Nestucca Bay National Wildlife Refuge Invasive Velvet Grass Management Plan

A plan to combat invasive Velvet grass and create favorable conditions for the threatened Oregon Silverspot Butterfly

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Introduction

The purpose of the Nestucca Bay National Wildlife Refuge (NBNWR) invasive velvet grass management plan is to protect Oregon Silverspot butterfly (OSB) populations from the indirect effects of invasive grasses threaten the OSB by pushing out its larval host plant, early blue violet (*Viola adunca*; VIAD).

The NBNWR is a 1,202 acre Oregon coastal refuge originally established in 1991 to protect habitat for threatened geese. The refuge now includes prairies which support re-introduced populations of the federally-endangered OSB. Oregon silverspot butterfly reproduction relies on the presence of early blue violet, VIAD. Over the past decade, the invasive grasses, velvet grass (*Holcus lanatus*; HOLA) and rat's tail fescue (*Festuca myuros*; FEYA), have established in the NBNWR, forming dense monocultures and reducing habitat for VIAD. Since the establishment of these invasive grasses, the team at the NBNWR have employed numerous management strategies to limit the growth of HOLA and FEYA (see *Management History*). These strategies showed short-term success and, in 2016, the site was deemed viable for OSB and the species was reintroduced. However, both invasive grasses have since reestablished and the scope of viable management strategies have become more complex due to the OSB's presence and federally-endangered status.

The goal of the management plan was two-fold: first, to organize relevant information on the management of HOLA and FEYA and potential non-target effects on the OSB and second, to develop and describe an informed management strategy to reduce or eradicate populations of HOLA and FEYA, while avoiding negative impacts to OSB fitness and survival.

Methods

This report was commissioned and formed in partnership with David Thomson with NBNWR and Dr. Catherine de Rivera at Portland State University. To produce this report, we used a combination of information from published research, practitioner interviews, white papers, web resources, and a site tour. For the literature review component, we focused on published research involving HOLA and FEYA optimum abiotic conditions, treatment of these weeds using herbicides, herbicide mixtures, burning, and mowing, and potential non-target effects of these management strategies on the OSB and other butterflies.

We supplemented these findings with a site tour conducted in November 2022 as well as practitioner interviews with two personnel associated closely with the project either presently or in the past. The interview personnel included Bill Medlen, a volunteer at NBNWR for over 10 years, and Ian Silvernail, the former lead manager at NBNWR from 2012 to 2020.

Species and Area Description

Summary: The NBNWR management team is fighting the invasive perennial bunchgrass called velvet grass. It quickly colonizes an area after disturbance and creates seeds at a high rate that remain viable in the soil for years. The species is tolerant to a wide variety of conditions including acid bogs and lime quarries. The high acidity of Nestucca Bay soils make velvet grass able to thrive. Managers were able to eliminate the grass in 2016, but it has returned. The introduction of OSB to the site limits the management options available to managers in combating velvet grass, with herbicide being the most promising option. Fusilade mixed with NuFilm -IR shows to have little to no negative impact on OSB.

Velvet Grass Ecology

Holcus lanatus is a perennial bunchgrass non-native to many coastal regions across North America. HOLA likely originated from southwestern Europe and was introduced to the western US several centuries ago where it now forms dense monocultures that inhibit the growth of native grasses through direct competition and interference through the production of allelopathic compounds (Holloran et al, 2004; Pitcher & Russo, 1988).

> *"At the beginning of the project, Velvet grass was not a problem, but it has become a major component throughout the management process."* – Ian Silvernail, 2022

Velvet grass is difficult to manage due to the rapid spread and growth of seeds and its resistance to several common management strategies. The seeds are dispersed by wind and can travel as far as 17 meters from the parent plant (Holloran et al, 2004), with 90% of seeds falling within 5.2 meters of the host plant (Ross, 1982). Once deposited, seeds form resistant and extensive seed banks that germinate and grow under a wide range of conditions (Pitcher & Russo, 1988). Germination often begins in late autumn while flowering occurs between May and July (Pitcher & Russo, 1988). The literature shows some disagreement regarding timing of viable seeds, with one study showing that viable seeds are shed from January to July (Watt, 1977) while another shows viable seeds are shed from June to September (Pitcher & Russo, 1988). Seed production of HOLA is very high with 19,000 seeds per square meter per plant (Watt, 1978) and a peak of up to 240,000 viable seeds shed in March (in England) per plant (Watt, 1977). Each of these seeds remain viable for at least 48 weeks (Pitcher & Russo, 1988) and as long as 12 years (Watt, 1978) with 90-99% germinating under moist conditions (Pitcher & Russo, 1988).

