Assessing multiple treatment methods to control *Festuca arundinacea* using prescribed burning, herbicide, brush-cutting and hydro_mechanical_obliteration (H_M_O).

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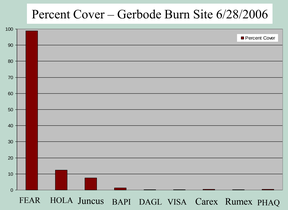
Abstract: On September 27th 2011, a controlled burn was conducted by NPS staff on eight acres of tall fescue in the Gerbode Valley, Marin Headlands, Sausalito CA. The goal of the burn was to significantly reduce tall fescue thatch in order to apply additional control treatments and begin the habitat restoration of a coastal swale plant community. The burn was a success and reduced the absolute cover of tall fescue from 99% to 22%, compared to pre-burn conditions from 2006 data. Plots were subsequently installed on 2 acres of the site to determine the results of three follow-up control treatments: treatment with herbicide, brush-cutting, and hydro-mechanical obliteration (H_M_O). Currently, data shows that herbicide treatment was the most effective at reducing the re-growth of *F. arundinacea*. Following those treatments, one of two re-vegetation techniques were implemented: broadcast seeding or native out-planting. A total of 14 pounds of seed was broadcast and 4,882 native plants were planted across the larger site as well within selected plots.

Biology: *Festuca arundinacea*, commonly referred to as tall fescue, is an invasive perennial bunchgrass native to Europe. Predominantly spread by seed, this species forms dense monocultures in a variety of open habitats, reducing native plant diversity and the quality of wildlife habitat. Tall fescue is frequently infected with an endophytic fungus which causes illness to wild animals, making biological control difficult. This herbivore resistant grass species has been widely used throughout the U.S. for turf, lawns, athletic fields, and golf courses.

Project Description: The purpose of the burn in Gerbode Valley was for resource management, rather than for hazardous fuel reduction. The burn was designed to open up the thatch canopy of the dense fescue meadow and develop Integrated Pest Management prescriptions to follow fire. Follow up treatment methods of brush-cutting, glyphosate application, and H.M.O. were carried out. These control methods were complimented by broadcast seeding and out planting. Different combinations of treatment and planting methods were utilized in 25 study plots within the burn area to assess best practices for restoring the valley.

Goals:

1. Enhance native biological diversity within the unit boundaries.
2. Test the effectiveness of fire as a weed control treatment in the Marin Headlands.
3. Reduce fuel loading within the unit boundaries.
4. Develop cooperative fire management practices between NPS and local government departments.
5. Educate the public and NPS employees about the role of prescribed fire in natural resource management.

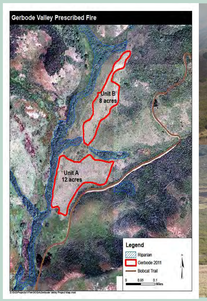


Resource objectives:

1. Decrease the percent cover of Tall Fescue (*Festuca arundinacea*) by at least 10% one year following treatment.
2. Increase the diversity and percent cover of native species one year following treatment (see chart).
3. Complete research documenting the effectiveness of fire on weed control and as a restoration treatment.
4. Test re-vegetation techniques to restore a coastal swale plant community

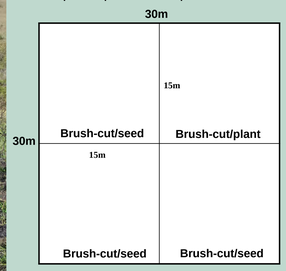
Methods and Materials:

Prescribed Burn: The area proposed for the burn on September 27th, 2011 was split into two units: Unit A to the south, a 12 acre parcel, and Unit B to the north, an 8 acre parcel. The first Unit was not treated in 2011 and will hopefully be subject to fire management in the future. On September 26th, a test burn occurred in the northern most corner of Unit B to assess how well the accumulated thatch would ignite and continue to burn. On the 27th, ignition began at 12:15p.m. where the test burn left off. Fire management staff simultaneously lit the east and west edges of the burn unit. Ignition continued slowly with pauses to allow for smoke dispersion and was completed by 3:00 PM. Fire behavior was good with slow backing, 1-3ft flame lengths and good consumption. Equipment on site included several fire engines, on site water and a large number of fire management personnel.



Study Plots: Within burn Unit B, there were ten 30mx30m experimental plots established, each with four 15mx15m subplots. Each of the subplots had a combination of one treatment method and one re-vegetation technique. Five 15mx15m control plots were also established for baseline post-burn data.

Example experimental plot:



Treatments:

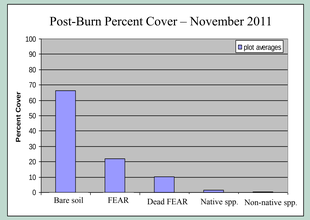
- 1.5% glyphosate application on re-sprouting fescue bunches.
- Brush-cutting at crown level and higher.
- Hydro mechanical Obliteration (H.M.O.) of fescue bunches.

