and time consuming. Weed populations were recorded with GPS and descriptive data was attached in ArcGIS. Each year, all known 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 regional weed boards.

2009 Summary

In 2009 significant work was performed on tall oatgrass, sulfur cinquefoil, mouse-ear hawkweed, knapweeds, tansy ragwort, and reed canary grass. Common toadflax, leafy spurge, blueweed, and knotweed were not widespread but received treatement. Below is a table summary of 2009 control efforts.

Species Code	Latin Name	Common Name	2009 infestations	2009 stem count
SEJA	*Senecio jacobaea*	Tansy ragwort	59	398
CESPP	*Centaurea spp.*	Knapweed species	167	1326
EUES	*Euphorbia esula*	Leafy spurge	12	1231
ECVU	*Echium vulgare*	Blueweed	24	170
LIVU	*Linaria vulgaris*	Common toadflax	2	2300
PORE	*Potentilla recta*	Sulfur cinquefoil	169	17201
AREL	*Arrhenatherum elatius*	Tall oatgrass	103	3371
HIPI	*Hieracium pilosella*	Mouse-ear hawkweed	203	4654
POCU	*Polygonum cuspidatum*	Japanese knotweed	4	252
SIVU	*Silene vulgaris*	Bladder campion	17	160

NOXIOUS WEEDS SUMMARY TABLE

January-March

- TNC staff participated in the annual IPM workshop held in Lacey (4872, 4864)
- ATV boom sprayer was purchased (4865, 4872, 4864)

April-June

- Performed Tall Oat Grass control at TA 7S, TA 15, Johnson Prairie (TA 22), Weir Prairies (TA 21) and Range 76 (4910, 4911)
- Sulfur cinquefoil control at TA 6, MP 13 (4865, 4910)
- Mouse-ear hawkweed control at TA 6, TA 12, TA 21 (4910)
- Reed canary grass control at Exeter Spring (4909)
- Pipeline restoration at TA 15 (4911)
- Wet prairie restoration at TA 15 (4911)
- Continued grass control on the large Collins plot at TA 15 (4911)
- Sprayed Fusilade on 3.5 acre grass control plot in TA 15 near the Muck Creek triangle (4910)
- Prepared new and old seed plots at TA 13 (4911)
- Retreated Spurgeon Creek seed plot (4911)
- Performed Milestone trials on Mouse-ear Hawkweed (4911)
- South Muck Creek Triangle (TA 15) – Sprayed Fusilade on 3.5 acre grass control plot (4910)

July-September

- Knapweed control (4910)
- Sulfur cinquefoil control (4910, 4909)
- Blueweed control (4910)
- Knotweed control (4909)
- Tansy ragwort control (4910)
- Reed canary grass control on Muck Creek (4909, 4915)
- Site preparation for Spurgeon Creek seed plots (4911)
- Applied Fusilade as post-burn treatment to 4.6 acres of TA 7S and 5.2 acres of TA 15 (4910)

October-December

- Reed Canary Grass: treated areas mowed in the summer in TA 12, TA 13 and TA 14 (4909, 4915)
- Treated yellow-flag iris infestation at Shaver Kettle (TA 12) (4915)
- Treated Earthworks preparation area (4911)
- Treated wet prairie restoration area in TA 15 (4915)
- Treated pipeline restoration area in TA 15 (4911)
- Post burn Fusilade application at TA 15 (4910)
- Attended and gave presentation about noxious weed strategies at Yakima Weed Conference 2009 (4910)

UPLAND INVASIVE SPECIES TASKS COMPLETED

Unless otherwise noted, upland weed control was conducted under the Fort Lewis Training Lands task order (TNC# 4910). Maps can be found at the end of this section.

Weed Species Control

Tall Oatgrass. Tall oatgrass control continued throughout Fort Lewis this year using a 0.75% solution of Fusilade DX plus 0.25% Nufilm IR. Upper Weir Prairie (TA 21) and Johnson Prairie (TA 22) were the first to be treated and the densest areas of tall oat grass are being reduced. Additional satellite populations were found this year, but they were small clumps and treated with Fusilade. Currently, the most significant patch of tall oat grass is in the northeast corner of Johnson Prairie; it appears, due to the robust plants, that this area may not have received treatment last year. Next year, this area will need additional focus and planning should be done with butterfly biologists since the area has lots of great native plants and is a known butterfly hotspot.

Figure 27 Oatgrass spraying at Upper Weir

Twenty-six acres of training area 7S was boom sprayed for a 2nd year with Fusilade. Tall oatgrass control has been quite good here, perhaps too good, as a prolific amount of *Hypochaeris radicata* has colonized the area vacated by tall oat grass. Data was collected from the Fusilade and Poast experimental plots for the last time and all plots were treated with Fusilade. Analysis of the data is currently underway.

Figure 18 Taylors checkerspot at Range 76

A small area of Range 76 was treated for tall oat grass during Pride Week. This occasion was notable because several Taylor's Checkerspots were seen despite the cold and overcast conditions.

Tall oatgrass is likely going to be a perpetual problem for land managers in the Puget Sound. Once this plant become established the likelihood of eradication is slim and is further exacerbated by the fact that there is a tremendous sink of tall oatgrass on private lands surround natural areas. The most effective strategy will involve yearly surveys and immediate treatment of new infestations. Diligence every year is the only way to keep tall oatgrass from becoming established.

Sulfur Cinquefoil. Despite increased effort every year, sulfur cinquefoil continues to expand its distribution throughout Fort Lewis. The good news is that while the number of infestations has increased, the number of plants treated has decreased, indicating that control efforts are proving successful. The difficulty is that one missed population can produce 100,000s of seeds, so it is imperative to find and treat as many infestations as possible.

A new tool was added to the invasive species toolbox this year. The herbicide Milestone VM was first utilized on Fort Lewis for control of mouse-ear hawkweed but some discouraging observations of sulfur cinquefoil flowering in areas that had already been treated facilitated a switch to Milestone as the herbicide of choice for controlling cinquefoil. Other factors that contributed to this decision were positive results seen on McChord AFB and the fact that sulfur cinquefoil is on the Milestone label for control, whereas it is not on

Figure 29 Sulfur cinquefoil control near Range 76

the label for Garlon 3A. Field observations indicate very good control of cinquefoil using Milestone; trials will be implemented in 2010 to determine true efficacy.

During the second quarter of 2009, sulfur cinquefoil was controlled at Mortar Point 13 with the WCC during and after Pride Week. Additionally, cinquefoil near Mortar Point 12 was treated during Pride Week with TNC and Fort Lewis staff. A fairly large cluster of cinquefoil was found in this area that had clearly went to seed last year, indicating that this area will need to be treated for many years to come. This sulfur cinquefoil was treated with a 2.5% solution of Element 3A plus 0.25% Nufilm.

Work on this tenacious pest continued into the 3rd quarter. TNC staff treated significantly more cinquefoil than in previous years, including several very large infestations in TA 14 that were identified by range control. The worst infestation is still found near Mortar Point 13 and TA 6 near Muck Creek. It was also treated in TAs 13, 14, 15 and 18.

Mouse-ear hawkweed. This year Milestone VM (aminopyralid) was implemented as the herbicide of choice for mouse-ear hawkweed control. Trials were established comparing Milestone with Transline (clopyralid), which was previously the chemical of choice. Twenty (20) plots were treated, half with 0.5% Milestone VM and half with 0.75% Transline. Monitoring done one month later proved that both offered 100% control. Since both were suitable, we chose to use Milestone as it is reportedly less mobile and not as persistant as Transline. Additionally, it can be used for knapweed and sulfur cinquefoil control, which simplifies protocols for field staff.

Mouse-ear hawkweed control occurred at TA 6, TA 12 and Lower Weir Prairie (TA 21). We mowed several acres of scotch broom prior to surveying TA 6 this year so that the rosettes would be easier to find, and, in fact, much more hawkweed was discovered in the mowed areas. Additional populations were brought to our attention by Fort Lewis Range Control at TA 6. All known and discovered populations were treated with a 0.5% solution of Milestone VM plus 0.25% Nufilm and received follow-up treatment if necessary. Due to the dense population and intensive training done in the area, mouse-ear hawkweed will likely continue to be a pest in TA 6 into the foreseeable future, even with successful control methods.

