

Field Guide for Managing Rush Skeletonweed in the Southwest



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Rush skeletonweed (*Chondrilla juncea* L.)

Sunflower family (Asteraceae), Lactuceae tribe (Cichorieae)

Rush skeletonweed is an invasive plant in the Southwest that has been listed as a noxious weed in Arizona. This field guide serves as the U.S. Forest Service's recommendations for management of rush skeletonweed in forests, woodlands, and rangelands associated with its Southwestern Region. The Southwestern Region covers Arizona and New Mexico, which together have 11 national forests. The Region also administers 4 national grasslands located in northeastern New Mexico, western Oklahoma, and the Texas panhandle.

Description

Rush skeletonweed (synonyms: skeletonweed, hogbite, gum succory, devil's grass, naked weed) is a wiry-looking perennial that was introduced from Eurasia. Given favorable conditions, the species can spread rapidly and form dense infestations. Thus far, three distinct genotypes have been identified with each genotype differing slightly in the appearance of the rosette leaves and branching. In the rosette stage, rush skeletonweed resembles common dandelion (*Taraxacum officinale*) or chicory (*Cichorium intybus* L.). After bolting, rush skeletonweed can be distinguished by its brown, downward-pointing hairs near the base of the flowering stem.

Growth Characteristics

- Long-lived perennial herbaceous plant; mimics a biennial (overwinters as a rosette).
- Deep and stout taproot; rapidly grows overwinter to a depth of 3 to 7 feet.
- Rosette base with 2 to 5 inch hairless reddish-brown leaves with purplish incised margins and lobes pointing backward toward the leaf base; lobes are so deep the leaf looks nearly pinnate.
- Produces bright green or yellowish, wiry, erectly branching flowering stems in spring; stem has few narrow, linear leaves with entire margins and brown, downward-pointing hairs at its base. Flowering stem

is persistent and becomes increasingly tough as it matures; 16 to 48 inches tall.

- Exudes a white milky substance from cut, broken, or damaged stem, leaf, and root surfaces.
- Small, bright yellow flowers from May until first frost; flowers are located on the end of the branch (terminal) or between the branch and stem (axillary). The flowers may be directly attached to the branch (sessile) or be on short stalks (pedicelled); flowers may also be found in clusters of 2 to 5. Instead of the disk and ray flowers common to other species in the Asteraceae family, rush skeletonweed has only one type of flower (ligulate). Heads have 9 to 12 strap-shaped flowers; each flower has 5 fused petals that have a toothed appearance at the tip.
- Reproduces mainly vegetatively via adventitious buds near the top of the taproot; lateral roots near surface can become rhizome like and also have root buds; dense patches of cloned plants may form in response to damage.
- Seed is asexually produced (15,000 to 20,000 seeds per plant). Seeds are oblong, ribbed achenes with a pappus of numerous soft bristles. Depending on soil conditions, seeds may remain viable from 6 months to more than 8 years. Seed quickly germinates in response to available moisture; seedling mortality rate is high should extremely dry conditions occur immediately after establishment.

Ecology

Impacts/Threats

Rapid spread of rush skeletonweed is potentially high once it is introduced to an area with favorable growth conditions; it is difficult to eradicate once established. The weed diminishes preferred rangeland forage and reduces plant and animal diversity. It also causes lost production in wheat fields, and its persistent flower stems are so tough they can hamper harvest machinery.

Site/Distribution

Rush skeletonweed adapts to a wide range of climate zones and environmental conditions. However, it is limited by the amount of calcium and phosphorous available in the soil. Generally, rush skeletonweed prefers well-drained sand or gravel and does not fare well in waterlogged or heavy clay soils. It also favors areas with 10 to 40 inches of precipitation, preferably with moisture available at the onset of the cool season and in the spring. It can invade roadsides and other transportation corridors, rotational pastures, croplands (especially grain fields), waste areas, and rangelands.

The species is now widespread in western States including Washington, Oregon, Idaho, Montana, and California. An isolated, yet expanding population has been found in the Grand Canyon National Park in Arizona.

