Interim Medusahead Management Guide for the Intermountain West

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Summary

Medusahead is an exotic annual grass that is decreasing livestock forage production, increasing wildfire frequency, and reducing biodiversity in sagebrush rangelands. The spread of medusahead should be reduced by treating infestations along roads, increasing or maintaining high perennial bunchgrass abundance, and monitoring for and eradicating small medusahead populations. The best control of medusahead is achieved with prescribed burning followed by a fall application of a pre-emergent herbicide. Seeding crested wheatgrass and squirreltail one year after application of a pre-emergent herbicide has been successfully used to revegetate medusahead-invaded sagebrush plant communities. Additional research is needed to determine if native plants can be established and effectively resist re-invasion after medusahead control.

Introduction


Figure 1. Photograph of medusahead seedheads.

Medusahead (*Taeniatherum caput-medusae* (L.) Nevski) (Fig. 1) is an exotic annual grass that has invaded millions of acres in Oregon, Idaho, California, Utah, Washington, and Nevada. It is native to the Mediterranean region of Eurasia and is well-adapted to the climate of the Intermountain West. Medusahead invasion often results in near-monocultures of medusahead (George 1992; Davies and Svejcar 2008), a vegetation change that decreases biodiversity, degrades wildlife habitat, reduces livestock forage production and increases fine fuel loads in sagebrush plant communities (Davies and Svejcar 2008; Davies IN PRESS). Medusahead is extremely competitive with native vegetation (Hironaka and Sindelar 1975; Goebel et al. 1988; James et al. 2008; Young and Mangold 2008), especially on heavy, clayey soils, and has even displaced cheatgrass in some areas (Young 1992; Miller et al. 1999). It often germinates in the fall and has the ability for root growth at low temperatures during winter and early spring and is therefore able to capitalize on and deplete soil moisture while most desirable perennial grasses are in a dormant state (Hironaka 1961). Invasion by medusahead frequently results in the formation of a dense layer of litter that decomposes slowly because of high silica content (Bovey et al. 1961; Young 1992). The resulting highly persistent thatch layer suppresses native plant growth (Bovey et al. 1961; Harris 1965), while promoting the germination of medusahead seed (Young 1992). An accumulation of medusahead litter also increases the amount and continuity of fine fuel, which can increase the frequency of wildfires to the detriment of native vegetation (Torell et al. 1961; Davies and Svejcar 2008). An increase in the frequency of fire not only escalates the risk of mortality for desirable vegetation; it also increases soil resource availability which promotes continued medusahead dominance of the plant community. Similarly to other exotic annual grasses, revegetation of medusahead-invaded plant communities is expensive and often unsuccessful because seeded vegetation rarely establishes (Young 1992; Monaco et al. 2005).

This interim management guide is designed to provide land managers with information about what conditions allow medusahead invasion, methods to prevent medusahead spread, and strategies to revegetate medusahead-invaded plant communities. The purpose of this management guide is to provide scientifically tested solutions to the medusahead problem in the Intermountain West.

Conditions that Allow Medusahead Invasion (Site Susceptibility)

Sagebrush plant communities with high soil clay content, including those with high shrink and swell potential, are especially susceptible to medusahead invasion (Young 1992; Miller et al. 1999; Young et al. 1999). Although medusahead is perhaps most problematic on clay soils, it also appears to be able to invade loamy soils (Miller 1996). Well-drained, coarser textured (sandy) soils, however, appear to be less susceptible to invasion (Horton 1991). Medusahead is especially competitive where precipitation comes in the cool season and the hot season is relatively dry (Major et al. 1960), a climate pattern largely characteristic of the Intermountain West. It is also has a competitive advantage over most native species in areas where extra moisture accumulates from topography or high soil clay content near the soil surface (Dahl and Tisdale 1975).