The infestation at TA 12 was surveyed and treated again this year. This area is showing positive signs of control. While one rather large new population was discovered, the rest of the hawkweed is definitely being reduced.

The infestation discovered at Lower Weir was treated again and significantly fewer rosettes were observed compared to last year. This population should be controllable, but there might be more undiscovered plants in the area as TNC land stewards discovered mouse-ear hawkweed on Tenolquot Prairie, which is adjacent to Fort Lewis.

Knapweed species. Knapweed (*Centaurea* spp.) control efforts also switched to Milestone VM this year. While knapweed is still widespread, data indicates that infestations have held steady while stem counts have decreased. This indicates that efforts are successful. The unfortunate news is that control efforts in the future will likely take the same amount of time and effort but will yield a decrease in treated plants. With military vehicles constantly being a vector for Eastern Washington weeds, it can be assumed that knapweed vigilance will be required in perpetuity. Knapweed species were treated on North Fort Lewis, TAs F, 6, 7N, 7S, 8, 12, 13 and 22.


Figure 30: Blueweed flowering

Blueweed Control. The blueweed (*Echium vulgare*) plants near the Fort Lewis main gate and along Muck Creek in TA 13 were treated with a solution of 0.5% Milestone VM and 0.25% Nufilm IR. The infestation found between TA 7S and 7N was visited again and a few individuals were treated, but the area where most had been found in the past had been paved over during recent construction. As with other pest plants this year, we switched from using Garlon 3A as had been the standard practice. Control efforts have been positive as our data indicates that more infestations were treated than in years past, but the total number of plants is decreasing.

*Leafy Spurge***.** This year a huge infestation of leafy spurge was rediscovered on Marion Prairie (TA 18). Review of historical records indicates that this site had been treated prior to 2005 but has since been overlooked. Leafy spurge is one of the most difficult weeds to eradicate in North America, which makes this oversight an even greater error. Therefore, it will be the highest priority to escalate control efforts this year, which should include comparing the effectiveness of different herbicides and investigating the use of biological control agents.

Tansy Ragwort Control . Tansy ragwort (*Senecio jacobaea*) control continues on Fort Lewis. Infestations were found mostly along major roads. In past years, we have seen tansy ragwort set seed after being treated with herbicide, so this year all populations were hand pulled and bagged.

Common Toadflax . Infestations were treated with a 2% solution of Aquamaster and 0.25% Nufilm IR. Areas treated in the past continue to put up stems after two years of control which indicates that this plant will require control into the foreseeable future unless a better control strategy is discovered. Additionally, several infestations of common toadflax (*Linaria vulgaris*) were discovered in TA 18. This plant, like leafy spurge, is very difficult to control because of its resiliency and rhizomatous propagation. Additionally, the literature suggests that toadflax

respond positively to fire. Considering these circumstances it is critical to increase control efforts before toadflax becomes a widespread problem. It would also be advisable to conduct herbicide trials to determine if there is an alternative that can provide better control.

Post-burn Fusilade Treatment

As The Nature Conservancy's regional fire program grows, controlled burns will hopefully expand significantly on Fort Lewis. Fire is a superior control method for many invasive species, such as Scotch broom, but there are others that are fire tolerant and will become future targets of chemical control. Some grasses, particularly *Agrostis capellaris* and *Arrhenatherum elatius*, are threatening the prairie ecosystem and are not controlled by fire. However, these grasses can be controlled quite effectively with Fusilade DX, which does not harm the desirable species of *Festuca roemeri* or *Carex inops*. It is hoped that applying Fusilade to an area a couple weeks after burning will be very successful at controlling these grasses when they are germinating or resprouting following the fire and most vulnerable.

This year, 4.6 acres were treated at TA 7S a few weeks following the prescribed fire with a solution of 0.75% Fusilade DX, 1.5% Garlon 4 Ultra and 0.25% Nufilm IR. The Garlon was added to this formula in the hope that it would control the large amount of *Hypochaeris radicata*. Unfortunately, Garlon 4 Ultra was not effective at this rate and higher concentration or a different herbicide may be required. A well designed experiment could offer some great insight into effective control of Hyphochaeris with a post-burn herbicide application.

Pipeline Restoration

Preparation work of the pipeline at TA 15 was done again this spring. Sections of the pipeline that were previously planted with fescue were treated with a solution of 2.5% Element 3A, 0.75% Fusilade DX and 0.25% Nufilm IR; sections without fescue were treated with a 1.5% solution of Round-up Pro. (TNC#4911).

Figure 31: Spraying at TA 15 wet prairie plot.

Wet Prairie

The large wet prairie restoration site near Muck Creek received a third year of site preparation this year with a 1.5% solution of Round-up Pro. This site still has a significant amount of weeds which probably is due to a missed treatment a few years ago. Native plants that had been planted in the center of the plot were avoided. (TNC#4911).

Large Collins Plot

One large (100mx100m) Collins plot at TA 15 was sprayed with a 0.75% solution of Fusilade DX plus 0.25% Nufilm IR for grass control. The

other large Collins plot in TA 23 did not require spraying this year because it was burned and sprayed last fall. (TNC#4911).

Seed Plots at TA13

The seed plot adjacent to Muck Creek in TA 13 was treated again this spring with a solution of 1.5% Round-up Pro. An additional seed plot was started not far south from the original plot. This plot was treated identically and will require additionally treatments in the future. (TNC#4911).

Site selection for seed plots on Fort Lewis has been constantly evolving. After treating a new site in early summer, a more preferred site was identified by Fort Lewis Range Control and this site was treated with a 2% solution of Round-up in September. The current strategy is to till this area and then continue site preparation with herbicide in the spring. (TNC#4911).

Spurgeon Creek Seed Plot

A large section was retreated at the Spurgeon Creek seed plot with a 2% solution of Round-up Pro. Originally, we had hoped to expand the section that was treated last year, but boom sprayer malfunction limited us to re-treating only the section that was done last year. (TNC#4911).

Hawkweed Milestone Trials

This year we experimented with a new herbicide called Milestone VM, which is very similar to Transline but is thought to be more environmentally friendly. 14 experimental plots were surveyed and treated with Milestone VM or Transline. All plots demonstrated 100% control of hawkweed. Since both chemicals were equal in controlling mouse-ear hawkweed, we have decided to switch to Milestone VM due to its better environmental reputation. As a result, all follow-up treatments of mouse-ear hawkweed were done with a 0.5% solution of Milestone VM plus 0.25% Nufilm IR. (TNC#4911).