Planting/seeding: A total of 14 pounds of seed was broadcast into 10 plots at a rate of 8.4 lb. per acre. 4,882 native plants were planted across the larger site as well as within selected plots.

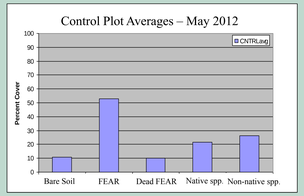
Monitoring: To monitor vegetation succession and percent cover following the burn, random line point intercept was used at 30cm intervals to determine composition and cover. Data was collected in November 2011 and again in May 2012.

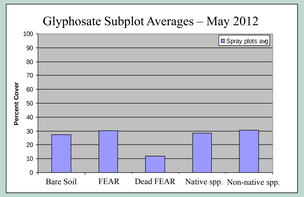
Species Planted	Species sown
slough sedge	purple needlegrass
common rush	slough sedge
CA canary grass	cow parsnip
blue-eyed grass	CA canary grass
blue wild rye	sneezeweed
creeping rush	lizard tail
Cow parsnip	blue wild rye
blackberry	common rush
arroyo willow	CA oatgrass
yarrow	yarrow
aster	red fescue
Californica sage	CA brome
bush lupine	
Horkelia	
sticky monkey flower	
CA brome	
CA oatgrass	
pacific sanicle	
mugwart	
wax myrtle	
yerba buena	
gumplant	
CA bee plant	

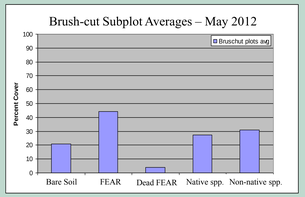
Results: The prescribed burn in Gerbode Valley was successful in reducing tall fescue thatch cover from 99%, recorded in 2006, to 22%, recorded two months following the burn in November, 2011.

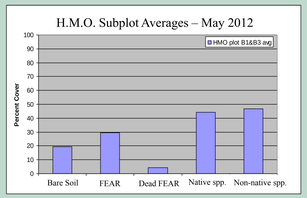


Compared to the 52.74% average cover in the five control plots, the subplots treated with 1.5% glyphosate solution had the least amount of live, re-sprouted tall fescue at 30.26% cover - indicated in the graphs by its four-letter code FEAR. The mechanical brush-cutting treatment proved to be the least effective, with 44.42% average live fescue cover in corresponding subplots. The 29.38% average live fescue cover in the H.M.O. treatment subplots was actually slightly less than the average of chemically treated subplots. Because this graph is only representative of two subplots, the data is not as informative of that collected in the glyphosate application plots.









Management Timeline

- September 27th, 2011 – Prescribed burn conducted
- October 2011- Study plots set up and point intercept data collection
- November 1 - Herbicide application began
- November 2011 through February 2012 planting 4882 natives
- January 2012 - broadcast seeding
- May – data collection
- June & July – Seed head removal of re-sprouted tall fescue

And H.M.O. treatment in remaining study plots

- August – bull thistle removal using scythes
- September – Monitoring of July H.M.O. treatment plots

Discussion/Management Implications: As the pre and post-burn data shows, fire is effective at decreasing tall fescue thatch in the Marin Headlands, Sausalito, CA. Follow up treatment with glyphosate on re-sprouting bunches was the most effective fescue control follow-up method. While other studies have demonstrated that mowing can be effective at controlling tall fescue, we were unable to obtain the equipment post burn to try repeated mowing. Therefore we tested brush-cutting with hand operated equipment to simulate mowing. This technique was not effective for several reasons: The tall height and lumpiness of the burned fescue stumps made the terrain lumpy and it was difficult to cut them at or below the soil level. Another challenge we encountered was that by mid January, soils on the site were too wet for heavy equipment to access and continue to treat the study plots with H.M.O. Because our data on H.M.O. effectiveness is only representative of two plots, this picture is somewhat skewed, but it does lend insight to an alternative treatment method for tall fescue where chemical application is not an option.

Challenges: One of the biggest challenges we faced with this project was the persistence of wet weather and muddy conditions on the way out to the burn site. It was almost impossible to get the H.M.O. equipment out to the subplots for the first round of treatments due to the size of the vehicle and the shear weight of all the water needed. This resulted in a delay of one of the treatment methods and a skewed picture of the method's effectiveness at controlling tall fescue. Another challenge was the short time frame with which we needed to remove seed heads from the remaining tall fescue before they dropped seed into the study plots and the removal of equally large amounts of bull thistle, *Cirsium vulgare*, a predictable post burn species. Both of these tasks required large amounts of labor and determination on the part of staff and volunteers to accomplish which we did not plan for. So, as usual, adaptive management and ingenuity (volunteer driven) became an important part of the process and we used a very effective new tool the scythe as a result.

Future Plans: Future plans in the remaining 6 acres of Unit B are mapping vegetation trends within and outside the plots to inform our replanting strategies, ongoing treatment of tall fescue and bull thistle and re-sampling of the plots in Spring 2013.

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