

Ecology and Management of Rush Skeletonweed (*Chondrilla juncea* L.)

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Figure 1. The rush skeletonweed population (foreground) is part of a several thousand acre infestation in Idaho. Photo by Brad J. Gamett, Butte County Weed Department, Idaho, used with permission.

Abstract

Rush skeletonweed, a member of the sunflower family (Asteraceae), is an herbaceous perennial with a rosette very similar to that of dandelion. The downward pointing, stiff hairs on the lower four to six inches of the flowering stem are a good identifying feature. It reproduces by seed and root sprouts. One flower stem 1.6 to 3.3 feet (50 to 100 centimeters) tall bearing small yellow flowerheads is produced per rosette in early summer. Each flower is capable of producing nine to 12 seeds and plants can produce 1,500 or more seeds that are fully developed 13 to 15 days after flowering. Plants five to seven weeks old or older are capable of vegetative reproduction from root buds.

Native to Asia, the Mediterranean, and North Africa, rush skeletonweed was first found in a Sanders County tree plantation in 1987 and has subsequently been reported from Flathead, Lincoln, Sanders, and Treasure counties in Montana. Rush skeletonweed occupies about 700 acres in northwestern Montana. A new population in southern Ravalli County was reported in 2006. And in 2007, an invasion was detected in eastern Montana along a highway in Treasure County. Establishment is most likely on disturbed sites, particularly those affected by wildfire and cheatgrass invasion. Populations are found most often on low-nutrient, coarse-textured soils in open forest types and shrub-steppe plant communities. Rush skeletonweed is a problem in wheat and grain fields and rangelands where it reduces yields and forage production (see Figure 1).

Because it is a relatively new invader in Montana, herbicides are most commonly recommended for rush skeletonweed control. Herbicides most effective for root kill are picloram, clopyralid, aminopyralid, and dicamba. Hand pulling several times each growing season might be effective on newly established populations. Large infestations that cannot be eradicated should be grazed to prevent flowering and seed production. Cattle will graze early flowering plants, horses will graze plants in the vegetative stage, and sheep will graze plants in the rosette to flowering stage. Biological control agents are effective in certain locations. Preventing large-scale disturbance and maintaining a competitive plant community are important to prevent invasion and to reduce spread. Ecosystem management to prevent invasion includes early control of cheatgrass, since primary invasions of cheatgrass drive both secondary invasions of rush skeletonweed and the cheatgrass-wildfire cycle, which promotes additional expansion of rush skeletonweed.



Figure 2. The rosette, inflorescence, flower, and seed of rush skeletonweed. Diagram or Graphic; Britton, N.L., and A. Brown. 1913. An illustrated flora of the northern United States, Canada, and the British possessions. Vol. 3: 314. Available from USDA PLANTS Database.

PLANT BIOLOGY

Identification

Rush skeletonweed forms a rosette of prostrate, glabrous (without hairs) leaves 1.6 to 24.7 inches (4-12 centimeters) long, 0.6 to 1.8 inches (1.5 to 4.5 centimeters) wide, and oblanceolate in shape (see Figure 2). The leaf margins are deeply and irregularly toothed with lobes pointing backwards toward the leaf base (runcinate) similar to the rosette leaves of dandelion (*Taraxacum* spp). The leaf base narrows to a short, winged petiole. One flowering stem grows per rosette. These stems reach heights of 1.6 to 3.3 feet (50-100 centimeters) and have numerous spreading or ascending branches (see Figure 3). They are glabrous except for short, rigid, downward-pointing hairs near the base, similar to prickly lettuce (*Lactuca serriola*). Generally the stems are leafless, but they may have long-linear, bract-like leaves, or leaves similar to the rosette leaves but smaller and only on the lower part of the stem. The rosette leaves die at flowering leaving a skeleton-like stem.



Figure 3. Rush skeletonweed rosette and flowering stem. Photo from the Ericson Diagnostic Laboratory, University of Idaho, Moscow, Idaho.