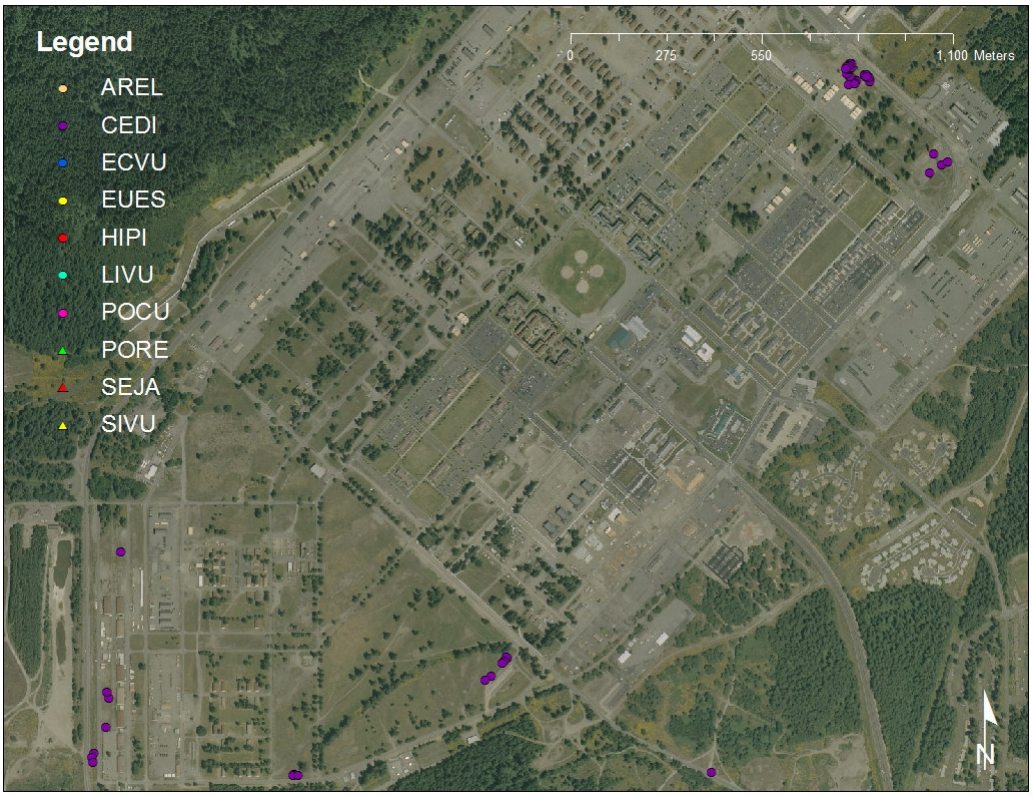


Figure 32: Knapweed control sites on North Fort Lewis

Figure 33: Knapweed and Blueweed control sites in cantonment and TA 7S

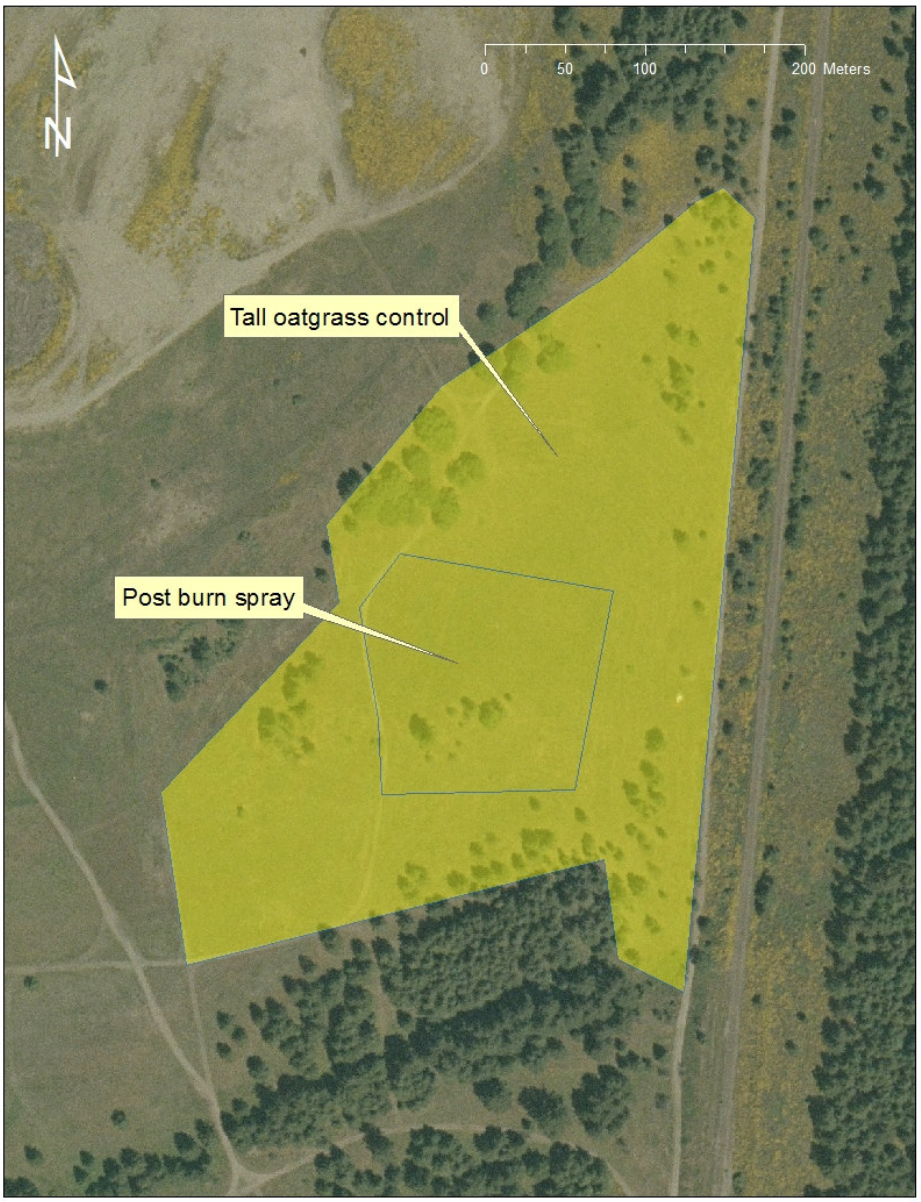


Figure 34: TA 7S boom spraying for tall oatgrass

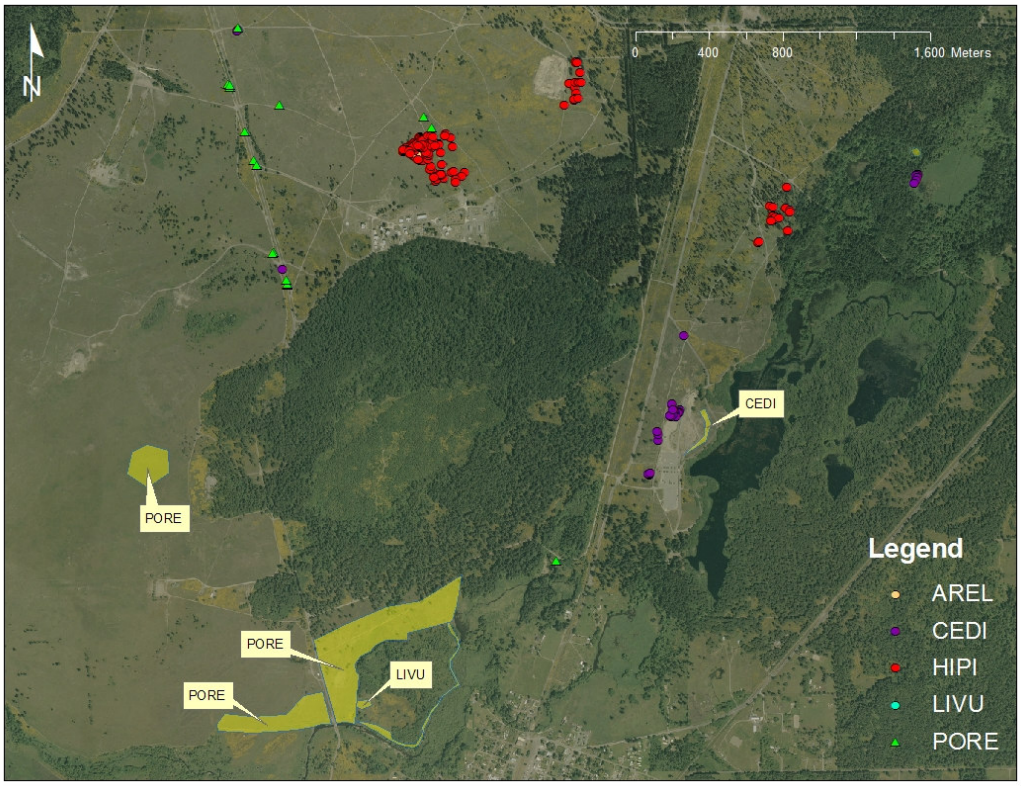


