Rush Skeletonweed

Chondrilla juncea L.

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Introduction

Rush skeletonweed is an exotic herbaceous biennial or creeping perennial plant indigenous to Central Asia and the Mediterranean region. Introduced into the eastern United States during the 1870s, it has since become troublesome in many western states. Rush skeletonweed is an aggressive plant that infests cropland, rangeland, and other disturbed areas. In particular, rush skeletonweed threatens the productivity of a) cropland (small grains, potatoes) due to an extensive root system that enables it to effectively compete with crops for water and nutrients (especially nitrogen), and because of its strong wiry stems and latex sap that interfere with harvest equipment; and b) rangeland through displacement of native or beneficial species, thereby reducing forage for livestock and wildlife.

Overall acreage infested with rush skeletonweed in the Pacific Northwest (defined here as Washington, Oregon, and Idaho) and California is in the millions and continues to increase, elevating rush skeletonweed to a top priority for many land managers. Rush skeletonweed is designated "noxious" and targeted for intensive control or eradication in the Pacific Northwest as well as California, Colorado, Montana, and Nevada. Arizona and South Dakota have taken action to prohibit the introduction of rush skeletonweed into their states. Curiously, rush skeletonweed is not currently listed by the federal government as a noxious weed.

DISTINGUISHING RUSH SKELETONWEED ROSETTE TRAITS

1. Teeth of leaves curve and point back toward the crown, resembling a dandelion rosette.
2. Leaves are hairless.
3. Leaves contain milky latex sap.

KEY PLANT ID POINTS

1. Yellow flowers.
2. Wiry stems 1–4′ in height.
3. Stem and aerial branches are nearly leafless and skeleton-like.
4. Downward-pointing hairs cover the lower 4–6″ of stem; the upper stem is smooth and hairless.
5. Stems, leaves, and roots contain milky latex sap.
6. Roots have lateral shoots from which new plants develop.

Identification

Rush skeletonweed is a broadleaf plant in the sunflower (*Asteraceae*) family. It occurs as a rosette (Fig. 1A) from fall through early spring after germination and emergence and as a 1–4-foot-(0.3–1.2 m) tall plant during the summer. The rosette leaves are 2–5 inches (5–12 cm) long, ½–2 inches (1–5 cm) wide, hairless, and broader toward the tip than the base. The leaf margins have deep, irregular teeth with lobes that point backward toward the leaf base, similar to the rosette leaves of a dandelion (*Taraxacum officinale,* Weber). The leaves begin to senesce as the flower stem lengthens and completely die back at flowering. The lower 4–6 inches (10–15 cm) of the stem are covered with stiff downward-pointing hairs (Fig. 1B), while the upper stem is relatively hairless. The stem and its many thin aerial branches may produce a few narrow inconspicuous linear leaves, giving the plant a skeleton-like appearance (Fig. 1C). The stems, leaves, and roots of the plant exude a milky white latex sap when cut or broken.

Rush skeletonweed flower heads develop during the summer and bloom into late fall until the first killing frost. The bright yellow flowers (Fig. 1D) are small—less than an inch (2.5 cm) in diameter—and are scattered

Figure 1. A) Rush skeletonweed rosette (Utah State University Archive, Utah State University, UGA 1459571; B) stem and downward-pointing hairs (Richard Old, XID Services, Inc., UGA 5230051); C) plant (Eric Coombs, Oregon Department of Agriculture, UGA 5435900); D) flower, fruit (Steve Dewey, Utah State University, UGA 1459575); and E) seeds (Steve Hurst, USDA NRCS Plants Database, UGA 5306099).

along the stem and at branch tips, either as single flower heads or in 2–5-head clusters. Each flower head has 9–12 ligulate (strap-shaped) florets that resemble petals. Each floret has small teeth across its blunt tip. The fruits of rush skeletonweed are achenes (seeds) that are about 1/8 inch (3 mm) long and ribbed, and turn a dark brown or olive-green when mature (Fig. 1E). The seeds look very similar to those of the dandelion with each having a white pappus attached to a short stalk (Fig. 1D), enabling them to be dispersed by the wind.