Velvet grass typically exists in soils with a pH range of 5 to 6 (average pH of 5.7) (Ripley, 1984), yet is tolerant to a wide range of soil pH (3.5 to 8) and stands exist and are able to form fungal associations in soils as acidic as acid bogs and as alkaline as lime quarries (Pitcher & Russo, 1988; Young et al., 2018). The plant can also tolerate low fertility soils, with its competitiveness increasing with increasing soil fertility (Pitcher & Russon, 1988), and shows adaptability to a wide range of climatic conditions different from that of its home range (Macel et al., 2007). High tolerance and competitive ability along with high reproductive rates make HOLA difficult to control. Indeed, HOLA has been shown to be the most prevalent in heavily managed grasslands (Bekker et al., 1997), highlighting both HOLA's difficulty to control and how casually applied management strategies may ultimately prove to be counter-productive.

Management History

Management of HOLA has been ongoing at NBNWR for at least the last 10 years (Medlen, 2022). The prairie site at NBNWR was originally used as a dairy farm prior to its listing as federally-managed land (Silvernail, 2022). This prior land use led to fertile soils of frequent disturbance and high acidity, conditions which lend themselves to infestation by invasive weeds (Bekker et al., 1997; Silvernail, 2022). Shortly after the land became federally managed, broadband sprays of glyphosate were used to clear existing plants and native flora was replanted in a strategy to reset the prairie back to native early seral succession stages (Silvernail, 2022). It was at this point that HOLA began invading the site and became a primary management issue (Silvernail, 2022).

Initially, HOLA was treated through sprays of Poast (sethoxydim), but, shortly after, this practice was discontinued due to current literature showing the herbicide was harmful to invertebrates (specifically honeybees) (Silvernail, 2022). Managers then switched to spot sprays with the grass-specific herbicide Fusilade and experimented with different application timings (fall, spring, and both fall and spring) (Silvernail, 2022). This strategy showed limited success with HOLA continuing to appear over each following summer (Silvernail, 2022). However, the effectiveness of these sprays may have been limited due to spot sprays (which are difficult to implement due to HOLA's modest size and presence before late spring) and wet weather conditions in fall making herbicide application ineffective or impossible (Medlen, 2022). Land managers then performed prescribed burns, successfully eliminating HOLA in 2016, and re-introducing the OSB shortly thereafter. Following re-introduction, however, viable management strategies became limited due to the presence of the endangered OSB and HOLA quickly re-invaded. Since then, managers at the NBNWR have attempted a combination of plot-based strategies including mowing, controlled burns, herbicide applications, and others to try and reduce the presence of HOLA while limiting non-target effects on the OSB population.

Potential Non-Target Effects on the Oregon Silverspot Butterfly

The OSB is adapted to prairies of frequent disturbance so non-broadcast, non-chemical management strategies of HOLA (such as burning or mowing) are unlikely to negatively impact OSB's survival (Medlen, 2022; Silvernail, 2022). However, these strategies have been shown to be ineffective or counterproductive in management of HOLA (covered in Objectives, Strategies and Activities).

Chemical management strategies seem to be the most promising approach to managing HOLA, yet chemical intervention has the capacity to negatively impact native flora and/or the lifecycle of invertebrates depending on the active ingredient, mixed adjuvants, and timing of the application (Doll et al., 2022a; Doll et al., 2022b; Schultz et al., 2016). Of the nine herbicides considered, only Stinger (clopyralid) and Fusilade (fluazifop-p-butyl) mixed with NuFilm -IR had published literature showing weak or no positive or negative effects on OSB across its lifecycle (Doll et al., 2022a; Doll et al., 2022b). Of these two herbicides, only Fusilade had evidence supporting the use of broadcast spraying, while Stinger had evidence supporting the use of only spot spraying (Doll et al., 2022b). Other chemicals considered by NBNWR management such as Poast (sethoxydim) showed negative effects on other Oregon butterfly genera or showed inconclusive results (Schultz et al., 2016).