Figure 35: Cinquefoil, knapweed and hawkweed near MP 13

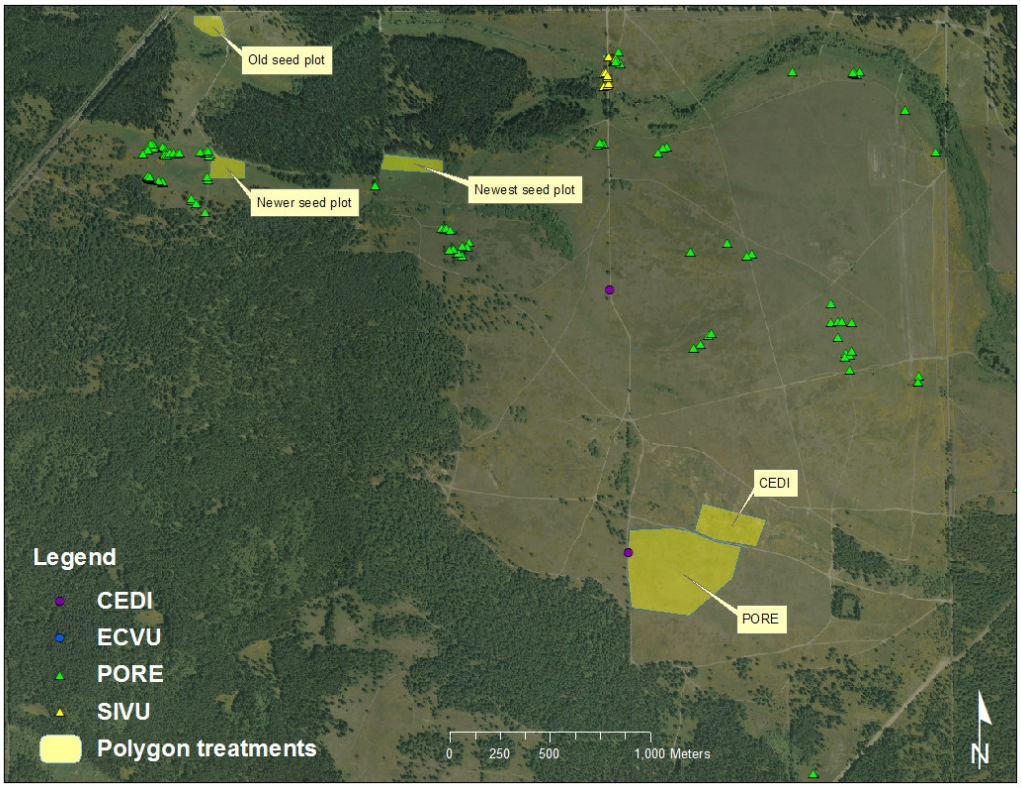


Figure36: Control efforts at TA 12, 13 & 14

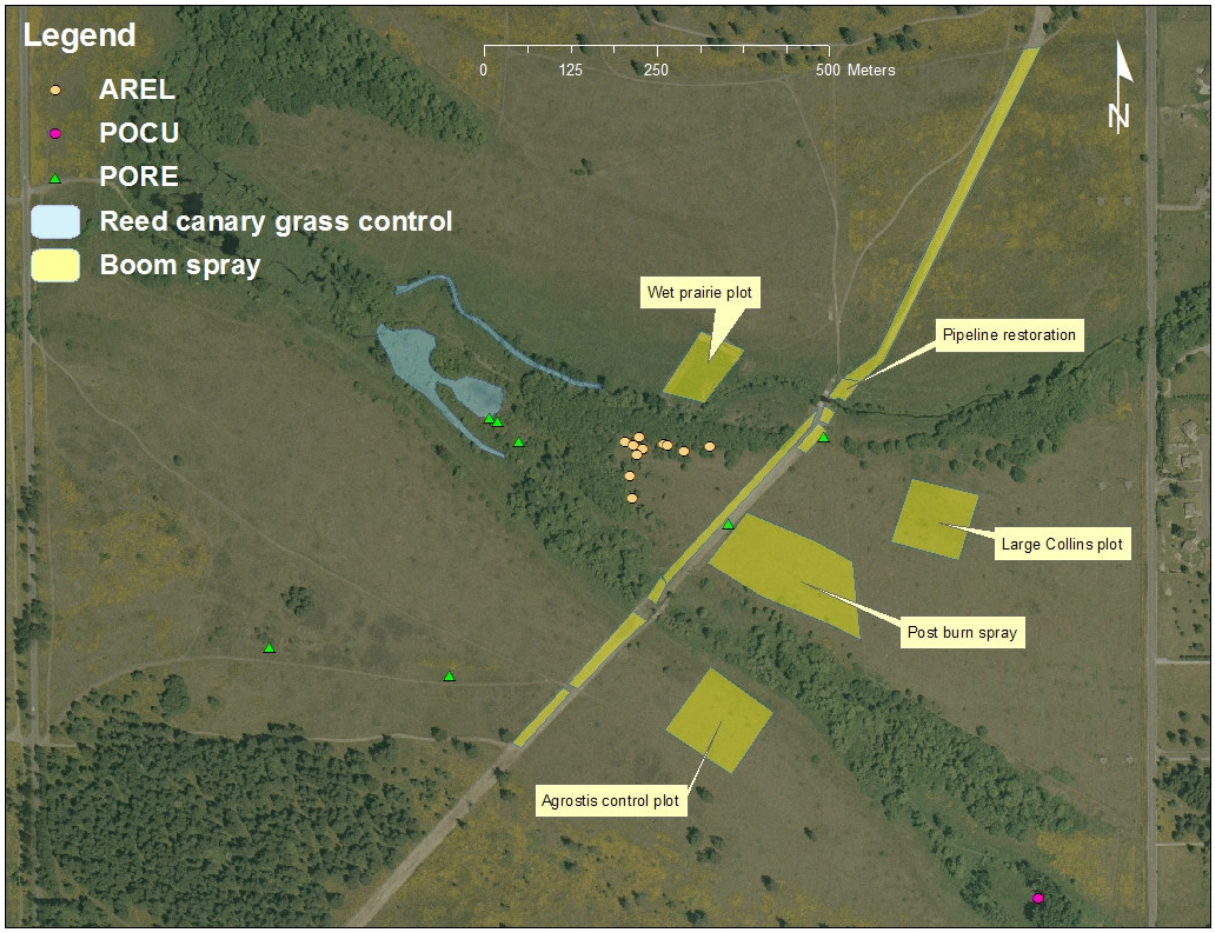


Figure 37: Restoration efforts at TA 15

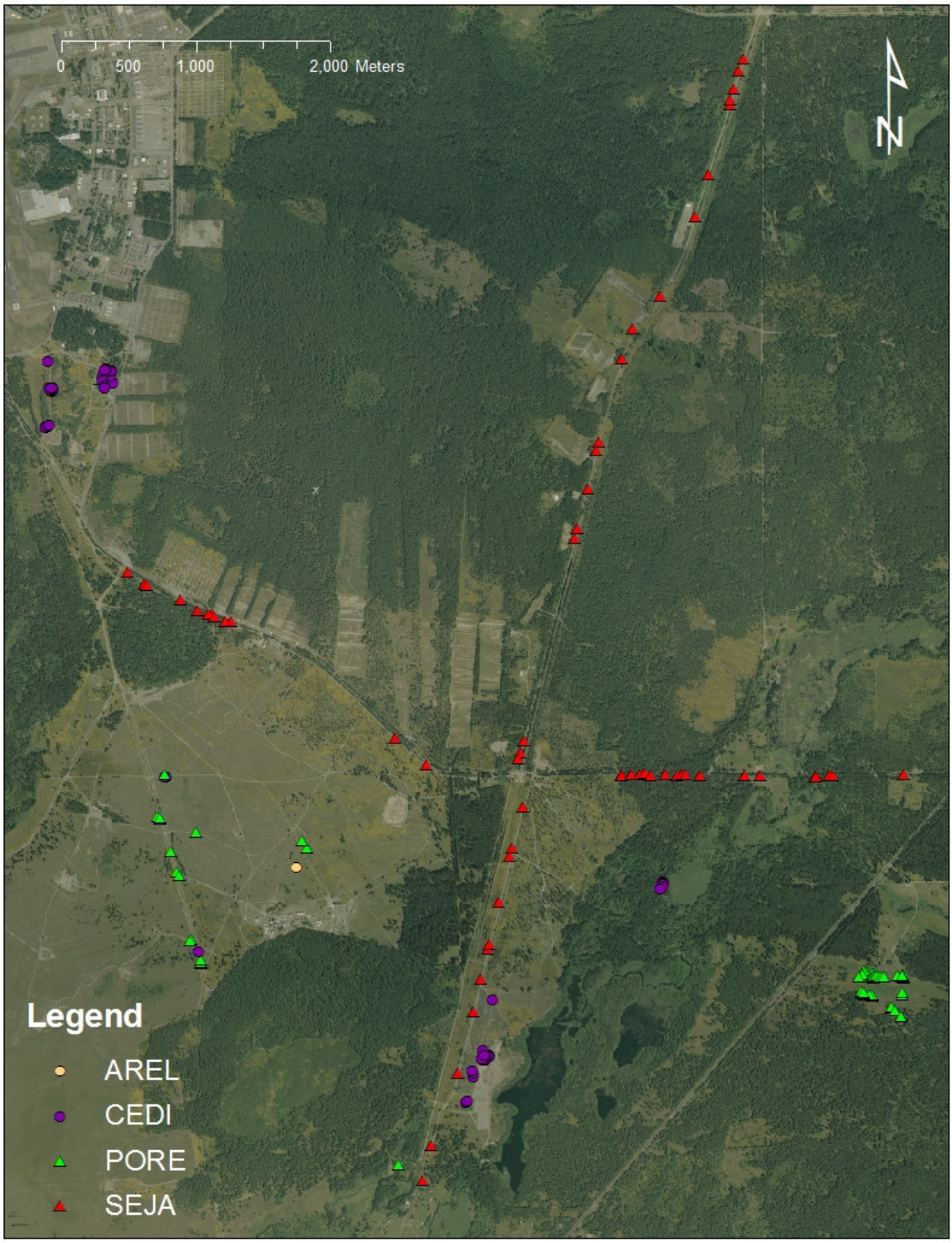