Variation

Traits of the 3 most commonly identified morphological variants or biotypes of rush skeletonweed located in the Pacific Northwest are provided in Table 1. Recent studies that use more precise fingerprinting than the original isozyme method indicate the presence of additional genotypes of rush skeletonweed in the United States. Because each biotype reacts differently to environmental conditions and control measures, a better understanding of the biotypes can help identify and improve control measures. Such an extensive genotypic review is, however, outside the scope of this publication.

Similar Species

Numerous species present in the western United States are similar in appearance to rush skeletonweed, especially those in the same family and tribe. To help with identification, the similarities and differences of certain species are briefly discussed and illustrated in Fig. 2.

Growth and Reproduction

A long-lived perennial outside of its native range, rush skeletonweed reproduces both by seed and by vegetative means. It produces seeds without fertilization (an "obligate apomict"), enabling seeds that are dispersed far from the parent plant to evolve in isolation and form genetically distinct biotypes that can adapt to and colonize new areas. While hundreds of biotypes exist worldwide, 3–5 are presently known to exist in the western United States and specifically the Pacific Northwest. The biotypes differ in height, branching, flowering period, and susceptibility to control measures (see Table 1 for 3 biotype comparisons).

Table 1. Rush skeletonweed biotypes.

Biotype	Significant Traits	Maximum Height	Time of Flowering
#1 "Banks" (Banks, ID)	Susceptible to rust fungus, gall midge, and gall mite	3′ (0.9 m) (approximately)	Mid-July to early August
#2 "Washington early-flowering" (Post Falls, ID)	Bushy, compact, extensive branching	2′–4′ (0.6–1.2 m) (depending on source)	Mid-June to mid-July (depending on source)
#3 "Washington late-flowering" (Spokane, WA)	Thick stems, upright, sparsely branched; susceptible to rust fungus, gall midge, and gall mite	4′ (1.2 m) (approximately)	Mid-July to October

A. **Dandelion** (*Taraxacum officinale*)

Similarities:
Rosettes—hairless leaves, lobes opposite, point backward, milky latex sap
Differences:
Stems—hollow, unbranched, leafless, fleshy; Flower heads—larger

B. **Chicory** (*Cichorium intybus*)

Similarities:
Plants—may appear skeleton-like in late season
Differences:
Rosettes—lobes point out/forwards, not always opposite; Basal leaves—scattered, coarse hairs; Flowers—blue; Milky sap—none

C. **Yellow Starthistle** (*Centaurea solstitialis*)

Similarities:
Rosettes—comparable; Flowers—yellow; Plants—somewhat skeleton-like appearance
Differences:
Plants—grayish-green, covered in fine hair; Stems—winged; Flower heads—very long, spiny bracts

D. **Prickly Lettuce** (*Lactuca serriola*)

Similarities:
Plants—stiff hairs at plant base, milky latex sap; Flowers—comparable
Differences:
Hairs—stiff hairs cover entire stem & undersides of leaf margins; Stems—1 main flowering stem, multi-branched upper half

E. **Rush Skeletonplant** (*Lygodesmia juncea*)

Similarities:
Plants—skeleton-like, milky latex sap
Differences:
Native plant; Rosette—no winter rosette; Height—4–16″ (10–40 cm); Flowers—pink