Recently disturbed plant communities are highly susceptible to invasion by medusahead. Increases in soil nutrient concentrations frequently associated with disturbances tend to favor exotic annual grasses over native perennial bunchgrasses (Vasquez et al. 2008). Medusahead overlaps in its spatial and temporal use of soil nutrients more with perennial bunchgrasses than other plant functional groups (James et al. 2008). Therefore, established perennial bunchgrasses are the most important component of the plant community for competing with medusahead and, as such, reductions in their density tend to increase the susceptibility of a site to invasion (Davies 2008). An increase of one perennial bunchgrass per yard squared resulted in an approximate 15-20% decline in medusahead establishment (Davies 2008). However, medusahead is able to establish and persist even in diverse native plant communities (Miller 1996).

Prevention Medusahead Spread

Preventing the spread of medusahead is important because once medusahead has invaded a plant community it very difficult and expensive to control. Additionally, some of the impacts of medusahead invasion may be irreversible. For example, many native plant species displaced by medusahead may not be available for restoration projects (Davies and Svejcar 2008). Thus, prevention is a critical component of a successful management plan for addressing the medusahead problem. The following three strategies should be used for preventing the continued spread of medusahead: 1) limit medusahead seed from dispersing to non-invaded areas; 2) reduce site availability (available space and resources) for medusahead; and 3) detect and eradicate new medusahead infestations.

Limit Seed Dispersal

The majority of medusahead seeds disperse within the existing infestation or within a few yards of the edge of the infestation (Davies 2008). Therefore, controlling medusahead at the edges of infestations can greatly reduce the spread of medusahead into non-invaded plant communities. Sheley et al. (1999) suggested that applying herbicides around the perimeter of invasive plant infestations could reduce the amount of seed dispersing into the adjacent non-invaded plant community. Using a pre-emergent herbicide compare to a non-selective contact herbicide around the perimeter would reduce medusahead and other annuals, but not negatively impact perennial vegetation. Consequently, in situations where it is not feasible to treat a large medusahead infestation, focusing treatments around the perimeter of established infestations will help reduce the rate of spread. Establishing competitive bunchgrasses at the edge of medusahead infestations is another method to reduce the spread on medusahead into adjacent non-invaded plant communities. For example, Davies et al. (2010) found that seeding a 6 m wide area with crested wheatgrass (*Agropyron desertorum* (Fisch. ex Link) Schult) resulted in a 40-fold decrease in the establishment of medusahead in the non-invaded areas.

Medusahead seeds are spread longer distances by vehicle and animals, therefore, limiting the contact of medusahead with these vectors is important. Davies and Johnson (2008) and Davies (2008) suggested that animals and vehicles should be excluded from infestations when exotic annual grass seeds could be dispersed. Either closing or creating a medusahead control zone along roads that intersect medusahead infestations would markedly decrease its spread. When clay soils are moist, the soil along with imbedded medusahead seeds can stick to vehicles and be transported great distances. Thus, controlling medusahead along unimproved roads is critical to reducing the spread of medusahead. Moving livestock out of areas with invasive annual grass infestations prior to seed set may also limit their spread. Care should be taken to not move cattle directly from medusahead-invaded rangeland pastures to rangelands without medusahead.

Reduce Site Availability

Medusahead seeds that disperse into non-invaded plant communities must establish and persist to become a problem. Thus, decreasing the likelihood that dispersing medusahead seeds will find a suitable site to establish and persist will decrease the spread of medusahead. Although maintaining high functional plant group diversity maintains low resource availability both temporally and spatially (Davies et al. 2007), not all functional groups contribute equally to invasion resistance. Perennial grasses have been found to be the most important functional group for reducing site availability for medusahead (Davies 2008; James et al. 2008). Perennial bunchgrasses are major consumers of soil nutrients (James et al. 2008) and accordingly, the ability of medusahead to establish in sagebrush plant communities is greatly decreased as the density of perennial grasses increases (Davies 2008). In plant communities highly susceptible to invasion, resistance can be increased by establishing perennial grasses in the existing plant communities. Davies et al. (2010) found that establishing crested wheatgrass in plant communities increased their resistance to medusahead invasion.