Spread

Although rush skeletonweed produces wind-dispersed seed, it spreads mainly through vegetative propagation that arises from adventitious buds. Root fragments as little as about one-half inch in length can produce new plants even if buried in soil to a depth of 3 feet. Seed or root fragments may be introduced into new areas via transportation corridors such as roadways and train tracks. Rush skeletonweed may also spread through transported hay that is not certified to be weed-free or by attachment of propagules that adhere to the undercarriages of off-road vehicles and road maintenance equipment. The most rapid spread appears to occur at mid-elevation areas.

Invasive Features

While rush skeletonweed is capable of spreading rapidly, it does not typically invade stands of native vegetation in good condition. Open plant communities, drought, and soil disturbance from human or animal activities can increase the likelihood for invasion. The competitiveness of rush skeletonweed is believed to be related to its ability to reproduce vegetatively in response to damage such as severed roots, stems cut near the base, and fire. Once established, grasses are unlikely to outcompete rush skeletonweed for water and nutrients.

Management

Prevention along with early detection are the most cost-effective management actions against this invasive plant. An integrated management strategy that combines several control methods should be implemented to contain, reduce, or eradicate populations of mature rush skeletonweed. As with other perennial weeds that primarily reproduce vegetatively, treatment should involve attacking the extensive root system.

The following action measures should be considered when planning an overall management approach:

- Maintain healthy plant communities and the presence of ground litter to prevent or limit rush skeletonweed infestations. This may involve improving grazing management practices to prevent excessive grazing and the reseeded of disturbed areas with desirable forbs and grasses.
- Use certified weed-free seed and hay; use pellets for horses used in backcountry areas.
- Eradicate new populations of rush skeletonweed as early as possible.
- Detect, report, and map large infestations. Keep annual records of reported infestations.
- Combine cultural, biological, and chemical methods for effective rush skeletonweed control.
- Implement a monitoring and follow-up treatment plan for missed plants and seedlings.

Table 1 summarizes management options for controlling rush skeletonweed under various situations. Further details on these management options follow the table. Choice of individual control method(s) for rush skeletonweed depends on the extent and density of infestation, current land use, and site conditions (weather, accessibility, terrain, other flora and fauna present, etc.). The specific biotype of rush skeletonweed present should also be considered as each one may respond uniquely to different treatments. Other considerations include treatment effectiveness, overall cost, and number of years needed to achieve control. More than one control method will likely be needed for a particular site.

Table 1. Management options*

Site	Physical Control	Cultural Control	Biological Control	Chemical Control
Roadsides, fence lines, or non-crop areas	Cultivation may increase root spread and is not recommended. Repeated mowing is a suppression option along roadways although this will not kill the weed.	Use seed, mulch, and fill materials certified to be weed-free. Avoid driving vehicles and equipment through infested areas; wash if travel through these areas is unavoidable. Educate road crews and others to identify and report infestations.	Several classic biocontrol agents are available for use alone or in combination with herbicide control (see table 2 for recommendations).	Use truck or tractor-mounted spraying equipment to broadcast treat. Wash underneath vehicle after application to prevent spread.
Rangelands, pastures, or riparian corridors	Mowing, tilling, and burning are not recommended as these practices often increase weed density. Where feasible, consider planting competitive legumes, such as alfalfa and clover.	Use seed and forage hay certified to be weed-free; use pellets for horses in backcountry areas. Always evaluate the need to reseed. While grasses will not outcompete established stands of rush skeletonweed, the presence of native vegetation in good condition may deter further invasion.	Several classic biocontrol agents are available for use alone or in combination with herbicide control (see table 2 for recommendations). Moderate, continuous grazing by sheep and goats can reduce rosette formation and seed production. If possible, avoid grazing when rush skeletonweed is in flower or after seed has set. Closely manage grazing to prevent overuse.	In areas difficult to access, an ATV-mounted sprayer or backpack unit may be the most practical application methods. Wash underneath vehicle after application to prevent spread.
Wilderness, other natural areas, and/or small infestations	Hand removal by pulling or digging 2 to 3 times per year for several years may aid in control. Pull when soil is moist; remove all root material; wear gloves for pulling. These methods are most effective on very small populations of newly established plants.	Use seed and forage hay certified to be weed-free; use pellets for horses in backcountry areas. Post signs warning visitors to remove seeds after passing through infested areas; discourage travel through infested areas if possible.	Same as above.	Use backpack or hand-held sprayers. Broadcast spraying with ground methods may be used on thicker stands if allowed. Remove seed from clothing to prevent spread.