Figure 2. Rush skeletonweed look-alike plant species. A. Dandelion: A1) rosette (Lynn Sosnoskie, University of Georgia, UGA 5140008); A2) plant (Mary Ellen Harte, UGA 5106060); A3) flower (Mary Ellen Harte, UGA 5106061); and A4) seeds (Chris Evans, River to River CWMA, UGA 1380081); B. Chicory: B1) basal leaves (Ohio State Weed Lab Archive, The Ohio State University, UGA 1555189); B2) plant (Joseph M. DiTomaso, University of California-Davis, UGA 5374372); B3) flower (Richard Old, XID Services, Inc., UGA 5230068); and B4) seeds (Ken Chamberlain, The Oho State University, UGA 1553153); C. Yellow Starthistle: C1) rosette (Steve Dewey, Utah State University, UGA 1459671); C2) plant (Charles Turner, USDA Agricultural Research Service, UGA 0022047); C3) flower (Barry Rice, sarracenia.com, UGA 5391594); and C4) fruits (Cindy Roche, UGA 1350005); D. Prickly Lettuce: D1) foliage (Ohio State Weed Lab Archive, The Ohio State University, UGA 1557110); D2) plant (Joseph M. DiTomaso, University of California-Davis, UGA 5374518); D3) flower (Ohio State Weed Lab Archive, The Ohio State University, UGA 1553219); and D4) fruits (Ohio State Weed Lab Archive, The Ohio State University, UGA 1551080); E. Rush Skeletonplant: E1) plant (Pamela B. Trewatha, Missouri State University); E2) plant (Pamela B. Trewatha, Missouri State University); E3) flower (Pamela B. Trewatha, Missouri State University); and E4) seeds (Pamela B. Trewatha, Missouri State University).

An established, vigorous plant growing in favorable field conditions produces on average 20,000 seeds in a single year. While individual flower heads bloom for a mere day, flowering continues until a killing frost. Within 3–15 days of flowering, seeds mature and are dispersed. The rough fruit coat readily adheres to animals, equipment, and other vectors. Seed viability is relatively high, ranging from 60 to 100%. Germination occurs over a wide range of temperatures (7–40°C). Seedlings cannot survive without sufficient soil moisture for 3–6 weeks following germination.

Seed dispersal by the wind accounts for most long-range dispersal of rush skeletonweed; however, most local population increase is due to vegetative regeneration. Rush skeletonweed has a slender taproot that can reach depths of more than 7 feet (2.1 m) and can produce rhizome-like lateral roots. Vegetative spread occurs when daughter rosettes form (usually in the fall) from adventitious buds located near the top of the taproot and along major lateral roots. Plants overwinter as rosettes and grow again in the spring. Vegetative spread also occurs when injury causes root fragments as small as ½ inch (1.3 cm) and as deep as 2 feet (0.6 m) to regenerate. Successful regeneration depends on plant biotype, age, and soil and climatic conditions.

Ecology and Distribution

Rush skeletonweed generally occurs in well-drained, rocky, or sandy-textured soils in climates that are cold in winter, warm in summer, and wet early in the year. In western North America, rush skeletonweed is commonly found along transportation corridors or in areas heavily altered by fire, drought, logging, cultivation, or overgrazing. Rush skeletonweed has become particularly pervasive in Pacific Northwest wheat-growing regions and rangelands. South and central Idaho currently serve as the epicenter of western infestations, with rush skeletonweed spreading outward from these heavily-invaded regions (Fig. 3).

Economic Impact

Rush skeletonweed now occupies approximately 6.2 million acres (2.5 million hectares) of rangeland in the Pacific Northwest and California; 4 million infested acres (1.6 million hectares) are located in Idaho alone after first being discovered there as recently as 1961. While there are no known studies on estimated economic losses in North America from rush skeletonweed, infestations in Australia resulted in reduced grain yields of up to 80%, causing huge shifts of land from wheat production to pasture. Similar losses in small grain yields could occur in the western United States, although to date the weed has predominantly infested rangeland in California and the Pacific Northwest. Reduced forage production of rangeland results in direct losses to the cattle industry. While the losses are real and significant, individual landowners may deem the cost to control large infestations unjustified due to low productivity of the land, leading to further spread of the weed.