The flowerheads (capitula) are solitary or in groups of two to five in the stem branch axils, along the branches, and at the branch ends (see Figure 4). The cylindrical involucre has two rows of bracts; the outer row is very short and crown-like, the inner row has seven to nine linear-lanceolate bracts with either no hairs, sparsely tomentose, or sometimes a row of rigid hairs on

the median line. Each capitulum bears nine to 12 bright yellow, ligulate florets. The florets produce achenes (small fruits) three to four millimeters long and with numerous ribs. At the tip of the achene is a beak five to six millimeters long that bears a pappus of numerous soft bristles (see Figure 5). The pappus facilitates wind dispersal.



Figure 4. Rush skeletonweed flowerhead. Photo by Joseph DiTomaso, University of California, Davis, used with permission.

The taproot of rush skeletonweed is small in diameter but penetrates deep into the soil. Lateral roots are produced along its entire length. Rosettes can grow from adventitious buds at the top of the taproot and along the major lateral roots. The roots are brittle and easily break during cultivation or other soil disturbance. Thick white latex exudes from the leaves, stems and roots of rush skeletonweed when they are broken or cut.



Figure 5. Rush skeletonweed achenes. Photo by Joseph DiTomaso, University of California, Davis, used with permission.

Life History

In its native Eurasian range, rush skeletonweed is described as a biennial. In its invaded ranges in Australia and North and South America it is described as a perennial living up to 20 years. There are also variations in its form. The root system is long-lived, rich in carbohydrate reserves, and adventitious buds on the roots enable a plant to grow year after year. New plants can arise from intact roots or root fragments and local population expansion is mainly by vegetative regeneration. One to several rosettes grows from adventitious root buds of the parent plant usually in autumn (September and October). Plants overwinter as rosettes and begin growth again in the spring (March and April). Rosettes can begin growth in summer if moisture follows drought and rosettes that initiate growth in summer usually flower immediately. Flowering stems elongate from the central growing points of rosettes in April and May. As the flowering stems grow the rosette leaves die leaving nearly leafless plants during the summer. Flower buds form in June and July, and plants bloom in July. The capitulum opens early in the morning and closes before sunset. In hot dry conditions the capitulum will only remain open for a couple of hours. Seeds form without pollination (apomictic). Seeds are fully developed about two weeks after flowering and a small number of seeds have been observed to germinate three days after flowering. Seed production peaks in July and August but can continue into November. Per plant production under field conditions can be as high 10,000, and seed production from dense populations were estimated to be 70,000 per square meter. Flowering stems usually die in October at about the time new rosettes begin to appear; however the timing is variable depending on moisture conditions.

Rush skeletonweed seeds might not develop long-lived seedbanks since seeds display little or no dormancy and only remain viable in the soil for 6 to 18 months. However, an Idaho study found 60% of seeds stored for one year maintained their viability. Seeds have high survival rates (up to 80% viability) and as little as 5 millimeters of rain will stimulate germination. Burial of seeds greater than 25 millimeters in the soil prevents germination. Seedlings may emerge at any time moisture is available and temperatures are above 45° F (7° C), but most germination occurs in the fall. Seedlings require a continuous supply of moisture for three to six weeks to survive desiccation. Seedlings grow slowly in the fall and overwinter as rosettes, but seedling roots grow rapidly. Rosettes developed from seedlings emerged in autumn usually produce a flowering stem the spring following emergence.

Habitat

Rush skeletonweed originated from the Transcaspian region of Eurasia, its native range extending from western Europe and northern Africa to central Asia. It has become widespread in wheat growing regions and rangelands of Idaho, Oregon, and Washington. It is considered an early seral species invading disturbed areas in crop, pasture, and forest lands. It seldom invades intact plant communities. Optimum climatic conditions for rush skeletonweed are cool winters and warm summers without severe drought and with winter and spring precipitation typical of semi-arid and Mediterranean climates. It has been found in areas with annual precipitation ranging from nine to 59 inches (23 to 150 centimeters) and elevation ranging from sea level to 6,000 feet. Summer temperatures of at least 59° F (15° C) are required for flower and seed production. Rush skeletonweed has no absolute requirement for vernalization (cold period) although it accelerates flowering. It is found on a wide range of soil types but is most abundant on sandy and sandy-loam soils. It is a weed of cultivated sites, open areas and disturbances. In Montana it has been found on logging roads and log decking areas, along roads, highways, railroads and power lines, in Christmas tree plantations and backyards, on hillsides and in hay fields. Areas affected by wildfire and pastures weakened by drought, overgrazing, or cheatgrass invasion are susceptible to rush skeletonweed invasion.

