Use of Integrated Pest Management to Restore Meadows Infested with Perennial Pepperweed at Malheur National Wildlife Refuge

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INTRODUCTION

Perennial pepperweed (*Lepidium latifolium*), and exotic species herein referred to as pepperweed, is a cool-season perennial that is widely distributed throughout western North American. Pepperweed is frequently found in riparian habitats from high-altitude meadows to alkaline sinks in desert valleys and coastal marshes (Weber 1989). After establishment in riparian areas, pepperweed typically spreads to meadows and pastures, where it forms dense monotypic stands (Tosso et al. 1986). Vegetation displaced by pepperweed provides important habitat and forage for wildlife. On the Malheur National Wildlife Refuge (MNWR), pepperweed has displaced 5 and 10 percent of the meadow and grass/shrub uplands, respectively, that are critical habitats for nesting aquatic and neotropical birds (U.S. Fish Wildl. Serv., unpubl. data). Because hay from infested pastures is not marketable, pepperweed jeopardizes the haying program on the MNWR , which also provides short and medium grasses for sandhill cranes (*Grus canadensis*), shorebirds, and waterfowl.

The goal of our study is to restore native vegetation in MNWR meadows infested with pepperweed using integrated pest management (IPM) techniques (herbicides, disking, fire, and combinations thereof). A second part of this study to be initiated during fall 1996 will determine whether seeding or transplanting of native species will be necessary to restore native plant communities in areas where pepperweed is controlled. Because little information exists regarding the efficacies of control methods, the objectives of our study are to determine pepperweed control and response of native vegetation associated with IPM techniques at MNWR.

Study Area

MNWR is locationed 51 km southeast of Burns, Oregon. The 75,087-ha refuge is characterized by the following habitat types: grass/shrub uplands (34 percent), wetlands (33 percent; ponds sloughs, and seasonal wetlands), alkali lake beds (17 percent), meadows (14 percent), croplands (1 percent), and riparian (<1 percent). Mean monthly temperature and precipitation range from -10 (January) to 30° C (August), and 0.2 (August) to 1.1 cm (March), respectively.

The Malheur-Harney Lake Basin, which encompasses MNWR, is an important area for wildlife, particularly migrating and nesting aquatic birds. Large numbers of waterfowl, geese, trundra swans (*Cygnus columbianus*), and sandhill cranes use the Basin during fall and spring migrations. Peregrine falcons (*Falco rusticolus*) and bald eagles (*Haliaeetus luecocephalus*) use the Basin during spring migrations. Malheur Lake is a major production area in the Pacific flyway for redheads (*Aythya americana*) and canvasbacks (*A. valisineria*) as well as colonial waterbirds and shorebirds. Uplands characterized by basin big sagebrush (*Artemisia tridentata*), basin wildrye (*Leymus cinerus*), black greasewood (*Sarcobates vermiculatus*), and saltgrass (*Distichlis spicata*) provide habitat for upland-nesting waterfowl as well as passarines. Meadows with perennial grasses such as creeping wildrye (*L. triticoides*), bottle brush squirreltail (*Sitanion hystrix*), basin wildrye, Nevada bluegrass (*Poa nevadensis*), and saltgrass provide nesting cover for waterfowl, shorebirds, and wetland-obligate passarines, as well as foraging areas for Canada geese and sandhill cranes.

METHODS

Within three meadows (Big Sage [BS], Oliver Springs [OS], and Skunk Farm [SF] at MNWR, nine 0.24-ha (66 x 36 m) plots were established and randomly assigned to one of the following experimental groups during 1995: Telar®, Escort®, disk, Telar®-disk, Escort®-disk, fire, Telar®-fire, Escort®-fire, and control (untreated). Study plots were predominantly pepperweed interspersed with trace amounts of creeping wildrye, squirreltail, basin wildrye, saltgrass, cheatgrass (*Bromus tectorum*), and forbs (e.g., flix-weed [*Descurainia sophia*]) as well as rushes (*Juncus* spp.) and sedges (*Carex* spp.) in lower (wet) areas.