Management Strategies

Once rush skeletonweed is well established, it is nearly impossible to eradicate due to its prolific seed production and far-reaching dispersal capabilities, as well as its deep, extensive root system and regenerative capabilities. Successful management of well-established populations of rush skeletonweed requires a sustained and integrated approach using an arsenal of control methods and regular evaluation. The optimal combination and timing of control methods depends on various attributes of the infested area such as size, location, age, density, terrain, soil type, climate, and plant community. After the infested community is inventoried and mapped, a management plan that integrates appropriate control methods (see Table 2) can be determined and set in motion. The highest priority management objectives should be to prevent seed production and frequently monitor for new rush skeletonweed plants to enable rapid and effective response.

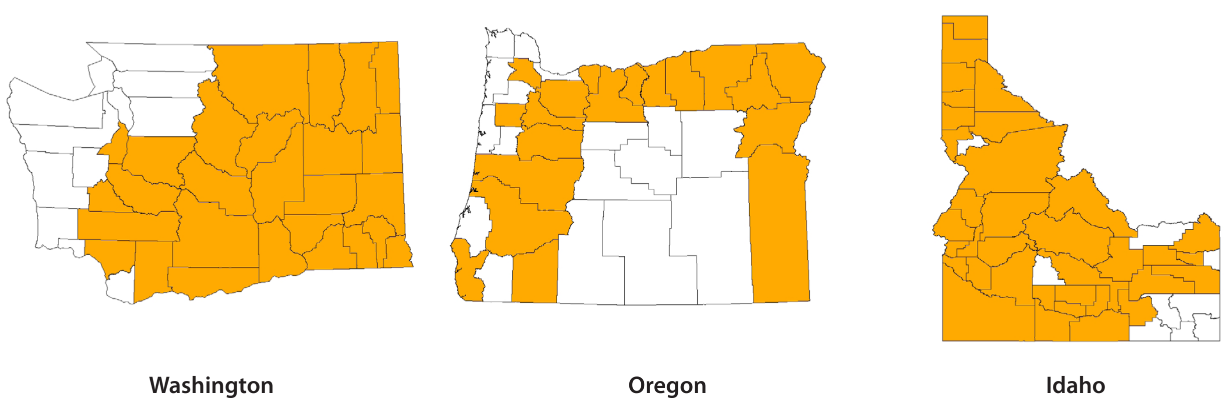


Figure 3. Distribution of rush skeletonweed in the Pacific Northwest states of Washington, Oregon, and Idaho in 2010. (Maps courtesy of the USDA-NRCS Plants Database, updated with current survey information from Greg Haubrich, Washington State Department of Agriculture; Eric Coombs, Oregon State Department of Agriculture; and Stephen Cox, Idaho State Department of Agriculture.)

Table 2. Control options for rush skeletonweed infestations.

Method	Technique/Timing	Advantages	Disadvantages
Hand pulling	Immediately on new infestations and those with plants < 5 weeks old; multiple times throughout growing season	Inexpensive; can eliminate young plants quickly	Time-consuming for well-established populations; requires repeated visits
Mowing	Multiple times throughout growing season prior to seed production	Easy to do on suitable terrain	Requires multiple visits and only before seed production
Cultivation	Immediately on plants < 5 weeks old; multiple times during growing season; on dry soils at depths of 10 inches (25 cm)	Can eliminate young infestations in a single treatment	Established populations can spread via root fragments and require multiple visits; disturbs soil
Grazing	Intensive grazing by cattle, goats, or sheep while plants are young—goats later as well, but all before seed production	Inexpensive, efficient, and provides fodder for livestock; similar to mowing except more selective	Requires continuous grazing, which can damage soil and vegetative community
Herbicides	Treat fall and winter rosettes if possible; spring rosettes in addition or alternatively; consult the *PNW Weed Management Handbook*	Can significantly suppress or kill plants; can provide residual control	Expensive; often requires reapplications; may have non-target effects for several years
Biocontrol	Release rust fungus in spring or fall, mites in summer, gall midges in spring, moths in spring and/or summer	Decreases vigor, reproduction, and biomass; inexpensive; self-perpetuating; best for inaccessible infestations	Slow initial impact