Proper grazing management of native plant communities is required to minimize site availability for medusahead. Over-grazing by livestock can reduced the ability of native plants communities to resist exotic annual grass invasion (Daubenmire 1970, Mack 1981, Knapp 1996). However, grazing elimination does not prevent invasion. Exotic annual grasses have been found in plant communities that have not been grazed by domestic livestock (Svejcar and Tausch 1991, Davies et al. 2006). Over-grazing decreases the resistance of plant communities to exotic annual grass invasion; however, completely eliminating grazing can also promote annual grass invasion. Long-term elimination of livestock grazing allows fine fuels to accumulate to the point that perennial bunchgrass mortality during fires will be high because of elevated fire temperatures from the additional fuels (Davies et al. 2009). High perennial grass mortality opens up sites for exotic annual grass invasion (Davies et al. 2009). Areas that experienced moderate levels of grazed (~40% utilization with some years of rest and deferred use), in contrast to non-grazed areas, often have an increase in perennial grasses following fire and are not as likely to be invaded by exotic annual grasses (Davies et al. 2009). Sheley et al. (2008) also demonstrated that proper grazing management could increase the ability of crested wheatgrass to exclude medusahead from plant communities. Thus, it is critical to manage grazing and other disturbances to minimize adverse impacts to perennial bunchgrasses that would increase the risk of medusahead invasion.

Detecting and Eradicating Small Infestations

Early detection and eradication of small infestations is critical to reducing the spread of medusahead. This is important because uncontrollable events may lead to new invasions despite efforts directed at limiting seed dispersal and site availability. If small infestations are not eradicated, medusahead gains a foothold. This increases medusahead seed availability and subsequently increases the risk that the surrounding non-invaded plant communities will be invaded. Early detection and eradication of small infestations has been demonstrated to be more successful at limiting the spread of invasive species than trying to control large infestations (Moody and Mack 1988; Smith et al. 1999).

Strategic inventorying and monitoring rangelands are critical for detection of new medusahead infestations. Prioritizing efforts by potential risk can greatly decrease the cost of inventorying. Because long-distance dispersal of medusahead is mainly by vehicles and animals, searching along roads and trails should receive top priority. Without vehicles or animal transport, most medusahead seeds disperse relatively short (< 2 yards) distances (Davies 2008); thus, searching more intensely near established infestations would strategically limit the amount of resources expended. Areas that have been recently disturbed or have high site availability because of low large perennial bunchgrass densities (< 3 per yard) should also receive high priority because only a few medusahead seeds would be needed to establish a successful infestation.

The goal of early detection and eradication of small medusahead infestations is to protect much larger areas from invasion. Expensive and often intensive efforts may be needed to eradicate small infestations, but are justified by the larger area protected from medusahead invasion. A critical and potentially overlooked element of eradication is that treatments may need to be applied more than once. Original treatments to eradicate medusahead should be monitored and reapplied as necessary to ensure that the medusahead does not re-occupy the site from the seed bank. Care should also be taken to prevent other invasive plants from occupying the sites made available when eradicating medusahead.

Revegetation (rehabilitation)

Revegetation of medusahead-invaded plant communities is needed to provide forage for livestock and habitat for wildlife. Integrated burning and herbicide treatments often improve medusahead control compared to individual treatments. For example, the control of medusahead with imazapic has been improved when the infestation is first treated with a prescribed burned (Monaco et al. 2005; Kyser et al. 2007; Sheley et al. 2007; Davies and Sheley 2011). However, rehabilitation of medusahead invaded sagebrush plant communities has frequently failed because seeded vegetation often does not establish after medusahead control (Young 1992; Monaco et al. 2005; Sheley et al. 2007). Because of the difficulty with establishing seeded vegetation after medusahead control, Davies and Sheley (2011) suggested that medusahead infestations with residual native perennial vegetation should receive priority for control treatments. Prescribed spring or fall burning followed by fall imazapic application provided the best control of medusahead and promoted residual perennial vegetation (Davies and Sheley 2011). Treatments that control medusahead, especially in plant communities which still have native plant functional groups, can greatly increase biodiversity. For example, spring burning followed by fall applications of imazapic doubled plant species diversity (Davies and Sheley 2011).

