



Larvae of the Gall Mite eat plant parts causing cauliflower-looking galls.



Adult Gall Midge on a stem



The gall on the leaf provides a safe place for maturing Midge Gall larvae.



Spots of Rust pustules on the leaf



Rust pustules on the leaf look like blisters on skin.

Integrated Weed Management (continued)

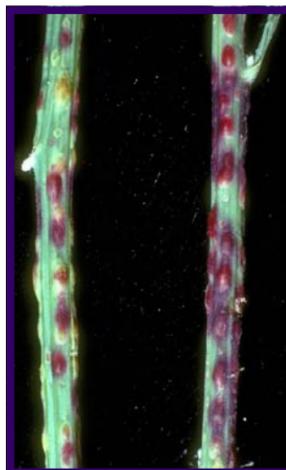
- Apply 5 oz. of Milestone; or 1 gallon of 2,4-D; plus 3 quarts of a good surfactant like Dyne-Amic, for each acre.
- For each acre, apply Escort, Telar, Curtail or Redeem at 0.5 to 1 oz.; Tordon at 1 quart; or Weedmaster at 1 quart. They are all very effective, but do not use them along creeks.
- For larger areas, consider having an aerial spray of Milestone in the fall. First, put colored ribbons on some Rush Skeletonweed plants to help the pilot spot the infestations.
- Spray Milestone in the vicinity of mature Rush Skeletonweed plants in the late fall when they are readily visible. Milestone's residual will knock down new seedlings the following spring.
- Overall, follow the herbicide's label instructions.
- Survey your property in mid-summer to determine if there are any bio-controls present. Look for evidence of their presence such as purple blotches and spots, or mite galls. You will not be able to see the insects themselves, only some evidence of their presence. Even if you have never released bio-controls yourself, some bio-controls can travel great distances from neighboring properties.
- Determine if additional bio-controls will be helpful in controlling this noxious weed. Staff from the weed board can offer assistance in making this evaluation by inspecting the property with a landowner.
- Consider the purchase of more bio-controls for your property. Contact the weed board for more information on available sources of the bio-controls.
- Dr. Gary Piper of Washington State University provides many local landowners with bio-controls for Rush Skeletonweed. Landowners should contact the weed board to arrange for the purchase of the bio-controls. The weed board will contact Dr. Piper for delivery arrangements, and a bill for the bio-controls will be sent to the landowner from Dr. Piper sometime in the fall.
- The bio-controls are sent to the weed board about the third week of July, in large 25-pound plastic trash sacks full of infected plant materials.
- Weed board staff will assist landowners with the release of the bio-controls. About one-to-two hours is required in releasing each bag of bio-controls, as individual pieces of infected plant material are placed on the landowner's healthy Rush Skeletonweed plants.
- If a landowner has sufficient bio-controls, it is wise to redistribute bio-controls to areas not yet infected by the bio-controls. First make an evaluation on where the bio-controls should be released. The galls with the mites should be cut off dried-up plants and then released on top of healthy plants in the center of an uninfected patch. For the Midge and Rust, a teepee will work, but make sure the flowers and seed heads are cut off or absent.
- Once there are sufficient bio-controls on the noxious weeds, leave the weeds alone. Do not mow or plow the infected plants under, since this may result in the death and destruction of the bio-control insects. Be patient. The bio-controls need a few seasons.
- Make sure that the Rush Skeletonweed does not go to seed.



Damage by the Gall Mite



Gall Midge by gall on stem



Purple galls on stem



Teepee of Rush Skeletonweed stems used to redistribute Midge and Rust bio-agents.

Rush Skeletonweed: Options for Control

Rush Skeletonweed: Options for Control

Rush Skeletonweed, a deep-rooted, perennial forb in the sunflower family, is a highly-competitive and aggressive noxious weed. Rush Skeletonweed is found in most of Lincoln County, including Odessa, Harrington, Sprague, Edwall, Reardan and Davenport. It is rampant on the sandy hills overlooking Lake Roosevelt and the Spokane River, and along the I-90 corridor at the south end of the county. Only the northwest portion of the county near Wilbur, Almira, Creston and Coulee Dam has little Rush Skeletonweed so far.