Prevention

Proactive steps can help prevent introduction of rush skeletonweed into noninfested areas. Landowners should

- Limit or avoid motorized vehicle driving through infested areas—particularly during flowering and seeding.
- Clean contaminated equipment before leaving infested areas or before entering uninfested areas.
- Manage for or maintain healthy plant communities.
- Quarantine livestock that have fed on weed-infested forage for 7 or more days to allow pass-through of weed seeds before moving to infested areas.
- Use weed-free seed, soil, gravel, rock, hay, manure, and feed.
- Limit soil disturbances and seed disturbed ground with desirable plant species.

Early Detection and Rapid Response

Early detection and rapid response is an approach to weed control that emphasizes the control of new invasive weeds while populations are localized and still small enough (usually less than 2.5 acres [1 hectare]) to contain and/or eradicate. Detecting new populations of rush skeletonweed begins with regular monitoring. Once a new infestation of rush skeletonweed is verified, landowners should notify their local Extension office or noxious weed control district. A concentrated effort should then be made to eradicate the weed prior to flowering using one or more of the control options described in Table 2. Biological control should be considered for infestations where other methods are unfeasible.

Physical and Mechanical Control

Physical and mechanical control methods, by themselves, are not well suited for established populations of rush skeletonweed because mechanically injuring the plant stimulates budding on horizontal roots and causes root fragments to regenerate, ultimately resulting in an increase in stand density. These methods can, however, be combined with other control methods for more effective control:

- Hand pulling or digging are realistically limited to small, new infestations. For maximum effectiveness, landowners should pull or dig rush skeletonweed before seed set and when the soil is sufficiently moist to reduce breakage and allow for removal of as much of the root system as possible; bag all plant parts and remove them from the site; and routinely monitor the site over the long term (3–8 years) to contend with any regrowth.
- Because mowing misses flat rosettes, leaves the root system intact, delays seed production, and often increases stand density, its use should be limited to accessible areas (e.g., pastures, roadsides) that can be regularly mowed. The key is to mow often and *always* before flowering (seed production). Mowing can sometimes be successfully followed by herbicide treatments.

- Because cultivation spreads viable root fragments, it is often responsible for increased proliferation of rush skeletonweed on agricultural lands. Continuous cultivation would be necessary to reduce an established stand of rush skeletonweed.

Cultural Control

Cultural control methods can be effectively used to weaken the competitive capacity of rush skeletonweed. Seeding of competitive vegetative species (e.g., perennial rhizomatous grasses, legumes) is widely recognized as a deterrent for invasive weeds. Land management practices that improve the health, vigor, and competitiveness of beneficial plant species include strategic irrigation, crop rotation, fertility treatment, and prescribed grazing practices. Rush skeletonweed can be deterred by using legumes in crop-pasture rotations to improve soil fertility by fixing nitrogen. Alfalfa in particular has far-reaching roots that compete well for deep soil moisture, as well as copious foliage that deprives young rush skeletonweed plants of much-needed light.

Burning is not recommended. By removing competition, fire creates a disturbance that actually favors expansion of rush skeletonweed. In addition, rush skeletonweed remains green late into the season and can even produce seeds following a burn.

Chemical Control

Herbicides are most effective on young plants (less than 5 years of age), on relatively small infestations, and when combined with other control methods. Herbicidal control is generally neither feasible nor economical on vast infestations and on remote or rough rangeland. Most herbicides perform best when applied to rosettes in spring and fall, according to the guidelines in Table 3.