Infestations lacking enough residual desirable vegetation (~3 large perennial bunchgrasses and 3 perennial forbs per yard^2) to reoccupy the site after medusahead control will need to be seeded in order to establish a productive, re-invasion resistant plant community. Recent work has demonstrated that medusahead infestations can be controlled and perennial bunchgrasses successfully established with a prescribed burn treatment followed by a fall application of pre-emergent herbicide such as imazapic (Fig. 2). Davies (2010) reported that spring or fall prescribed burning followed by a fall application of imazapic (6 oz per acre) and a drill-seeding of perennial bunchgrasses (crested wheatgrass and squirreltail [*Elymus elymoides*

(Raf.)]) at 18 lbs per acre the next fall successfully controlled medusahead and established a perennial bunchgrass-dominated plant community. Imazapic was applied in mid-October as soon as the prescribed burns were completed and before emergence of medusahead. Perennial bunchgrasses were seeded one year after imazapic application to reduce the likelihood of perennial bunchgrass seedling mortality from imazapic. These treatments produced perennial grass densities that were 7- to 10-fold greater than untreated medusahead communities. Where possible, burning should be applied to reduce the medusahead litter to improve herbicide contact with the soil, improve the seedbed for seeded species, and minimize favorable conditions for medusahead germination and establishment. If burning cannot be implemented because of logistical or liability issues, other management actions, such has heavy grazing or mechanical treatments, should be implemented to reduce medusahead thatch prior to the application of pre-emergent herbicides. Pre-emergent herbicide application should occur early in the fall before medusahead begins growth. If medusahead growth has already begun, successful control is less likely and will require that either a surfactant and/or a contact herbicide (e.g. glyophate) be applied with the pre-emergent herbicide.

Individual treatments appear to be less effective than treatments applied in combination. For instance, Davies (2010) found that imazapic application without a prior burning treatment controlled medusahead initially, but the density of desired species remained the same because seeded species did not establish. Burning probably provided a favorable seedbed for perennial bunchgrass establishment by removing medusahead litter and increasing soil nutrients, as well as, improving the effectiveness of the imazapic application by increasing herbicide contact with the target. Perennial bunchgrass cover did increase following the application of imazapic without first burning, but without an increase in perennial bunchgrass density treatment longevity is doubtful (Davies 2010). Similarly, prescribed burning without imazapic application is not an effective treatment for controlling medusahead or promoting seeded bunchgrasses in the Intermountain West (Kyser et al 2008; Davies 2010).