For all herbicide treatments, Telar® (84g/ha [3 ounce/acre]) or Escort® (28 g/ha [1 ounce/acre]) were mixed with Sylgard® 309 (silicon based nonionic surfactant at 0.24 liters per 379 liters [0.5 pints per 100 gallons] of spray solution [0.063 percent solution]) and applied by a tractor-mounted broadcast sprayer on days with windspeeds $\leq$8 km/hr, and no precipitation 24 hrs before or after treatment. All herbicide treatments were applied either during bud development before flowering (OS and SF; June 13 and 15) or at the start of flowering (BS; July 5). The disk treatment application consisted of early (July 11) followed by late summer (August 23) diskings with a 4.3-m disk (91.4 cm blades) to produce a smooth soil surface for germination of the soil seed bank. Early summer (June 13 to July 5) application of Escort® and Telar® followed by late summer (August 23) disking was used for both herbicide-disk treatments. For both herbicide-fire treatments, herbicides were sprayed in early summer (June 13 to July 5) and then vegetation was cut to a height of 10 cm with a tractor-propelled brush mower 1 week before burning (October 17) to increase fire heat at the soil surface for pepperweed control. For fire only treatments, plots were similarly mowed 1 week before the fall burn (October 17). All burns were accomplished with back fires ignited by drip torches.

Fire behavior and vegetative response to treatments were assessed from within a central core area (0.18-ha; 60 x 30 m) within each plot. Core areas were used to minimize the effect of unevenly treated edges of plots.

Pre- and post-burn herbaceous fuels were measured by collecting all material in 10 sampling frames (1 m^2) randomly located throughout the core area of each plot treated with fire. Fuels collected in these plots were partitioned into the following categories: live grass/forb, dead grass/forb, live pepperweed, and dead pepperweed. In the laboratory, fuel samples were weighed (g), oven dried to constant weight for 48 hrs at 70° C, and then weighed again to determine moisture content and dry weight (DW). Fuel consumption by fire for each plot was calculated as the difference between the average biomass of all fuel types pre- and post-burn.

To determine pepperweed control and the vegetative response associated with IPM techniques, the core area within each plot was sampled during late May/early June 1995 (pre-treatment) and in 1996 (1-year post treatment). Each plot was divided in half within which four transects (30-m) were randomly located in each half of the core area. Pepperweed density (plant/m^2) and basal cover (%) of live plant species, bare ground, and residual plant material were determined with 0.35m^2 (1.0 x 0.35 m) rectangular and 50-point (4 cm between points; Bonham 1989) frames, respectively, placed at five equal (6 m) intervals along each transect. Because transects were considered samples, pepperweed density and cover values were averages of values from the five frames along each transect.

RESULTS AND DISCUSSION

A lack of adequate fuels (forbs and grasses) available at OS and SF resulted in unsuccessful burns at these meadows. Approximately 50 percent more pre-burn biomass (fuel) was present at BS compared with OS and SF (69, 48, and 46 g/m^2 DW, respectively). Moreover, BS had a greater proportion of its pre-burn biomass associated with live grass/forb (55 percent) compared with OS (8 percent) and SF (15 percent). In contrast, BS had a smaller proportion of its pre-burn biomass associated with live and dead pepperweed (15 percent) compared with OS (62 percent) and SF (56 percent). Plots with fire treatments at all meadows had approximately the same proportion of pre-burn biomass for dead grasses and forbs (30 percent). At BS, fuels consumed by burns were 94, 92, and 82 percent for Telar®-fire, Escort®-fire, and fire treatments, respectively.

After one post-treatment year, Telar® and Escort® alone and in combination with disking or fire reduced pepperweed densities by >90 percent. For the herbicide only treatments, Telar® reduced pepperweed densities 100 percent in all three meadows; whereas Escort® control ranged from 90 (BS) to 100 percent (OS). Similarly, the Telar®-disk treatment had better control compared with Escort®-disk; pepperweed densities were reduced 100 percent for Telar®-disk at all three meadows compared with 98 (SK) to 99 percent (BS and OS) for Escort®-disk. For the herbicide-fire treatments at BS, the Telar®- and Escort®-fire plots had 100 and 97 percent reductions in pepperweed densities, respectively. In contrast with treatments involving herbicides that consistently controlled pepperweed, the disk treatment only slightly decreased (32 [SF] to 46 percent [BS]) or increased (2 percent [OS]) pepperweed densities after one post-treatment year.