Rush Skeletonweed before bloom



Rush Skeletonweed at bloom



Rush Skeletonweed can grow into a colony of plants.

This noxious weed can be a serious threat to wheat farming since it will spread from undeveloped areas into crop fields. The weed can foul up harvesting machinery and contaminate the wheat crop. This weed will also reduce crop yields on farmland by aggressively out-competing for nutrients and soil moisture.



Pacific Northwest counties with Rush Skeletonweed infestations

In Australia, competition from

Rush Skeletonweed reduced wheat yields by as much as 80 percent, resulting in estimated losses of more than \$35 million.

Many landowners become increasingly frustrated in attempting to control this noxious weed. Herbicides seem to have little impact on the weed after it bolts, but that is often when it is first found. The best control strategy is preventing an invasion before it takes hold, and then eradicating small patches as soon as they appear. Do not till or cultivate patches of Rush Skeletonweed since root fragments will develop into new plants and spread the infestation. Follow an Integrated Approach of planting competitive legumes, such as alfalfa, spraying herbicides early before or when the plant bolts, spray rosettes again in the Fall after the first frost, use a good MSO surfactant with your spray, release bio-control insects on parcels larger than one acre, and redistribute bio-controls as needed. If you spray at

the right time with a good herbicide, MSO surfactant, with bio-controls, control of this noxious weed will be successful.



Rush Skeletonweed late in season



Typical Rush Skeletonweed



The stiff, down-turned hairs on the lower part of the stem identify this weed.

Biology of Rush Skeletonweed

- **Scientific Name:** *Chondrilla juncea* L.
- **Origin:** Central Asia and the Mediterranean Basin including North Africa, Morocco, Turkey, Italy, Spain and Portugal.
- **First Found:** Near Spokane, Washington in 1938, Idaho in 1960 and Oregon in 1971.
- **Where Found:** It thrives on well-drained, sandy-textured or rocky soils. It infests rangelands, semi-arid pastures, croplands, transportation right-of-ways, residential properties and other areas subjected to repeated soil disturbance.
- **Identification:** Rush Skeletonweed, a member of the sunflower (Asteraceae) family, is a rosette in the early spring that resembles a dandelion. The plant will bolt in a few days, growing 1 to 4 feet in height. There are coarse, downward-pointing brown hairs near the base of the stem.

- Its life-cycle begins in the fall with seed germination and seedling establishment, as well as re-growth from perennial roots. Plants usually over-winter as rosettes that resemble dandelions.
- **Roots:** It has a deep taproot of some 8 to 10 feet, with lateral roots, often four feet deep. When its roots are severed, they will produce shoots which can reach the soil surface from depths of 4 feet. Taproot cuttings of 1/2-inch wide and one-inch long can produce new plants.
- **Variability:** Only 3 distinct forms in the United States, designated A, B and C (narrow to broad), but more than 300 genotypes in Australia.
- **Stems:** Wiry stems interfere with harvesting and are full of white, milky latex sap. In 1940s, the Russians tried to make rubber out of the latex sap.
- **Flowers & Blooms:** Flowering begins in early summer and continues until the fall frost. Seeds develop nine to 15 days after flowers open. A plant can produce up to 20,000 seeds.

Lincoln County
Noxious Weed Control Board
405 Ross Street
Davenport, Wash. 99122
509-725-3646

Habitat and Plant Communities



Spray **now** before the plant bolts.



The weed will bolt a few days later.



Avoid out-of-control noxious weeds.



Rush Skeletonweed destroyed 70 to 80 percent of the wheat crop in Australia. If unchecked, it will disrupt agriculture here as well.