* Choice of a particular management option must be in compliance with existing regulations for the land resource.

Physical Control

New rush skeletonweed plants (younger than 5 weeks) have poorly developed roots and are easily killed when uprooted. With the exception of plants less than 5 weeks old, most rush skeletonweed will re-sprout from severed roots in previously weeded areas; therefore, removal of young plants as early as possible is critical.

Manual Methods

Hand removal –Hand pulling, hoeing, or digging can be effective for smaller, isolated infestations of rush

skeletonweed if repeated 2 to 3 times per year over a number of years (3 to 10). Removal is easier when the soil is moist and plants are beginning to bolt (but before seed set). While it is very important to pull up all parts of the plant (especially roots), it is unlikely that all root fragments will be removed.

It is recommended that treated areas be continually monitored (about every 2 weeks) to find and remove newly emerged weeds. Wear gloves and properly dispose of debris by burning in a very hot fire or by bagging and burying in a landfill to prevent spread.

Mechanical Methods

Most mechanical control methods for rush skeletonweed have limited effectiveness, especially in areas where the weed has become well established. Cultivation practices that do not eliminate the root system may lead to further spread and an increase in weed density. However, mechanical control may be helpful as part of an integrated management plan.

Tillage – Cultivation or tillage is not recommended for rush skeletonweed. Shallow disking should especially be avoided since deeply growing severed roots will quickly regenerate new stems and plants.

Mowing – Mowing is generally not recommended. Since rush skeletonweed has such a deep and extensive root system, mowing does not significantly impact nutrient reserves and may contribute to an increase in population density. However, repeated mowing before seed set is sometimes used along roadways for suppression of top growth. Consider repeated mowing along roadsides in combination with herbicides and the use of biocontrol agents. Rust and mites are recommended as biocontrol agents for use in roadside settings (see the “Integrated Control Methods” segment below for further information).

If using mowers to manage rush skeletonweed, the equipment should be cleaned after use to prevent movement of seed and root fragments into un-infested areas.

Prescribed Fire

Burning is not recommended. New plants from roots are quickly produced after fire, which often leads to increased dominance by rush skeletonweed. However, fire may be used to destroy debris.

Cultural Control

Prevention, early detection, and plant removal are critical for preventing rush skeletonweed establishment. Land managers, road crews, and the local public should be educated on identification of rush skeletonweed to help report all suspected infestations. Seed and materials used for mulch, forage, or fill should be certified to be weed-free; pellets may be used for horses in backcountry areas.

Biological Control

Grazing

Rush skeletonweed provides some grazing value in the rosette stage, but it is avoided by most animals after it has reached the bolting stage. Livestock (including cattle, horses, sheep, and goats) and some wildlife will graze rush skeletonweed until the stem becomes tough and woody (lignified); goats will graze later into the season than other livestock. Moderate, continuous grazing by sheep or goats has been found to prevent the weed from sending up a flowering stem during the summer, thus reducing seed production. Grazing should be discouraged wherever plants with flowers are present or when seed has already set. For information on combining grazing with other control methods, see the “Integrated Control Methods” segment below.