Objectives, Strategies, and Activities

Summary: Management activities at Nestucca Bay NWR are aimed at creating types of habitats that benefit OSB. We propose creating a study plot to test how herbicide treatments at designated times each year can help limit prevalence of velvet grass, in order to promote the early and mid-seral habitat needed to support OSB populations. In addition, managers should prioritize eliminating the HOLA seed bank present in the soils and ensuring that the grass isn't allowed to seed each year.

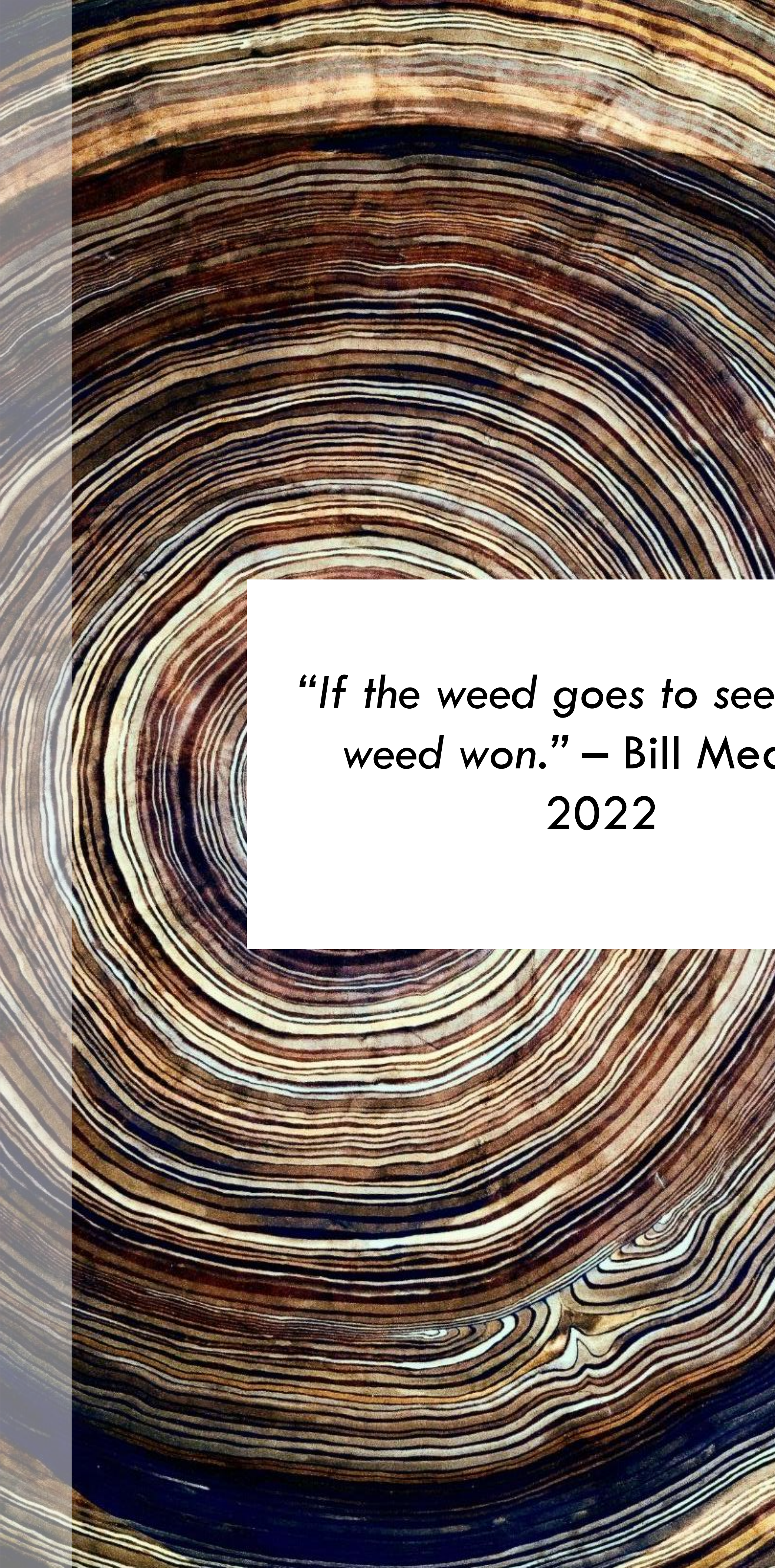
Strategy Overview

- The proposed strategy should first be tested across study plots, the size and number of which will depend on cost and staffing limitations.
- If plots must be cleared, mowing or hand-pulling should be used over prescribed burning to limit post-burn HOLA dominance.
- Each plot should have a 10.5+ meter buffer zone where treatment will be applied in a fashion identical to the study plot.
- Weather permitting, the treatment applied to each plot should include a winter (late January to late February) broadcast spray of Fusilade with NuFilm -IR, a spring (April to May) flagging and subsequent spot spray with a non-selective herbicide (e.g., glyphosate), and a fall (late September) broadcast spray of Fusilade with NuFilm -IR.
- Fusilade and NuFilm -IR broadcast sprays should be applied at a rate of 0.38 a.i./ha and with NuFilm -IR at 25% concentration of the active ingredient and non-selective herbicides should be applied as needed.
- Treatments should be applied for, at minimum, 2 years but possibly longer depending on how long it takes for the HOLA seed bank to be depleted.
- Counts of flags and/or GPS locations of flags should be recorded to perform quantitative analysis of the effectiveness of the above management strategy.

"Common velvetgrass is 'notoriously a prolific seed producer'...the greatest number of seeds produced per plant was 240,000 on plants from March-sown seed" **– Trudy Watt, 1976**

Equipment and Supplies

- Appropriate amounts of Fusilade and NuFilm -IR to apply two broadcast sprays per year over the study plot(s) at a rate of 0.38 a.i./ha and with NuFilm -IR at 25% concentration of the active ingredient.