- **Seeds:** One plant can produce up to 20,000 seeds and 90 percent are capable of germinating. The seeds have a parachute of fine hairs which allow them to travel along wind currents up to 20 miles, much like dandelions. Seeds are also carried in the fur and hair of animals, on the clothing of people, or by vehicles traveling through infested areas. The weed produces seeds without the need for fertilization, and thus each seedling is an identical clone to its parent.
- **Germination and Emergence:** Rush Skeletonweed seeds display virtually no dormancy. Seeds germinate within 24 hours under optimal conditions (59-86 degrees F). Buried seeds germinate within a year or two even if less than 0.3 inches of rain fall at one time. Seeds may remain viable for up to four years.
- **Over-Winter:** Rush Skeletonweed will over-winter as a rosette. The best time to apply herbicides is right after the first frost when the plant is moving nutrients down to its roots to survive winter.
- **Growth Pattern:** The plant initiates growth very early in the spring, by mid-April. The time to apply herbicides is very early in the spring, when the plant is still a rosette or when it is about to bolt, or later in the fall when it over-winters as a rosette.
- **Moisture Needed:** Rush Skeletonweed can flourish in either very dry or very wet environments. It thrives in habitats with 9 to 59 inches of annual precipitation. With its deep, 8-to-10-foot taproot, it can out-compete most plants. It is very drought-tolerant. Ranchers in dry Australia use the rosette of the weed for grazing sheep.
- **Vegetative Growth:** Rush Skeletonweed can vegetatively produce shoots from rhizomes and by regeneration following rootstock fragmentation. The vegetative spread is also at shoot buds located along the lateral roots and at the top of the main taproot.
- **Tilling or cultivation will stimulate new plants and more weed growth.** Root fragments will spread the plant.
- **Later in the Season:** At first, Rush Skeletonweed resembles the dandelion, but the rosette dies back as the flower stalk develops. The stems of the mature plant are sparsely leaved and wiry in appearance.
- Without control measures, this weed will produce a mono-culture of interconnected plants. A single plant can become an entire colony.



The new growth looks like dandelion leaves below last year's woody stems.



The taproot goes down 8 to 10 feet. If you plow, you will break up the roots, causing more growth and new plants.



Rush Skeletonweed seeds fly on the wind like dandelion.



Damage by Gall Mites, the most potent biocontrol for Rush Skeletonweed in our area. The Gall Mites cause the growths.

Integrated Weed Management

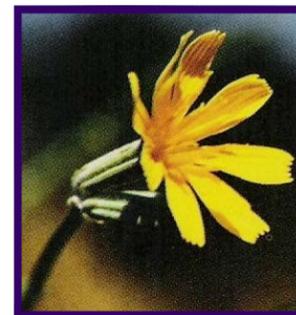
- Successful control of Rush Skeletonweed requires sustained effort, constant evaluation and a variety of improved strategies.
- Survey your property several times a season to determine the extent of any weed infestations.
- Prevent the spread of the noxious weed into new areas. Refrain from driving vehicles and machinery through Rush Skeletonweed infestations during the seeding period.
- Livestock should not graze weed-infested areas during seed formation.
- To prevent seed spread, limit access to the property by campers, hikers, off-road vehicles and horseback riders. Clean plant materials off the bottoms and wheels of vehicles.
- For very small infestations, diligent hand pulling or grubbing two or three times a year, for six to 10 years, can be helpful. New plants will emerge from severed roots and buried seeds. Pull out the young weed when the soil is wet.
- Due to its deep roots, mowing is not effective control since it will have a minimal effect on the weed's nutrient reserves. It will allow the plant to continue to move reserves down to its roots for more vegetative growth.
- Do not till or cultivate. Cultivation spreads root fragments and may actually increase the infestation.
- Plant competitive legumes, such as alfalfa, which will compete for soil moisture and may shade Rush Skeletonweed plants.
- Continuous grazing by sheep can reduce or prevent production of Rush Skeletonweed rosettes and seed. Moderate grazing is as effective as heavy grazing in controlling Rush Skeletonweed since heavy grazing decreases the competitive ability of desired species.
- Rush Skeletonweed is difficult to control with herbicides since most people spray too late in the season, and then without an effective surfactant like Dyne-Amic, an MSO-silicone blend.
- Effectively applying herbicides depends on spraying at the right time with an aggressive re-application program.
- Due to its rubbery plant surface, always use a good surfactant like Dyne-Amic, when spraying Rush Skeletonweed.
- In the spring, spray when the plant is still a rosette, or at least no later than when it is about to bolt.
- Spray the new rosette later in the fall, after the first frost.
- Spraying rosettes twice a season, early in the spring and later in the fall, should eradicate the weed after three years.
- Milestone and 2,4-D have been very effective in Lincoln County. These products can be used to the edge of a creek. A state applicator's license is not needed for their use. Unlike 2,4-D, Milestone provides some residual coverage for 1-2 years.