Figure 38: Cinquifoil, Knapweed and Tansy ragwort control at TAs 6, 12 & 10

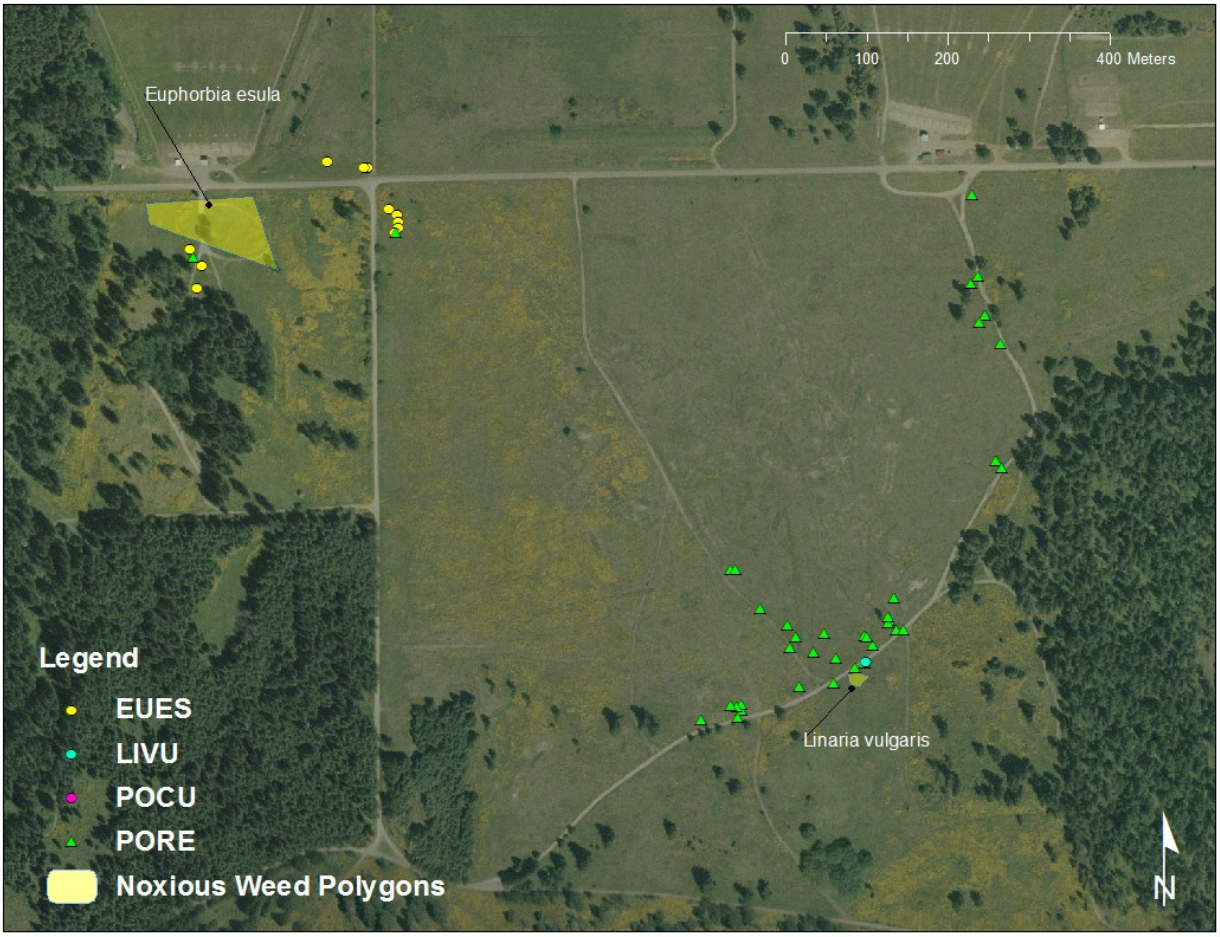


Figure 39: Cinquefoil, Leafy spurge and Common toadflax at TA 18

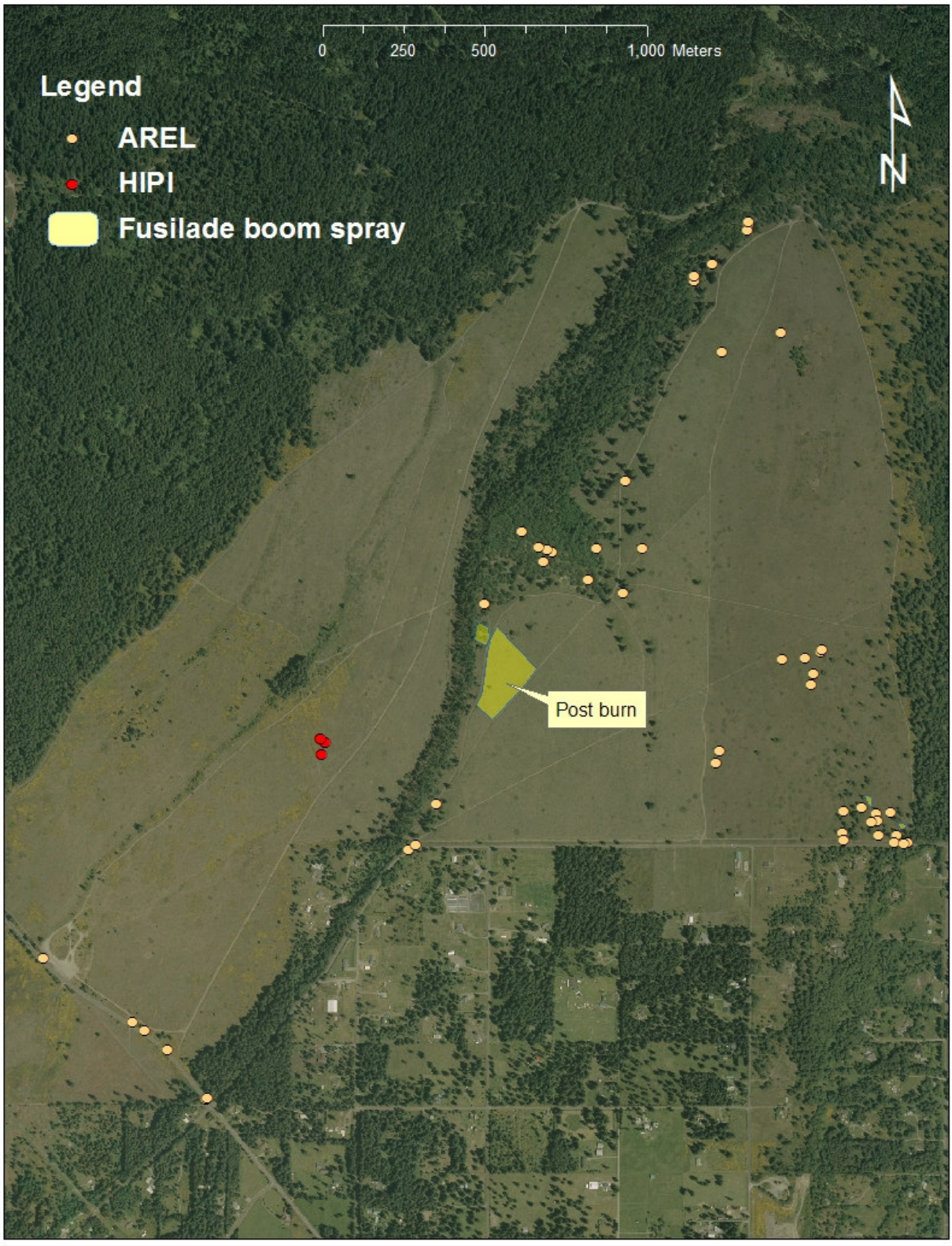


Figure 40:2 Oatgrass, hawkweed and post-burn control at Upper and Lower Weir (TA 21)