Livestock Grazing for Control

Moderate but continuous grazing of sheep and goats will result in more selective "mowing" of rush skeletonweed than a machine; however, if overgrazing is allowed to occur, desirable plant species can lose their competitive edge. While sheep are the hardiest grazers of rush skeletonweed, goats alone feed on the plants once they become woody. Cattle can be used to graze young rush skeletonweed plants, although they generally select grasses over forbs. Livestock should not be allowed to graze infested areas during flowering and seed set. Because rush skeletonweed quickly recovers once livestock grazing ceases, another form of control should

HERBICIDE USAGE

- **Always follow the product label and state laws when using herbicides.**
- Be sure that the herbicide is registered for use in your state, and for the intended purpose.
- Many herbicides are restricted use and can only be applied by a certified/licensed applicator.
- Always consider nontarget plants, nearby water sources, and residual effects when selecting an herbicide.
- The distinct rush skeletonweed genotypes react differently to herbicides. North American susceptibility studies are still needed.
- Rush skeletonweed rosettes are easier to identify and spray in the fall when there is no confusion with dandelions.
- Herbicides are more effectively translocated in the fall when rush skeletonweed plants are building food reserves for the winter.
- Use an effective surfactant on rush skeletonweed to aid in absorption and translocation of the herbicide.
- Successful herbicidal control of rush skeletonweed usually requires multiple treatments.

Table 3. Herbicide efficacy results. Rates below pertain to rangeland. For a list of additional crops and their suggested rates and procedures in your area, refer to the label. Additional information is available in the PNW Weed Management Handbook, *MISC0049.*

Herbicide	Life Stage Affected	Application Phenology	Application Rate
2,4–D	aboveground only	spring bolting	2 qt/A (4.8–9.5 L/ha)
Metsulfuron + Dicamba + 2,4–D	above- and belowground	spring rosette	1 oz/a + 8 fl oz/A + 16 fl oz/A (71 g/ha+0.6 L/ha+1.2 L/ha)
Clopyralid	above- and belowground	spring rosette	2–4 fl oz/A (148–296 mL/ha)
Clopyralid + dicamba	above- and belowground	spring rosette	3 fl oz/A + 8 fl oz/A 221.8 mL/ha + 0.6 L/ha)
Picloram	above- and belowground	fall rosette	16–32 fl oz/A (1.2–2.4 L/ha)
Aminopyralid	above- and belowground	spring rosette (fall rosette before hard frost)	5–7 fl oz/A (369–517 mL/ha)

be used to pick up where grazing leaves off. Mowing, biological control agents, or fall application of herbicides will augment the effects of grazing.

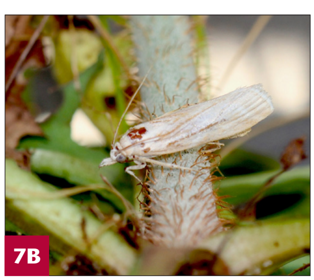
Biological Control

Biological control agents are selected natural enemies of rush skeletonweed that have been tested and approved for use. They are best suited for containment and reduction in areas where other control measures are impractical or would be too expensive. Biological control agents can help reduce the spread and density of established rush skeletonweed populations by weakening and suppressing the plants. Four biological control agents (Table 4) have been released to manage rush skeletonweed in the United States; their performance is somewhat dependent on local conditions (particularly climate) and plant biotype.

Once biological control agents are established, they are inexpensive, self-perpetuating, and can be released without regard to the terrain, often making them the only feasible choice for managing extensive and remote infestations. Biological control is, however, a very long-term option and requires patience and perseverance since the biocontrol agents require several years to reach sufficient population levels to impact rush skeletonweed infestations. The hope is that, over time, existing and new biological control agents will naturally increase to the point that they can eventually contain rush skeletonweed, and surplus biological control agents can then be harvested and transferred to uninfested sites of rush skeletonweed. Landowners should contact their local Extension educator, state department of agriculture, noxious weed control board, or university for more information.