Notice the lower stem's down-turned hairs and red veins.



Close-up of the down-turned hairs on the lower stem



The tiny yellow flower at the end of a stem



Rush Skeletonweed blooms and seeds about to fly away



Larvae of the Gall Mite, up close, through an electron microscope



Larvae of the gall midge, along with reddish-purple galls on the stem



Rust fungus on Rush Skeletonweed leaf



An appropriate area for bio-controls



Releasing bio-control insects would be easier than spraying on a hillside.



Rush Skeletonweed blossom and seeds. Notice the seeds will blow away like dandelion.

Gall Midge (*Cystiphora schmidtii*)

- **All** Rush Skeletonweed biotypes are attacked by the Midge, but the **late-flowering biotypes** are the **most heavily damaged**.
- Midge adults are **light brown** in color and are about **1/8 inch long**. They resemble **tiny mosquitoes** and are not readily seen.
- Males live **1 to 2 days**, and females live **3 to 4 days**.
- Females of the first generation lay eggs in rosette leaves. Eggs are inserted through the lower epidermis of a leaf, with individual eggs separated by **1/8 inch** or more.
- Succeeding generations, **up to 4**, develop on the flower stems until fall senescence.
- A female produces about **100 eggs** during her lifetime. Eggs incubate about **9 days**.
- Upon hatching, the **pink-to-orange larvae** feed on the tissues beneath the surface of the leaf or stem where they hatch. Feeding stimulates the plant to form **galls** which are characterized by **swelling** and **yellowish to reddish-purple discoloration** of the affected tissues. Galls become noticeable **10 to 12 days** after eggs have been deposited.
- Larvae develop in **4 to 7 days**. Mature larvae

cease to feed, but spin **silken cocoons** about themselves within the gall prior to pupating.

- The pupal period lasts **4 to 6 days**. The pupae rupture the gall epidermis and form **holes** through which the adults escape.
- The life cycle of a Midge can be completed in **24 to 44 days**. The Midge is active from **late-April to October**, with a peak from **August to October**.
- The Midge injures Rush Skeletonweed both in the rosette and flowering-stem stages. When galls are abundant, **photosynthesis is reduced**. The plant's epidermis is injured causing the leaves to **dry, turn yellow, and die prematurely**. Both spring and fall rosettes, especially seedling rosettes, may die.
- Midges are **most damaging to fall rosettes**, destroying over **50 percent** of the leaves formed.
- Infested plants have fewer branches and may produce **60 percent fewer flower heads** than uninfested plants.

Rust Fungus (*Puccinia chondrillina*)

- While the **Rust Fungus** has caused significant damage in **California**, its presence has not often been seen in **Lincoln County**, perhaps due to **lack of dew and humidity**.
- The **Rust Fungus** remains active **throughout the year**, and it may infect all **above-ground plant parts**.
- From spring to fall, cinnamon-brown-colored, round or "bull's-eye," eruptive pustules (blisters) called "**uredia**" develop on rosette leaves, stems and flower buds.
- The **uredia** produce **red-brown spores** that propagate the **fungus** during the growing season, but do not over-winter. Elongate lesions or **telia** are produced at the base of flowering stems. **Telia** produce **dark-brown teliospores** which remain dormant and over-winter until the following spring.
- **Rust development** is slowed or stopped during the winter but resumes rapid growth in the spring. In **March**, the **teliospores** pro-

duce **basidiospores**, the **pathogen's sexual stage**. These germinate on the **rosette leaves** and form clusters of **yellowish spermogonia** which eventually yield **spermata**. These produce **aecia** and **aeciospores** in **April**. **Aeciospores** germinate to produce **uredia** and **uredospores**, and this completes the life cycle.