- Broadcast sprays are typically applied via a tractor mounted sprayer (Medlen, 2022).
- Non-selective herbicides should be applied using a backpack sprayer with flat fan nozzle attachment.
- If abiotic management such as mowing or prescribed burning is required, appropriate equipment available to the NBNWR management should be used.
- Flags for marking HOLA individuals during spring.
- GIS or other data management software to record and evaluate changing springtime population size of HOLA.



"If the weed goes to seed, the weed won." – Bill Medlen, 2022

"Fire is not likely useful in the control of common velvetgrass because becaue it is likely to establish, persist, and/or spread after fire." – Corey Gucker, USDAFS, 2022

Strategy Basis

Abiotic Management

Key to NBNWR's goal of sustaining optimal habitat for the OSB is to maintain an early- to mid-seral succession stage that supports early blue violet and other nectar sources for the OSB. Yet this goal is complicated by the fact that this area would naturally progress to forest without prescribed disturbance (Thomson, 2022; Medlen, 2022; Silvernail, 2022), and that disturbance, both mechanical (e.g. mowing) and through prescribed burns, seems to exacerbate the spread of invasive HOLA (Clark et al., 2001; Tveten, 1997; Robinson & Chilcote, 1962). Oregon grasslands in the Willamette Valley and along coastal ranges both showed increased counts of HOLA 1-3 years following prescribed burns (Clark et al., 2001; Tveten, 1997) and this may be due to the heat resistant nature that HOLA seeds exhibit (Robinson & Chilcote, 1962). Mowing has also been shown to have little effect at eliminating HOLA both in Oregon and elsewhere (Clark et al., 2001; Robinson & Chilcote, 1962) and may be due to mowing activities increasing and extending seed dispersal distances (Strykstra et al., 1997). Both prescribed burns and mowing are limited due to the high dispersibility of HOLA seeds and resilient HOLA seed banks and allow HOLA to capitalize on newly-cleared and disturbed plots. Therefore it is recommended that management strategies focus on first reducing or eliminating seed banks in plots via herbicides before engaging in prescribed burns or mechanical removal.