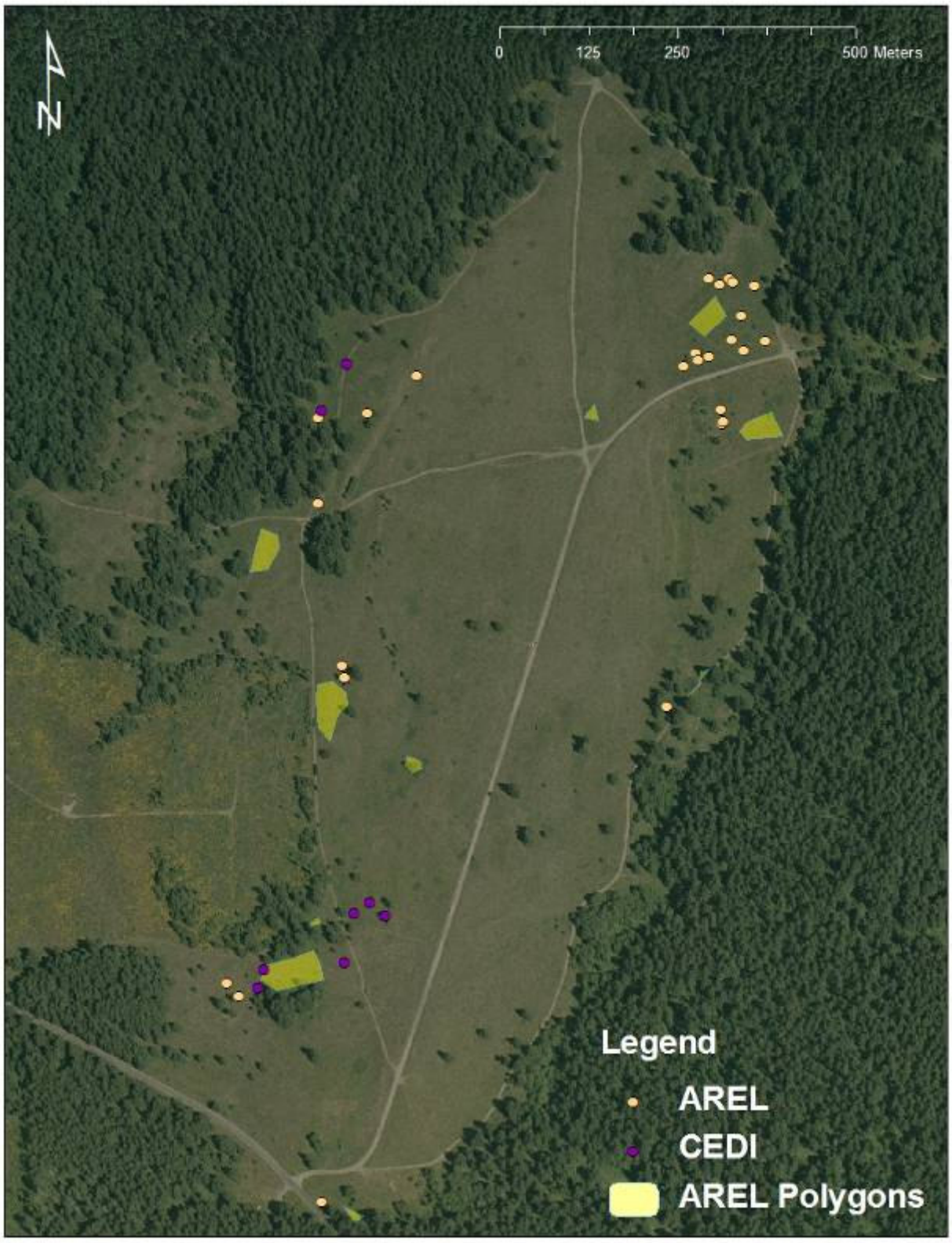


Figure 41: Tall oatgrass and knapweed control at Johnson Prairie (TA 22)

AQUATIC INVASIVE SPECIES

Reed Canary Grass

Muck Creek Enhancements

Figure 42: Winter 2009 flooding at Nixon Spring

The unique Muck Creek ecosystem continues to be a top priority for Fort Lewis and The Nature Conservancy. Reed canary grass is currently the most established and dominant invasive plant of this waterway and has restricted passage of salmon to historic spawning grounds. Thus a significant portion of Muck Creek was managed this year with control of reed canary grass in mind. Progress is certainly being made as the grass is being reduced, native vegetation is becoming established, and the sediment that has built of from years and years of reed canary grass is slowly washing away and exposing a bare gravel substrate. Lead by Fort Lewis and TNC staff, contractors were used this year to do the majority of brushcutting in July and spraying in October. This strategy was very quick and efficient and should certainly be employed in the future. In total 3 miles and 17 acres were managed.

The current management strategy is proving to be very effective as can be seen at Nixon Spring (see above) and Shaver Marsh (TA 12). In both cases, several years of treatments have significantly opened the waterway, enabling potential passage of salmon and steelhead species. Since most of the efforts on Muck Creek are done for these species, it is recommended to perform salmon surveys as a measurement of successful reed canary grass control.

Exeter Spring

Fort Lewis and TNC staff again took advantage of Pride Week to treat reed canary grass at Exeter Spring. While reed canary grass is still found throughout the spring, it is certainly being reduced as the grass is shorter, more gravel substrate is being release, and reed canary grass mats appear to be degrading. A 2.0% solution of Aquamaster plus 0.25% of Nufilm was used. The weather during the day of treatment was fluctuating rapidly between sunny and pleasant to overcast and raining. About an hour after we finished treatment a wave of rainshowers swept the area, and while there was at least 30 minutes for the treatment to become rainfast, the rain still might have reduced effectiveness.

Knotweed Control

All known knotweed (*Polygonum spp.*) sites were treated this year with a 0.5% solution of Milestone VM with 0.25% Nufilm IR. In the past Aquamaster or Habitat herbicides have been used for knotweed control, and while they have offered good control, large knotweed infestations continue to send up new stems. Hopefully, Milestone VM will be able to provide better control since it is translocated very well and has longer chemical activity. At the very least we will eliminate herbicide resistance by varying treatments.

Yellow Flag Iris

The once dense population at Shaver Kettle (TA 12) was treated again this year with a cut and squirt method using a 50% solution of Aquamaster. This site is showing great response to the iris control with densities falling from dense to sparse. Continued efforts may result in eradication from this *Howellia aquatilis* site. Another concern for this kettle is reed canary grass which was treated several years ago and since crept back. Well timed control should be implemented next year to avoid *Howellia*.

2010 Outlook

Generally, noxious weed control will continue with the same operating procedures as 2009. Known infestation sites will be surveyed and treated as appropriate and data will be recorded in a GIS compatible format. New objectives for the year include conducting herbicide comparison trials for sulfur cinquefoil, leafy spurge and common toadflax. The discovery of significant infestations of leafy spurge and common toadflax near Marion Prairie warrant an increased control effort.