- **Rust spores** are readily disseminated by **wind, water and animals**.
- A new generation of **uredospores** can be produced **every 2 weeks** during the summer on the floral shoots.
- **Rust infections** often kill plants prior to **bolting**. **Rust** causes **desiccation**, **reduced photosynthetic surface area**, **increased plant susceptibility to other pathogens**, and **suppressed plant growth**. Heavily-infested plants are **stunted and deformed**, with few branches.

Preventing Invasion & Containing Infestations



Rush Skeletonweed's rosette looks like dandelion.



Mixed in with bunchgrass, with biocontrols on right



The downward hairs on the lower stem

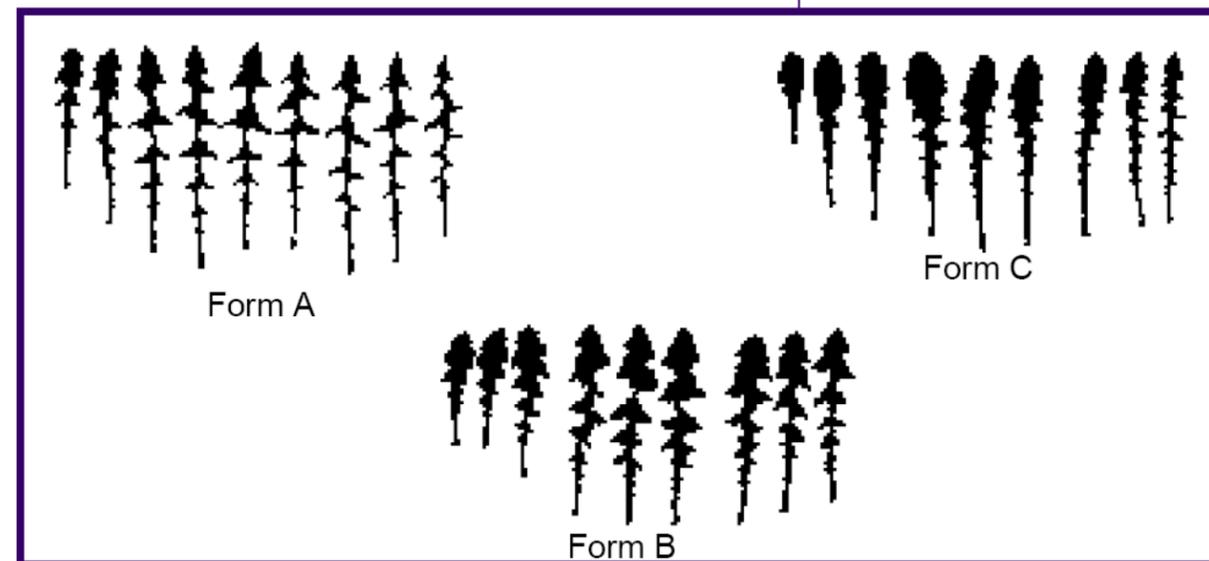
- **Integrated Weed Management:** Successful management of Rush Skeletonweed requires combining strategies to prevent the movement of weeds, containing existing infestations, and reducing weed infestations to tolerable levels.
- **Prevent Invasions:** Detect and eradicate new plants early. Refrain from driving vehicles and machinery through infested areas during seeding. Wash the undercarriage of vehicles and machinery before leaving infested areas. Do not use **hay, livestock feed or manure** contaminated with Rush Skeleton-

weed seeds. Livestock should not graze weed-infested areas during flowering and seed set. Avoid Rush Skeletonweed patches during cultivation. Go around small weed infestations during harvest. Screen irrigation water before it enters a clean field. Limit access to property to campers, hunters and off-road vehicles.

- **Proper Grazing Plan:** Alter the season used for grazing to allow favorable plants time to recover. Rotate livestock.
- **Early Detection:** Perform systematic surveys to locate new infestations. An eradication plan should include **spraying, re-vegetation and follow-up monitoring**.