After one post-treatment year, Telar® and Escort® alone and in combination with fire generally reduced cover of forbs and increased cover of grasses. Although forb cover at BS increased for Telar® (=46 percent) and Escort® (=27 percent) plots, it decreased (>91 percent) for these herbicide treatments at OS and SK. In contrast, grass cover increased for Telar® (=86 [OS] to =191 percent [BS]) and Escort® (=34 [SF] to =229 percent [OS]) treatments. Similarly, grass cover increased for fire alone (=22 percent) and in combination with Telar® (=91 percent) and Escort® (=145 percent) at BS. Although forb cover increased for the Telar®-fire plot (=317 percent), it decreased for fire only (-13 percent) and Escort®-fire (-43 percent) treatments.

Plots for Telar® and Escort® alone (all three meadows) and in combination with fire (BS only) were predominantly covered with creeping wildrye, as well as rushes and sedges in lower areas; however, the creeping wildrye on the Telar®- and Escort®-fire treatments was at least twice as tall compared with Telar® and Escort® plots. The vigorous stands of creeping wildrye on the Telar®- and Escort®-fire plots likely resulted from release of nutrients and/or stimulation of rhizome buds associated with burns. Although creeping wildrye was prevalent on the fire plot, its stand was not as vigorous as those for herbicide-fire treatments and resembled those for the Telar® and Escort® plots at BS.

Disking alone and in combination with herbicides reduced cover of forbs and grasses after one post-treatment year. For disk only plots, forb and grass cover decreased 46 (SF) to 97 percent (OS) and 13 (SF) to 100 percent (BS), respectively. Forb and grass cover decreases were larger for Telar®-disk treatments compared with disk plots where declines after one post-treatment year ranged from 94 (BS) to 100 percent (OS) and 60 (SF) to 100 percent (BS), respectively. Forb and grass cover also decreased for Escort®-disk treatments, where declines ranged from 71 (OS) to 100% (BS) and 49 (OS) to 100% (BS), respectively. Telar®- and Escort®-disk plots at all three meadows were characterized by bare ground with patches of cheatgrass and Canada thistle (*Cirsium arvense*), except those at BS with almost no vegetation. Alkaline soils as indicated by salt deposits, likely prevented plant establishment after treatments for these BS plots.

PRELIMINARY CONCLUSIONS

After one post-treatment year, Telar® and Escort® treatments alone and in combination with disking or fire reduced pepperweed densities, where all Telar® treatments appeared to result in slightly better control. Reductions in forb cover for Telar® and Escort® treatments likely were in response to herbicide applications. Herbicide-disk treatments reduced cover of native forbs and grasses and resulted in the establishment of undesirable, exotic species (cheatgrass and Canada thistle). Telar®- and Escort®-fire plots had more vigorous stands of native grasses, mostly creeping wildrye, compared with herbicide, only treatments at BS. Burns could not be conducted for OS and SF plots because adequate amounts of grasses and forbs were not present to carry a fire.

At this time, we cannot definitively determine which treatment will offer the best control and/or be the most cost effective method to restore pepperweed-infested habitats on MNWR. An additional 1 to 2 years of data collection will be needed to determine whether a longer period between control efforts is associated with Telar® as opposed to Escort® treatments in order to justify its higher cost ($151.34/ha [$0.72/g x 210.2 g/ha]) compared with Escort® ($51.87/ha [$0.74/g x 70.1 g/ha]). Field tests with two application rates for Telar® (28/ha [label minimum] and 84 g/ha [label maximum]) and one Escort® rate (28/ha) conducted at MNWR by Ron Crockett (Monsanto Agricultural Company) will provide additional insight regarding cost-effective measures to control pepperweed.

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