Figure 43: Reed canary grass efforts at Nixon Spring, Shaver Marsh (TA 12) & Johnson Marsh (TA 10)

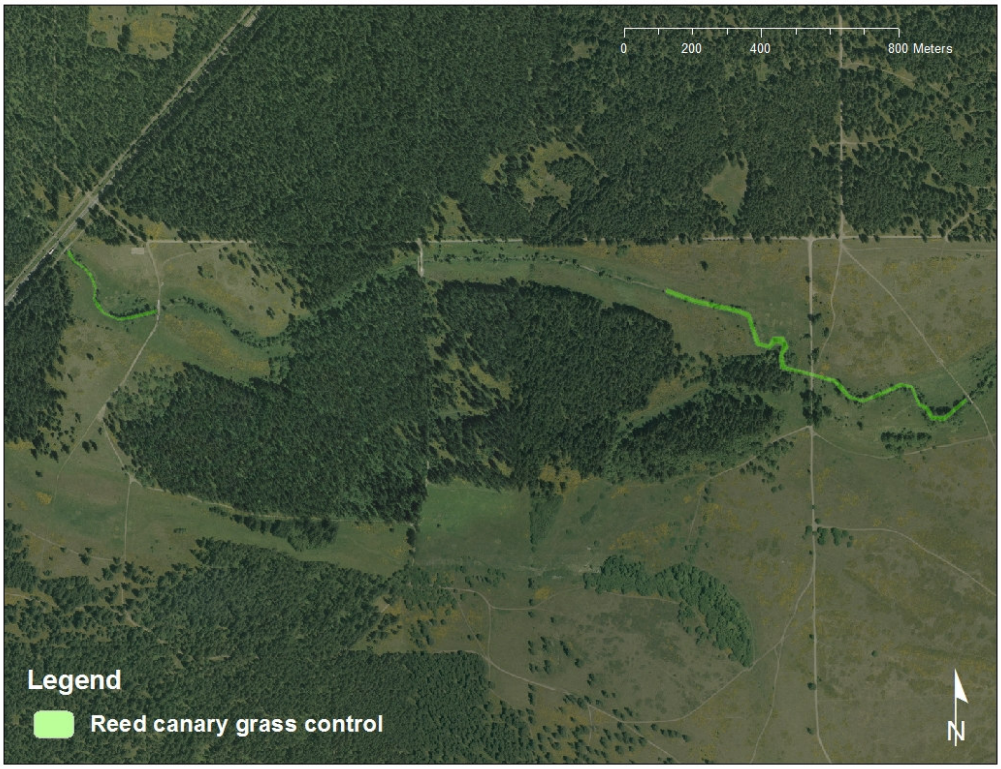


Figure 44:3 Reed canary grass control at TAs 13 & 14

Figure 45: Reed canary grass control at TA 15

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.

2009 Review

RIPARIAN ENHANCEMENT SUMMARY
April-June • Initiated Murrelet survey work on Nisqually corridor (TNC#4920). • Initiated early phase of invasive frog control work to improve conditions for Oregon spotted frog (TNC#4917). • Supported Oregon spotted frog rearing efforts at Northwest Trek and Scatter Creek Correctional facility (TNC#4917). • Initiated Bald Eagle survey project for Nisqually and Muck drainages (TNC#4908)
July-September • Completed murrelet survey project on Nisqually River corridor (TNC#4920) • Completed invasive frog control work (TNC#4917). • Supported Oregon spotted frog release work (TNC#4917). • Completed bald eagle survey project on Nisqually and Muck drainages (TNC#4908).

AQUATIC SPECIES MANAGEMENT

Murrelet Survey

Starting in late spring, we contracted Hamer Environmental L.P. to determine the likelihood of the presence of Marbled Murrelets (*Brachyramphus marmoratus*) within Fort Lewis and, if present, to document the number of birds detected. We strategically chose to conduct radar surveys for this species at 3 survey stations. The objectives of this monitoring program were to: use radar technology to determine the presence or absence of Marbled Murrelets within or adjacent to Fort Lewis and the Nisqually River; and document the numbers and flight patterns of any murrelet type targets that were detected. This survey will be complete mid-summer and a report will be prepared at that time. Ft Lewis Murrelet TNC# 4920.

Figure 19. Mobile radar set-up at survey station, on 15 July, 2009, Fort Lewis, WA.

Spotted Frog Management

Fort Lewis initiated the release of Oregon Spotted Frog, a federal candidate species, in cooperation with local partners in 2008. During late spring, TNC helped initiate a control effort to reduce populations of the invasive eastern bullfrog from release sites. And supported Northwest Trek and Department of Corrections in their Oregon spotted frog rearing efforts. Ft Lewis Spotted Frog 09 TNC#4917.

Bald Eagle Survey

Annual spring bald eagle surveys were completed at the beginning of summer and a final report was presented to Fort Lewis Fish and Wildlife. The survey was for nesting bald eagle territories on Fort Lewis, and was conducted with two helicopter surveys, on 27 April and on 18 June to determined the status and productivity of all known eagle nests. All known osprey nests, both natural and on artificial platforms, were also checked for activity. During both flights, searches for new eagle and osprey nests were also conducted. The surveys were conducted in a Robinson R-44 helicopter with a pilot, primary observer (Mark Stalmaster), and secondary observer (Ed McKinley in April and Todd Zuchowski in June), flying close to tree-top level. All major waterways and shorelines at Fort Lewis were surveyed. (Fort Lewis Bald Eagle 09 TNC# 4908).

APPENDIX – Summary of all 2009 Activities for Each Task Order

TABLE 11: Summary of all tasks completed in 2009 arranged by Fort Lewis task order (with TNC grant numbers).

Williams Pipeline (TNC#3010)

- Planted 30,000 fescue in northern stretch of Williams pipeline prairie restoration project.

Fort Lewis Prairies 2008 (TNC#3917)

- *Lower Weir Prairie.* Mowed 95 acres in southeast section of prairie using front mounted skid-steer mowers. This trial with alternative equipment proved useful; the front mounted mower was easier to use in dense broom with numerous obstacles.
- *South Weir.* Skid-steer mowed 35 acres of broom in polygon north of pipeline. This broom was very dense. Mowing focused on southwestern edge of polygon, which tends to be better quality. A 75 foot-wide strip was also mowed along rainier road in anticipation of possible summer prescribed burning.
- *Johnson Prairie.* Several small patches of broom were mowed along the perimeter to control dense patches of broom.

Fort Lewis Oak Woodland Restoration (TNC#3922)

- Mowed 48.3 acres at Sequalitchew Ecopark on North Fort- 3922
- Mowed 10.4 acres at Bauman Oak in Training Area 4- 3922
- Completed follow-up brush cutting of Scotch broom after mowing in winter at Bauman Oak and Sequalitchew Ecopark.
- Mowed 7.9 acres to control Scotch broom at Bunker Oak.
- Mowed 54 acres in the Ponderosa Pine Savannah of TA12
- Spot treated Scotch Broom over 44 acres at the Gravel pit in TA10
- Brush cut 3 acres at the Prairie Oak Preserve (POP)
- Applied herbicides to a *Vinca sp.* Infestation at Bunker Oak

Fort Lewis Howellia 2008 (TNC#4864)

- Purchased herbicide, PPE and other equipment for 2009 field season
- Partially funded IPM workshop
- TNC staff participated in the annual IPM workshop held in Lacey

Fort Lewis Invasives 2008 (TNC#4865)

- Purchased ATV boom sprayer
- Partially funded IPM workshop
- Conducted sulfur cinquefoil control at TA 6.
- Sulfur cinquefoil control at MP 13 and OP2

Fort Lewis Larks 2008 (TNC#4866)

- *Lower Weir Prairie.* Mowed 25 acres of broom on east edge with conventional tractor.
- *South Weir.* Mowed 7 acres of dense broom western tip of the prairie – an area that has not been intensively treated in the past. The highest quality 60 acres was brushcut to control sparse broom in the center of the prairie.
- *Upper Weir Prairie.* Mowed 68 acres of broom was southeast corner of the prairie in preparation for prescribed burning during summer 2009. An additional 69 acres of sparse broom was brushcut in two southwestern side polygons.
- *Johnson Prairie.* Brushcut 163 acres of sparse broom throughout the prairie.
- Coordinated preparations for 2009 lark nest exclosure study at 13th Division Prairie.

Fort Lewis Oaks 2008 (TNC#4867)

- Mowed 50 acres in oak management unit TA6MU1
- Mowed 15 acres in oak management unit TA6MU3
- Published squirrel monitoring article in Northwest Science

Fort Lewis Muck Creek (TNC#4872)

- Purchased herbicide, PPE and other equipment for 2009 field season
- TNC staff participated in the annual IPM workshop held in Lacey

Fort Lewis Butterflies 2008 (TNC#4877)

- Contacted national pollination experts in preparation for prairie pollinator research on Ft Lewis.
- Obtained scientific collection permit for pollinators.
- Constructed and installed 13 bee nesting blocks.
- Developed 2009 butterfly habitat enhancement workplan.
- Cooperated on fir removal project at Johnson Prairie.
- Mapped kinnikinik patches on Johnson Prairie.