Mechanical and Cultural Control

- For very small infestations, **diligent hand pulling or grubbing** two or three times a year, for **six to 10 years**, can be helpful. New plants will emerge from severed roots and buried seeds. Pull out the young weed when the soil is wet.
- Due to its deep roots, **mowing is not effective control** since it will have a **minimal effect** on the weed's nutrient reserves. It will allow the plant to continue to move reserves down to its roots for more vegetative growth. There will be a thicker infestation in later seasons. **Mowing is not the answer.**
- Do **not** till or cultivate. Cultivation spreads root fragments and may actually increase the infestation.
- Plant competitive legumes, such as **alfalfa**, which will compete for soil moisture and nutrients and may shade Rush Skeletonweed plants.
- **Continuous grazing** by sheep and goats can reduce or prevent production of Rush Skeletonweed rosettes and seed. **Moderate grazing** is as effective as **heavy grazing** in controlling Rush Skeletonweed since heavy grazing decreases the competitive ability of desired species.



The three forms of Rush Skeletonweed found in the United States. Australia has over 300 genotypes of Rush Skeletonweed.



Cattle will avoid Rush Skeletonweed.



It may be time to spray herbicides.



Rush Skeletonweed will invade wheat.



An elaborate spray unit



Spraying herbicides



Cattle Grazing on Rush Skeletonweed

- Cattle grazing on Rush Skeletonweed is not effective noxious weed control.
- Rush Skeletonweed contains a **white, milky sap** that is typically **not palatable** to cattle. As the plant matures, it gets **wiry** and somewhat **woody**, making digestion difficult
- Cattle avoid Rush Skeletonweed, but when forced to graze on it, they may nibble on rosettes and flowering stems early in the season, before lignified stems grow.
- Sheep and goats will graze the rosette and the early-flowering plant. Ranchers in Australia have used Rush Skeletonweed rosettes to feed sheep herds.
- Livestock should not graze weed-infested areas during flowering and seed set. Otherwise, seeds will pass through their digestive systems and spread infestations throughout an entire pasture.

Chemical Control of Rush Skeletonweed

- Rush Skeletonweed is difficult to control with herbicides since it is a **deep-rooted, rhizomatous perennial**. Some people think the weed is tolerant to herbicides.
- However, most people spray **too late** in the season for the herbicide to be effective.
- **In the spring**, spray when the plant is still a rosette, or at least **no later** than when it is about to bolt.
- Spray again **later** in the fall, after the first frost.
- Spraying rosettes twice a season, early in the spring and later in the fall, should eradicate the weed after three years.
- Effectively applying herbicides depends on spraying at the right time with an aggressive re-application program.
- Always use an effective surfactant like Dyne-Amic, an MSO-silicone blend.
- The weed has a **rubbery plant surface**, with few leaves to absorb the herbicide. The use of an MSO surfactant like Dyne-Amic is essential. Other good surfactants include Hasten and SYL-TAC.
- Milestone and 2,4-D have been very effective in Lincoln County. These products can be used to the edge of a creek. A state applicator's license is not needed for their use. Unlike 2,4-D, Milestone provides some residual coverage for 1-2 years.
- Apply 5 oz. of Milestone; or 1 gallon of 2,4-D; plus 3 quarts of a good surfactant like Dyne-Amic, for each acre.
- For each acre, apply Escort, Telar, Curtail or Redeem at 0.5 to 1 oz.; Tordon at 1 quart; or Weedmaster at 1 quart. They are all very effective, but do not use them along creeks.
- For larger areas, consider having an aerial spray of Milestone in the fall. First, put colored ribbons on some Rush Skeletonweed plants to help the pilot spot the infestations. Creek beds might be dried up in the fall making the use of Milestone feasible there too.
- Spray Milestone in the vicinity of mature Rush Skeletonweed plants in the late fall when they are readily visible. Milestone's residual will knock down new seedlings the following spring.
- An advantage of spraying in the fall is that the Rush Skeletonweed plants can be easily spotted, unlike the early spring when the plants are still rosettes resembling dandelions. It is essential to use a herbicide with a residual in the fall.
- In the fall, as temperatures cool and growth begins to slow or stop, **sugars produced by photosynthesis** flow more readily downward from leaves to roots to build food reserves for the winter. Herbicides applied in the fall are translocated to the roots and kill the buds which would otherwise generate new growth. The stress of winter may finish the job started by the herbicide application. Spraying in the fall is more effective than spraying in the spring.
- More is not necessarily better when applying herbicides to perennial weeds. Use an adequate, labeled rate to kill the weed, but allow it to live long enough to translocate the herbicide.
- Always follow the herbicide's label instructions.