Classical Biological Control

Four classical biocontrol agents have been approved for rush skeletonweed control in North America: a gall-forming mite, a midge, a rust fungus, and a root-feeding moth (table 2). In Australia, biocontrol agents are widely used on rush skeletonweed where the weed reportedly has become less of a problem due to this type of management. Biocontrol agents will not eradicate rush skeletonweed, but they will reduce seed production and stunt the weed’s competitive growth. In combination with herbicide application, biocontrol agents have been used successfully in rangeland settings to control rush skeletonweed (see the “Integrated Control Methods” segment below for further information).

Generally, it is recommended that the rust be released in the spring or fall; mites in the summer; and the midge in the spring. It is very important to consult persons familiar with use of these agents before making a release. Following the release of any biocontrol agent, patience and limited interference are recommended.

Organisms (insects, pathogens, etc.) used as biocontrol agents in southwestern States should be adaptable to arid environments and local conditions. Public, tribal, and private land managers may obtain biocontrol agents for release directly from local offices of the USDA Animal and Plant Health Inspection Service (APHIS) when these

Table 2. Classical biocontrol agents approved for rush skeletonweed

Species	Type of Agent	Site of Attack	Impacts	Use/Considerations for Release
<i>Aceria chondrillae</i>	gall-forming mite	shoots; axillary and terminal buds	Highly effective for reducing seed production and killing young plants.	More effective on certain rush skeleton biotypes; dependent on the presence of rosettes to overwinter. Readily available; an APHIS permit is required prior to transport across State lines.
<i>Bradyrrhoa gilveolella</i>	root-feeding moth	stem base and root; buds near root crown	Reduces plant vigor and reproduction; kills young plants and makes larger plants susceptible to fungi.	Limited establishment in Pacific Northwest. Lab-reared in Idaho; an APHIS permit is required prior to transport across State lines.
<i>Cystiphora schmidtii</i>	gall-forming midge	stems and leaves	Causes leaf damage when exiting from galls.	Consider using this and the following two agents together for greater impact. Readily available; an APHIS permit is required prior to transport across State lines.
<i>Puccinia chondrillina</i>	rust fungus	seedlings; whole plant	Kills seedlings; severely stresses host plant causing stunting and desiccation.	Appears to favor areas with higher overnight humidity; has done well in California. Readily available; an APHIS permit is required prior to transport across State lines.

agents are available. Other sources for biocontrol agents include locally developed insectaries or private companies.

A permit must be obtained from APHIS before biocontrol agents can be transported across State lines. Regulations and permit applications (PPQ 526 permit forms) pertaining to interstate shipment of biocontrol agents can be found at https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/permits/regulated-organism-and-soil-permits/sa_apply/ct_plantpest_howtoapply. Although biocontrol agents may be collected and released internally in a given State without an APHIS permit, the State’s department of agriculture or agricultural extension service should be consulted for any regulations relating to movement of these agents within the State.

Chemical Control

All herbicides recommended in table 3 may be considered for rush skeletonweed control. Selective herbicides include picloram, aminopyralid, or aminocyclopyrachlor in combination with chlorsulfuron or metsulfuron. Adding

2,4-D amine with these herbicides when spraying in the spring has provided enhanced control. When mixing the herbicide solution, add an effective surfactant as suggested on the label. Rush skeletonweed has a rubbery stem surface with few leaves, and herbicide uptake can be improved by including a methylated seed oil surfactant such as Dyne-Amic®.

Each herbicide product will have different requirements and restrictions according to the label. Read and understand prior to any application. To prevent resistance in rush skeletonweed as a result of repeated treatments, the label should be consulted for guidelines on rotating herbicide active ingredients. Consult the registrant if you have questions or need further detail.