Spread

Rush skeletonweed disperses primarily by seed, although root fragments will disperse by cultivation. Seeds are small, light weight, and the persistent pappus enables long-distance wind dispersal in complex spread patterns. The high dispersal rate and complex spread of rush skeletonweed poses sampling problems to land managers because vast areas must be regularly surveyed to detect new populations. Seeds also float in water currents. The ridges of seeds have barbs on them that attach to animals and clothing. Rush skeletonweed seeds also have been found in harvested hay.

Impacts

In Australia, rush skeletonweed is widely recognized as the most serious weed in wheat growing regions where it reduces yields and the wiry flowering stems, or their latex, clog harvesting equipment increasing which increases breakdown and maintenance costs. Infestations reduce forage potential, the stems interfere with livestock grazing, and there have been reports of the stems causing choking when eaten by cattle. Dense infestations reduce native plant diversity. It is good forage for sheep and horses. In Australia, the best fat lambs come from pastures heavily infested with rush skeletonweed.

MANAGEMENT ALTERNATIVES

Integrated Pest Management (IPM)

Rush skeletonweed is in the early phase of invasion in Montana with populations that occupy relatively small areas. Containment and reduction of existing populations, early detection of new populations, along with prevention of invasion are the primary goals for management. Populations are contained predominantly by aggressive use of herbicides followed by persistent monitoring to find plants that regenerate from root sprouts or seed. Containment of rush skeletonweed is difficult due to its long-distance dispersal abilities. Early detection of new populations is achieved by surveillance of regions near existing populations and areas of likely introduction keeping in mind that seeds can be carried considerable distances (up to 5 miles) by the wind. Most of the current populations are on logging disturbances and roads, believed to have spread from neighboring Idaho on logging equipment. However, the most recent known introduction in 2007 is on Interstate 90 in Treasure County and illustrates the potential for this weed to spread along roadsides and become established throughout the state. Additionally, rush skeletonweed is problematic in wheat fields, representing a sizable potential for invasion in Montana. Preventative measures include maintaining clean equipment free of weed seed and root fragments, using certified weed-free seed and forage, and managing disturbance to reduce establishment opportunities.

Herbicide ^{1/}

Rush skeletonweed's ability to regenerate from roots deep in the soil profile along with poor translocation of herbicides to the extensive root system makes this weed difficult to control with chemicals. Successful control using herbicides usually requires frequent reapplication. The poor soil conditions favored by the plant (e.g., dry, coarse, and low in organic matter) also reduce herbicide persistence in the soil. Additionally, the morphology of rush skeletonweed, specifically the lack of leaf area, also reduces herbicide translocation as a result of inadequate retention and adsorption. Translocation can be improved with silicone surfactants and water conditioning agents.

Picloram (one quart product per acre) or picloram combined with 2,4-D (one quart plus one quart per acre) applied to autumn rosettes are the herbicide treatments that give the best root kill. A single application is not likely to kill all root buds and applications in subsequent years will be necessary. Clopyralid, aminopyralid, and dicamba also translocate into the roots. Consult your local Extension agent for the herbicide treatment most effective in your area.

Hand Pulling

Hand pulling and digging can provide control of small populations if plants are pulled several times each year for many years. Hand pulling will stimulate adventitious growth from root buds for the first few years until root reserves are depleted. Six to 10 years of this mechanical control will be needed to eliminate populations.

^{1/} **Any mention of specific products in this publication does not constitute a recommendation by the NRCS. It is a violation of Federal law to use herbicides in a manner inconsistent with their labeling.**

Mowing

Mowing is not an effective control for rush skeletonweed. Rosettes are flat to the ground and missed by the mower blade. Mowing when plants bolt to flower may temporarily reduce seed production but plants will survive to flower again.

Tilling

Root fragments of rush skeletonweed will be spread by tillage and may increase infestation size. Tillage every six to eight weeks may effectively eliminate the weed. Currently in Montana, rush skeletonweed does not occupy sites where tillage is practical.