Fort Lewis Bald Eagle 09 (TNC#4908)

- Completed bald eagle surveys and final report

Fort Lewis Salmon 09 (TNC#4909)

- Conducted reed canary grass control at Exeter Spring.
- Knotweed control completed for all known infestations
- Sulfur cinquefoil control at TA 6 and MP 13
- Reed canary grass control on Muck Creek TA 13, 14 and 15
- Reed Canary Grass: treated areas that were mowed in the summer in TA 13 and TA 14

Fort Lewis Noxious Weeds 2009 (TNC#4910)

- Conducted mouse-ear hawkweed control at TA 6, TA 12, TA 21.
- Blueweed control along Muck Creek at TA 13
- Tansy ragwort control completed along major roadways
- Performed Tall Oat Grass control at TA 7S, TA 15, and Range 76
- Conducted spring and summer sulfur cinquefoil control at TA 12, 13, 14, 15 and 22
- Sprayed Fusilade on 3.5 acre grass control plot in TA 15 near the Muck Creek triangle
- South Muck Creek Triangle (TA 15) – Sprayed Fusilade on 3.5 acre grass control plot
- Applied Fusilade as post-burn treatment to 4.6 acres of TA 7S and 5.2 acres of TA 15
- Knapweed control at all locations
- Post burn Fusilade application at TA 15
- Attended and gave presentation about noxious weed strategies at Yakima Weed Conference 2009

Fort Lewis Prairie Habitat (TNC# 4911)

- Brush cut 334 acres of flowering Scotch broom: 163 acres at Johnson Prairie; 60 acres at South Weir Prairie; 68 acres at Upper Weir Prairie; 43 acres at Muck Creek Triangle.
- Performed Tall Oat Grass control at Johnson Prairie (TA 22) and Weir Prairies (TA 21)
- Treated pipeline restoration site at TA 15 to control weeds.
- Treated weeds at mesic prairie restoration site at TA 15.
- Continued grass control on the large Collins plot at TA 15.
- Prepared new and old seed plots at TA 13.
- Retreated Spurgeon Creek seed plot.
- Performed Milestone trials on Mouse-ear Hawkweed.

Prescribed fire:

- *Upper Weir Prairie.* Completed two oak woodland/prairie edge burns totaling 27 acres with focus on oak and snag protection.
- *South Weir Prairie.* Completed one burn totaling 60 acres. Attempted interior burn exclusions and nest box protection.
- *TA 15.* Completed one burn totaling 60 acres. Completed burn with hand crews and hose lay to minimize impact to prairie.
- *TA 7S.* Completed one burn totaling 60 acres.
- *TA 8*. Completed two burns totaling 120 acres.
- *Marion Prairie*. Completed one burn totaling 120 acres.
- *Ranges 86-93.* Completed three burn units totaling 248 acres.
- Site preparation for Spurgeon Creek seed plots
- Co-hosted fire ecology training course RX-310 with Fire Learning Network, which 11 Ft Lewis firefighters participated in 35 classroom hours. TNC# 4911.
- Wet prairie restoration at TA 15 (4911)
- Treated Earthworks preparation area
- Treated pipeline restoration area in TA 15

Fort Lewis Larks 2009 (TNC# 4912)

- *Lower Weir Prairie.* Completed two burns totaling 207 acres. Targeted torching of fir to enhance prairie.
- TA 14. Completed two burns totaling 369 acres. Minimized impacts to butterfly resources and favored lark habitat by creating more complete burn.
- *Upper Weir Prairie.* Completed two prairie burn projects totaling 171 acres.
- *TA6.* Completed three burns totaling 219 acres.
- Spray treated 51 acres of Scotch broom at Upper Weir Prairie
- Completed streaked horned lark nest predation study at 13th Division Prairie: surveyed lark nests, installed nest exclosures, banded nestlings and surveyed nest predation of other adjacent ground nesting birds
- Spray treated 74 acres of Scotch broom at Upper Weir Prairie.
- Mowed 50 acres of broom in the NE corner of Upper Weir Prairie in preparation for fire
- Conducted post-burn fire effects and severity monitoring at Upper Weir Prairie. TNC# 4912.

Fort Lewis Flora Survey (TNC#4913)

- Initiated rare prairie plant and weed surveys of several important prairie habitats.
- Completed rare prairie plant and weed surveys and final report of several important prairie habitats.

Fort Lewis Butterfly Habitat (TNC#4914)

- Mapped important larval resources for silverspot fritillaries on Johnson prairie to aid management planning.
- Mapped locations of hoary elfins, a state monitor species, on Johnson prairie to aid management planning.
- Released 61 Taylor's checkerspot larvae into three prairie habitat structures for future documentation of diapause habitat characteristics to aid restoration planning.
- Monitored survival of forbs planted in butterfly habitat enhancement plots on TA's 7S, 15, 22 and 23 to better inform best management practices for prairie restoration.
- Completed butterfly habitat mapping at Johnson Prairie
- Conducted Taylor's Checkerspot Diapause Habitat Characteristics
- Planted 18,600 native forb plugs at TAs 7S, Pacemaker, muck Creek Triangle prairie and Johnson Prairie for butterfly habitat enhancement.

Fort Lewis Howellia (TNC#4915)

- Reed canary grass control on Muck Creek at TA 10 and 12
- Reed Canary Grass: treated areas mowed in the summer in TA 10 and TA 12
- Treated yellow-flag iris infestation at Shaver Kettle (TA 12)
- Treated wet prairie restoration area in TA 15

Fort Lewis Gray Squirrel 09 (TNC#4916)

- Mowed 12 acre Oak stand east of Bill Lake (TNC#4916)
- Mowed 10 acre Oak savannah in TA8 near Spanaway Marsh (TNC#4916)
- Spot treated Scotch Broom over 241 acres in core WGS sites

Fort Lewis Spotted Frog 09 (TNC#4917)

- Initiated early phase of eastern bullfrog control effort.
- Supported Oregon spotted frog rearing efforts at Northwest Trek and Scatter Creek Correctional facility
- Supported Oregon spotted frog release work

Ft Lewis Gophers – TNC#4918:

- Collected seed from 40 species of prairie plants.
- *Johnson Prairie*. Completed two burn projects totaling 70 acres. Excluded several interior habitat patches from fire using hand crews and ATV.

Fort Lewis Murrelet 09 (TNC#4920)

- Completed marbled murrelet survey of Nisqually River corridor.
- Murrelet survey and report completed

Fort Lewis Fauna Survey (TNC#4921)

- Initiated systematic survey of pollinators on nine prairies at Fort Lewis to a) document baseline status of pollinator community in open habitats in western Washington, and b) investigate differences in pollinator communities relative to habitat quality to inform our restoration practices.
- Initiated collaborative investigation of pollinator limitation of Puget balsamroot on three prairies with scientists from the University of Puget Sound to provide information on the role of pollinators in seed production of a key prairie resource.
- Tagged 2 Townsend's big-eared bats as part of bat survey 09.
- Completed field portion of systematic pollinator survey
- Completed the 2009 study of Townsend's big-eared bat

Fort Lewis Cavity Creation 2009 (TNC#4923)

- Replaced and maintained guano trays for bat box experiment.
- Completed Sequalitchew Ecopark swift tower.
- Began the retrofitting of the bat steeple at Seqalitchew Ecopark
- Completed construction of bat steeple at Sequalitchew Ecopark (TNC#4923)
- Compiled results of bat box preference study and submitted abstract for presentation at SERNW conference (TNC#4923)
- Monitored cavities and compiled results for publication (TNC#4923)

Fort Lewis Burn 2009 (TNC#4928)

- Provided burn boss expertise to assist with Fort Lewis burn program development
- Hosted G-131 Advanced Wildland Fire for Structural Fire Fighters (8 hrs 10 students)
- Hosted S-290 Intermediate Wildland Fire Behavior: (24 hrs 18 students)
- Hosted S-212 Wildland Fire Chain Saw Operations (24 hrs 18 students)
- Hosted S-131 Advanced Fire Fighter (8 hrs 12 students)
- Hosted S-133 Look Up, Look Down, Look Around (4 hrs 12 students)
- Developed implementation guidance document based on 2009 season observations #4928.