**Rush Skeletonweed:
Options for Control**



A plant heavily galled by mites



Galled and ungalled flower stems



Rush Skeletonweed in bloom



A fall aerial spray with Milestone might be a good option for many.

Biological Control of Rush Skeletonweed

- Four biological control agents have been released for control of Rush Skeletonweed in North America: a mite, a midge, a rust, and a root-feeding moth (*Bradyrrhoa gilveolella*), soon to be released in the state of Montana.
- Grasshoppers and blister beetles are common native insects that often feed on Rush Skeletonweed, but are not suitable as biological control agents because they also feed on many desirable crops and plants.
- Introducing biological control agents does not guarantee short-term weed control. Several years are required for them to multiply to population levels that effectively suppress the weed.
- Bio-agents will not eradicate Rush Skeletonweed, but they will reduce seed production and stunt the weed, impairing its competitive ability and allow native plants and grasses to grow.
- Releasing bio-agents should be part of a total integrated vegetation management effort that includes the use of herbicides, fertilizers, competitive plants and grazing management techniques.
- Herbicides are most effective when applied to plants that are infected with biological control agents. Continue to spray herbicides if few midge galls are seen, but efforts should be made to preserve and redistribute mite galls.

Gall Mites (*Eriophyes chondrillae*)

- The Gall Mite is the most effective biological control agent against Rush Skeletonweed in the Pacific Northwest.
- The minute, yellowish-orange mite, barely visible to the naked eye, attacks all forms of Rush Skeletonweed. It has multiple generations each year, 4 to 8.
- Adult females over-winter in the central bud area of rosettes, but do not feed on the plant during this stage. In the spring, the mites ascend and attack the growing shoot produced from the rosette. Females will later infest the weed's terminal bud.
- Chemicals released by mites during feeding cause the formation of galls which appear as swollen, contorted masses of tiny, leafy buds. They resemble cauliflower. The first hint of gall development is a slight swelling of the bud and hooking of its tip or a flattening of the stem.
- The female mite generally lives 3 to 4 weeks, and during this time deposits between 60 and 100 eggs. Eggs mature in some 10 days during the summer. Several hundred adults and nymphs may feed within a gall.
- The green, leafy mite gall will eventually turn yellow and then brown as it desiccates and dries out. Mites escape from the deteriorating galls. Exiting females may infest buds on the same plant, be carried by the wind, or crawl to other plants. Mites will die within 2 to 3 days if the ambient humidity is below 50 percent at about 80 degrees F and they don't make it into another Rush Skeletonweed plant.
- Mites and galls continue to multiply and disperse until the weed's growth is stopped by lack of moisture or fall frost.
- One plant may be covered by as many as 4,000 galls during a summer season.
- Unfertilized female mites will produce male mites. Fertilization of females is by spermatophores, a stalked sperm sac attached to the inside of the gall and later collected by the female. When the gall dries and there is a mass mite exodus, the males deposit numerous spermatophores on the outside of the gall.
- To redistribute mite galls, place them on top of healthy Rush Skeletonweed plants in the center of the biggest patch. Release on damp days, in the evening or covering the plant with a plastic bag to help maintain higher humidity. If windy, lightly tie the gall to a healthy plant.
- Mites can reduce flower and seed production by 96 percent on weeds that they infest. They can reduce rosette regenerations following flowering by 76 percent.

**Rush Skeletonweed:
Options for Control**