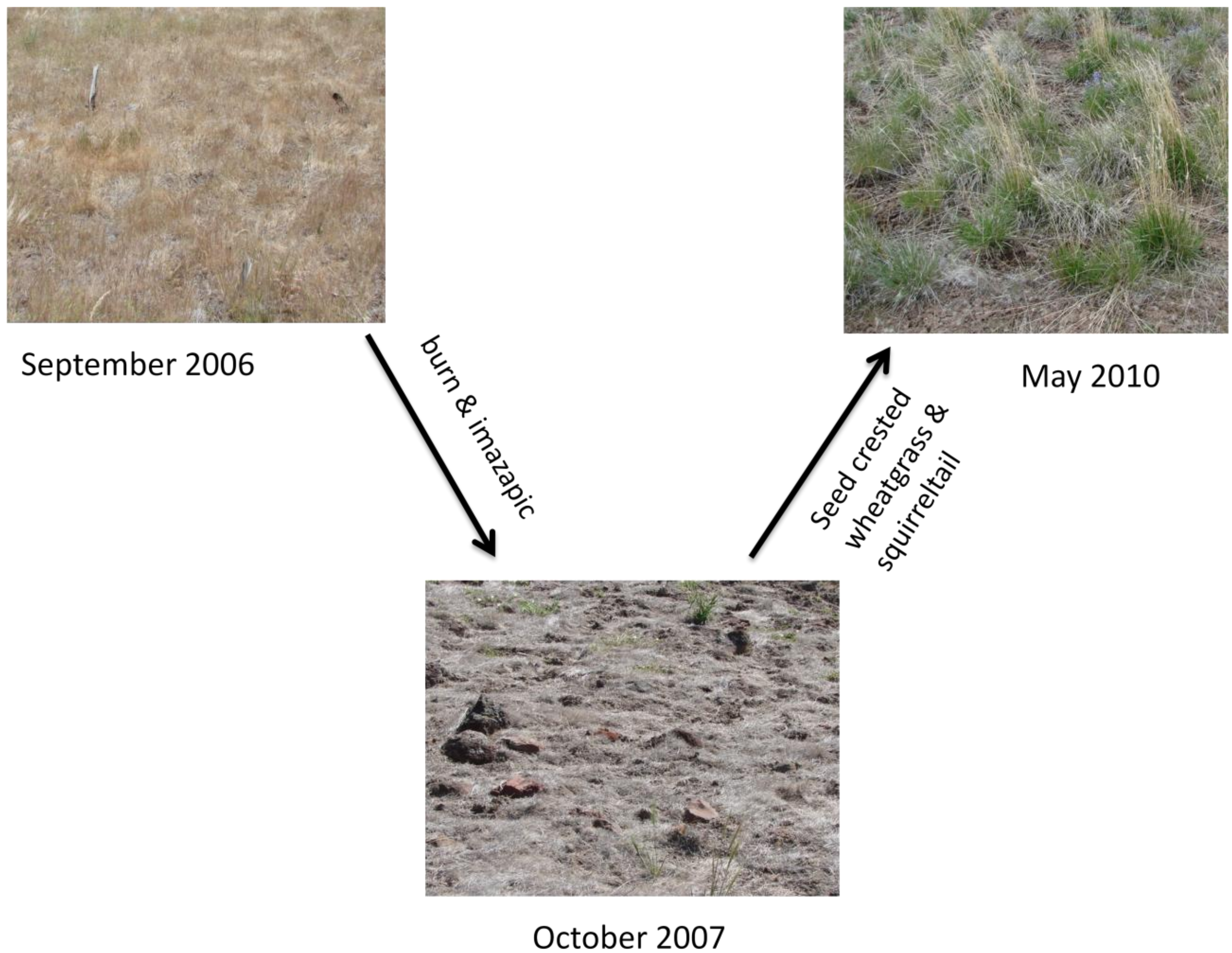

Figure 2. Example of management to revegetate medusahead-invaded sagebrush plant communities.

Revegetation vs. Restoration

Restoration of medusahead-invaded plant communities requires establishing the native plant community, while revegetation only requires establishing a functioning plant community that can be comprised of native, introduced (non-native), or a combination of native and introduced plants. Limited information exists to evaluate the effectiveness of restoration compared to revegetation of medusahead-invaded sagebrush steppe plant communities. However, restoration will be more expensive because of the need to use native plant species. Native bunchgrass seeds are often 5- to >10-fold more expensive than introduced perennial bunchgrass seeds. Furthermore, introduced plant species that could be used for revegetation efforts are often more competitive and thus, may provide better long-term resistance to medusahead re-invasion. Introduced perennial bunchgrasses also generally establish better than natives (Boyd and Davies 2010). Studies have recently been implemented to evaluate the effectiveness of native perennial bunchgrass/sagebrush compared to non-native plant communities to establish and resist medusahead re-invasion, but it is too early to obtain definitive results.

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