Table 4. Rush skeletonweed biological control agents approved for release in the Pacific Northwest.

Type/Scientific Name	Impact	Availability	Release
Rust fungus (*Puccinia chondrillina*, Fig. 4)	• Seedling/rosette death; reduced plant vigor and flower/seed production in mature plants • Variable impact depending on rust strain, rush skeletonweed biotype, and moisture	Readily available	Place infected plant parts onto uninfected plants.
Gall mite (*Aceria chondrillae* aka *Eriophyes chondrillae*, Fig. 5)	• Reduced aboveground/root biomass and flower/seed production • High winter mortality rate • Currently the most effective biocontrol agent in the Pacific Northwest	Readily available—collect where bud galls form	Place infected bud galls into areas containing uninfected plants.
Fly or gall midge (*Cystiphora schmidti*, Figs. 6A, 6B)	• Attacks all 3 biotypes • Gall formation can cause leaf and stem death, reducing overall plant vigor and seed output • Effectiveness diminished by gall predation by grasshoppers and parasitic wasps	Readily available—heavily parasitized in late season	Place infected stems into areas containing uninfected plants.
Root moth (*Bradyrrhoa gilveolella*, Figs. 7A, 7B)	• Larvae feeding/silk tubes damage roots; gall formation can cause leaf and stem death, reducing overall plant vigor and seed production • Sandy, loose soil essential for survival • Field establishment yet to be determined	Not available	Place infected plant parts or adult moths into areas containing uninfected plants.



Figures 4-7. Rush skeletonweed biological control agents. 4. Puccinia chondrillina *(Eric Coombs, Oregon Department of Agriculture); 5.* Eriophyes chondrillae *galls (Gary Piper, Washington State University); 6A.* Cystiphora schmidti *larva (Eric Coombs, Oregon Department of Agriculture); 6B.* C. schmidti *adult (Eric Coombs, Oregon Department of Agriculture); 7A.* Bradyrrhoa gilveolella *larva (Eric Coombs, Oregon Department of Agriculture); 7B.* B. gilveolella *adult (Eric Coombs, Oregon Department of Agriculture).*

Maintenance

Once the rush skeletonweed infestation has been successfully managed using the control options outlined above, competitive plants must be established in order to restore the disturbed area and create a desirable plant community that can withstand weed invasion. This may involve revegetation if there are not enough desired plants at the site to assist the natural recovery process. In addition, existing land management practices may have to be adapted to promote and maintain a healthy plant community. In any event, regular monitoring of the site as well as the entire property is critical to assure that new invaders are caught and treated early.

References

Coombs, E.M., J.K. Clark, G.L. Piper, and A.F. Cofrancesco, Jr., eds. 2004. *Biological Control of Invasive Plants in the United States*. Corvallis: Oregon State University Press.

Natural Resources Conservation Service. 2012. The PLANTS Database. U Department of Agriculture. National Plant Data Team. Greensboro, NC. http://plants.usda.gov.

Peachey, E., D. Ball, A. Hulting, T. Miller, D. Morishita, and P. Hutchinson, eds. 2012. *Pacific Northwest Weed Management Handbook*. Oregon State University, Washington State University, and University of Idaho. MISC0049, http://pnwhandbooks.org/weed/.

Sheley, R.L. and J.K. Petroff, eds. 1999. *Biology and Management of Noxious Rangeland Weeds*. Corvallis: Oregon State University Press.

Winston, R., M. Schwarzlander, J.F. Gaskin, and C. Crabtree, eds. 2009. *Rush Skeletonweed (Chondrilla Juncea) Management Plan for the Western United States*. Fort Collins, CO: Forest Health Technology Enterprise Team.

Yao, S., ed. 2009. Genotype Exploration is Key to Controlling Rush Skeletonweed. *Agricultural Research* 57(6): 22, http://www.ars.usda.gov/is/AR/archive/jul09/.

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