Chemical Management

Chemical management through the use of Fusilade is the most promising management method at reducing HOLA seed banks, given HOLA's resilience to abiotic management strategies and published literature showing little to no effects on OSB survival. Herbicide applications can be performed at NBNWR up to three times a year (Medlen, 2022; Silvernail, 2022), and each type of herbicide can only be applied up to two times per year to limit herbicide resistance. We recommend Fusilade should be applied in both broadcast sprays, supplemented with a non-selective herbicide spot spray for a total of three herbicide applications per year. The first treatment should be a broadcast spray of Fusilade in winter (late January to late February), or when first seed heads appear, to manage plants prior to seed dispersal. A second spot spray should occur in Spring (April/May) after flowering to prevent pollination between remaining HOLA individuals and maximize translocation of herbicide to the roots. A non-selective herbicide, such as glyphosate, should be applied during the spot spray as each type of herbicide can be applied twice per year (Thomson, 2022). Prior to spot spraying, it is recommended that personnel walk through the site flagging individuals in the morning prior to spraying. This serves two purposes: first, HOLA is easiest to identify in the morning when dew clings to the stems and leaves and second, to provide data that can be used to evaluate the effectiveness of the proposed strategy from year to year. Finally, a broadcast spray in Fall (late September; weather permitting) to capture still living adults from the previous two winter and spring sprays. All sprays Should be done midday or when plants are driest as moisture on the plants can limit the effectiveness of the herbicide.

"More specifically, we found that...a broadcast spray of fluazifop-P-butyl with Nu-Film®-IR, had a higher population growth rate than those that were untreated." – Doll et al., 2022

Where to Implement

Based on literature review, more field data is needed to determine if a strategy focused on limiting seed dispersal and seed banking is an effective approach to HOLA management. Therefore, we recommend the above strategy be applied in a number of study plots (depending on available personnel and/or cost restrictions) prior to applying the strategy more broadly across the refuge. The size of each plot will again depend on cost and staff restrictions but, regardless of size, each plot should have a 10.5 meters radius buffer zone (two times the 5.2 radius dispersal of 90% of HOLA seeds). Treatments should be applied identically within the study area as well as over the buffer zone. This buffer zone should limit seed dispersal from areas outside the study plot(s) and limit new growth in areas adjacent to the study area that may cause reseeding while the study is conducted.

"Common velvet-grass is most distinctive early in the morning when dew clings to the hairs on the stem and leaves." – Invasive Species in Garry Oak, 2003

Detection Methods

For broadcast sprays, no detection should be required - the herbicide should be applied to the entire plot plus a 10.5+ meter buffer zone to limit dispersal into the study plot from adjacent areas. For the spring spot spray, personnel should visit the plot(s) in the morning, as dew clings to the leaves and flowers of HOLA during this time making it easier to recognize HOLA and flag for spot spraying later on.

Timing

Weather permitting, the treatment applied to each plot should include a winter (late January to late February) broadcast spray, a spring (April to May) flagging and subsequent spot spray, and a fall (late September) broadcast spray. Again, for the spring spot spray, personnel should visit the plot(s) in the morning, as dew clings to the leaves and flowers of HOLA during this time making it easier to recognize HOLA and flag for spot spraying later on. Treatment should be applied for 2 years or more to combat the resilient seed bank of HOLA.

David Thomson gives us a thorough and engaging tour of the prairie.

Conclusion

The purpose of the Nestucca Bay National Wildlife Refuge (NBNWR) invasive velvet grass management plan is to protect Oregon Silverspot butterfly (*Speryeria zerene Hippolyta;* OSB) populations from the indirect effects of the invasive grass *Holcus lanatus* (HOLA) which threatens the OSB by pushing out its larval host plant, early blue violet (*Viola adunca*). To produce this report, we used a combination of information from published research, practitioner interviews, white papers, web resources and a site tour. We found that a likely cause for HOLA's persistance is volumous seed production, dispersal, and banking capabilities. We find and detail a potentially effective chemical management strategy through the use of the selective herbicide Fusilade. Herbicide treatment using Fusilade is the most promising and well-supported management method for reducing HOLA seed banks, given HOLA's resilience to abiotic management strategies and published literature showing little to no effects on OSB survival. It is our hope that the information and strategies detailed here, along with our supplemented annotated bibliography, will help the NBNWR in their efforts to eliminate invasive HOLA and preserve OSB populations in the years to come.

"We're discovering there is enough food out there for caterpillars...it's giving us hope that we haven't lost…we just have to be more targeted in how we manage." - Erica Henry, USFWS, 2021

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