Herbicide Application

Rush skeletonweed is difficult to control with herbicides, especially after the main stem has bolted and flowering occurs. Spraying should be done in either the spring or more effectively in the fall when the weed is in the rosette stage. The herbicide application is timed to prevent the formation of a flowering stem. It is important that an

Table 3. Herbicide recommendations

Common Chemical Name (active ingredient)	Product Example ¹	Broadcast Treatment (rate per acre)	Spot Treatment (spray solution) ²	Time of Application	Remarks
Picloram ³	Tordon 22K	1–2 quarts; add surfactant as recommended on label.	1–3%	At rosette stage in fall or early spring. Spray mature plants after first frost in the fall.	Restricted use herbicide that is selective although persistent. May be used in combination with 2,4-D ⁴ . At lower rate, may also be used in combination with biocontrol agents. Wait 2 months to reseed perennial grasses.
Aminopyralid	Milestone	5–7 ounces; add surfactant as recommended on label.	5–10%	Same as above.	Residual from late fall treatment of mature plants can be effective in controlling seedling emergence in the spring. May be used in combination with 2,4-D ⁴ . Labeled for use up to water’s edge. No grazing restrictions.
2,4-D amine ⁴	multiple products available	1 gallon; add surfactant as recommended on label.	3%	At rosette stage in spring (before bolt).	2,4-D ⁴ reduces aboveground growth but does not translocate into the extensive root system; thus, plant kill is poor. Combining this herbicide with another herbicide may increase efficacy.
Aminocyclopyrachlor + chlorsulfuron	Perspective	4.75–8 ounces; add surfactant as recommended on label.	Add 5–9 grams of dry flowable powder for each gallon of water.	Most effective on rosettes in late fall after frost.	A selective blend of active ingredients labeled for non-crop use (includes natural areas such as wildlife management areas, wildlife habitats, recreation areas, campgrounds, trailheads, and trails). Persistent; selective for broad-leaved plants; may cause temporary injury to some grass species. May be used on public, private, and tribal lands as part of an early detection and rapid response (EDRR) in treating infestations of invasive weed species.
Aminocyclopyrachlor + metsulfuron methyl	Streamline	4.75–9.5 ounces; add surfactant as recommended on label.	Same as above.	Same as above.	Same as above. May cause temporary injury in some grass species.
Imazapyr	Arsenal	3–4 pints	1%	Any time when plants are growing or in the fall after frost.	Nonselective herbicide used primarily for follow-up spot treatment. In addition to spray drift, nontarget plants may also be killed or injured by imazapyr through runoff, residue movement in soil, or root exudates from treated plants. Use direct spray or a wipe method when desirable plants are present.

¹ Trade names for products are provided for example purposes only, and other products with the same active ingredient(s) may be available. Individual product labels should be examined for specific information and appropriate use with rush skeletonweed.

² Spray solution is the herbicide/water ratio in a spray mix that may be used for spot treatment with backpack or hand-held sprayers. The amount of product applied during an annual growing season must not exceed the maximum application rate per acre as specified by the product label – refer to the product label for the site type and application.

³ Restricted-use pesticide – A certified applicator’s license is required for purchase and use of these pesticides.

⁴ 2,4-D is a restricted use pesticide in New Mexico only.

aggressive plan for re-treatment be followed to achieve long-term success. For example, spraying in the rosette stage early in the spring and again later in the fall (preferably after the first frost) has been shown to be effective in controlling rush skeletonweed. However, spray treatments often need to be repeated for 3 years.

Herbicides may be applied by wipes, backpack or hand-held sprayers, ATV or UTV sprayers, or conventional boom sprayers that are pulled or attached to a tractor or truck. In certain situations where rush skeletonweed is dense and widespread, aerial herbicide application by fixed-wing aircraft or helicopter should be considered. Any equipment used to spray herbicide should be calibrated.

Integrated Control Methods

Biocontrol agents

For heavily infested areas or areas difficult to treat with conventional methods, consider combining classical biocontrol agents with other control methods to reduce further spread. An appropriate biocontrol agent for rush skeletonweed may be used in conjunction with herbicide applications timed to prevent formation of flowering stems. Areas larger than an acre can be sprayed in the spring or fall, which is then followed by release of the biocontrol agent during the following growing season. This approach has been successful in providing long-term control. Other strategies integrated with biocontrol agents that may be considered for management of large infestations of rush skeletonweed include:

- **Mowing–biocontrol–herbicide treatment for roadsides** – For roadsides, mow repeatedly at 2 to 3-week intervals during the growing season. Consider releasing or bolstering biocontrol populations of rust and mites. In the fall or spring, apply herbicide to rush skeletonweed growing in the rosette stage. Typically, it is necessary to visit and re-treat areas later in the season which should be repeated for 1 or 2 years.
- **Grazing–herbicide–biocontrol treatment for rangeland** – For large infestations in a rangeland setting, use a moderate, continuous grazing approach

to maintain plants in rosette form, thus reducing seed production. Apply herbicide to rosettes in the fall that are effective in killing below ground portions. Introduce biocontrol agents or reinforce existing biocontrol populations in the season recommended for release of each particular agent. Midge agents are typically released in spring; mites in summer. Biocontrol agents can attack the plants that remain following herbicide application and further contribute to control.

Management Strategies

Preventive techniques should be practiced where suitable. Planning and treatments to control previously established patches of rush skeletonweed should be designed to meet the needs of each specific site. High priority should be given to eradicating small, isolated patches or satellite populations of rush skeletonweed on otherwise healthy sites, followed by weeds found along transportation corridors such as along railways or roadsides. For widespread infestations of rush skeletonweed, containment may be a more realistic goal than eradication.

When developing a strategy to control rush skeletonweed, consider complementary restoration activities (such as reseeding with native perennial plants) as a way to further limit rush skeletonweed populations. Where feasible, planting legumes such as clover and alfalfa has been shown to be an effective way to provide competition and reduce the density of rush skeletonweed.

Previously treated areas should always be monitored to detect recovering rush skeletonweed. Look for isolated, newly emerged rush skeletonweed plants in the spring and treat with herbicide. Monitor treated plants after 2 to 4 weeks to observe how plants have responded to treatment. If necessary, apply herbicide to plants that did not respond to the first treatment. Evaluate all treated areas in the fall and respray new growth if necessary.

In most cases, several consecutive years of field treatments will be necessary to eliminate or substantially reduce rush skeletonweed. Since it is ordinarily useless to treat an area only one time without retreatment, sufficient resources must be allocated for the area where control is attempted. After

initial treatment, it is important that resources are also available to respray or retreat the treated area successfully.

Adaptive Management

A persistent, coordinated commitment over many years is required for successful control of rush skeletonweed. Therefore, realistic goals and objectives should be established to prevent rush skeletonweed from spreading extensively throughout a given landscape. To improve long-term success, consider using an adaptive management approach with the overall goal of restoring desirable plant communities. The stepwise process for adaptive management involves:

1. Assessment of the overall weed problem,
2. Establishing management goals and objectives,
3. Implementation of control strategies and measures,
4. Monitoring the effectiveness of management actions,
5. Evaluating actual outcomes in relation to expected results, and
6. Adjusting practices as necessary.

Steps of this process should be repeated in sequence as part of a continuous learning cycle that improves management planning and strategy by learning from the outcomes of previous management actions. In general, an adaptive management approach is considered to be successful if:

1. Stakeholders are actively involved and remain committed to the process,
2. Monitoring and assessment are used to adjust and improve management decisions, and
3. Management goals and/or objectives for the resource are being achieved.

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Suggested Web Sites

For information on invasive species:

National Invasive Species Information Center
<http://www.invasivespeciesinfo.gov/>
 Invasive.org
<https://www.invasive.org/species.cfm>

For information about calibrating spray equipment: NMSU Cooperative Extension Service Guide A-613, *Sprayer Calibration*. Available at http://aces.nmsu.edu/pubs/_a/A-613.pdf

Herbicide labels online:

<http://www.cdms.net/>

**For more information or
other field guides, contact:**

USDA Forest Service
Southwestern Region
Forest Health
333 Broadway Blvd., SE
Albuquerque, NM 87102

**Or visit the Southwestern Region's
website for invasive species:**

<http://www.fs.usda.gov/goto/r3/invasivespecies>



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CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides carefully and lawfully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.