Irrigation

Irrigation is not recommended as a control by itself because it will stimulate seedling and rosette emergence. Where rush skeletonweed invades irrigated pastures and hayland, carefully planned irrigation management will stimulate the competitiveness of the forage crop and when combined with nutrient, forage harvest, and grazing management practices will help prevent the re-establishment of rush skeletonweed after other control practices are applied.

Fertilization

Rush skeletonweed produces larger and leafier rosettes, but not more rosettes, when nitrogen fertilizer is applied. One study found application of superphosphate (about 125 pounds/acre) reduced rosette densities by an average of 80%, probably due to increased competition from pasture plant species. Rush skeletonweed survival relies on a lack of competition, which is of greater importance than increased nutrient levels. That said, nutrient management of pastures and hayland will stimulate desired plant vigor and reduce the risk of invasion by rush skeletonweed.

Prescribed Burning

A study in Idaho shrub-steppe communities found a nearly six-fold increase in rush skeletonweed rosette emergence where wildfires burned compared to non-burned sites the autumn following the burn. Insulated by the soil, rush skeletonweed roots are protected from killing heat of fire. There was also greater seed germination on fire-affected soil compared to unaffected soil. The disturbance of fire produces conditions favorable to rush skeletonweed invasion and population expansion. Prescribed burning should not be conducted in or near areas where rush skeletonweed has invaded.

Grazing Management

Rush skeletonweed is good forage for sheep because it is palatable and nutritious in the rosette and early bolting stages. Continuous grazing in the spring and summer will keep it in the rosette stage, but it will quickly flower if grazing is discontinued. Continuous grazing of larger populations is a good strategy to prevent flowering and seed production and thus restrict spread to distant sites along wind currents. Most populations in Montana are small and therefore

prescribed grazing as a control may not be practical. However, prescribed grazing is recommended as a preventative management by maintaining a competitive pasture or rangeland plant community.

Biological Control

Three biological control agents have been released to manage rush skeletonweed but they have been successful only in certain locations. The skeletonweed root moth, *Bradyrrhoa gilveolella*, was introduced in Idaho in 2002 but establishment has not been confirmed by 2009. The rush skeletonweed gall midge, *Cystiphora schmidtii*, was first released in California in 1975 and is available for mass collection in California, Idaho, and Oregon. It damages rosettes and flowering stems and reduces seed production. The rush skeletonweed rust fungus, *Puccinia chondrillina*, is the first exotic plant pathogen to succeed as a classical biological control agent in North America by reducing rush skeletonweed to “tolerable levels.” It is readily available for redistribution in California, Idaho, Oregon, and Washington. The effectiveness of biocontrol agents vary depending on local conditions and plant genotype. The rust appears more effective in California and the mite appears to be more important in eastern Washington. Currently, the small size of rush skeletonweed infestations in Montana make biological control unpractical.

Revegetation

Rush skeletonweed is somewhat intolerant of shade and is seldom found on closed forest canopy sites. Disturbance is favorable to rush skeletonweed and removal of natural vegetation provides opportunities for establishment. Revegetation of disturbances is therefore an important measure to provide competition and hinder rush skeletonweed invasion. The use of legumes in crop-pasture rotations has been effective in reducing populations of the weed. Deeply rooted alfalfa is advantageous because it is competitive for deep soil moisture. Alfalfa also increases soil fertility and plant competition to reduce rush skeletonweed populations.

Species selected for re-vegetating disturbed sites and rush skeletonweed infestations should be appropriate for management objectives, adapted to site conditions, and competitive with the weed. Management objectives will determine if forage species or native species are seeded and species mixture components. The environmental conditions of the site, including precipitation, soil texture and depth, slope and aspect, will affect species establishment. On native rangeland, a diversity of perennial grass and forb species that occupy many niches over time and space will most fully utilize available resources and compete effectively with rush skeletonweed. Refer to [Montana Plant Materials Technical Note 46](#), ‘Seeding Rates and Recommended Cultivars,’ and Extension Bulletin EB19 ‘Dryland Pasture Species for Montana and Wyoming’ for seeding rate guidance and re-vegetation species selection. State, area, and field resource specialists can help determine the most appropriate, site-specific species mix and timing of seeding for local conditions.

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