

Reed Canarygrass

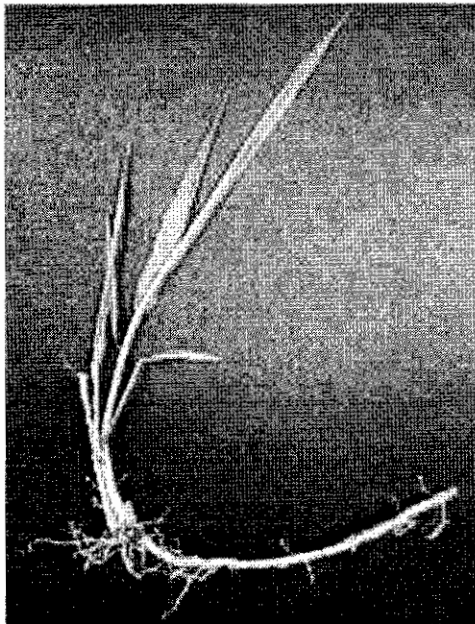
(*Phalaris arundinacea* L.)

Control & Management in the Pacific Northwest

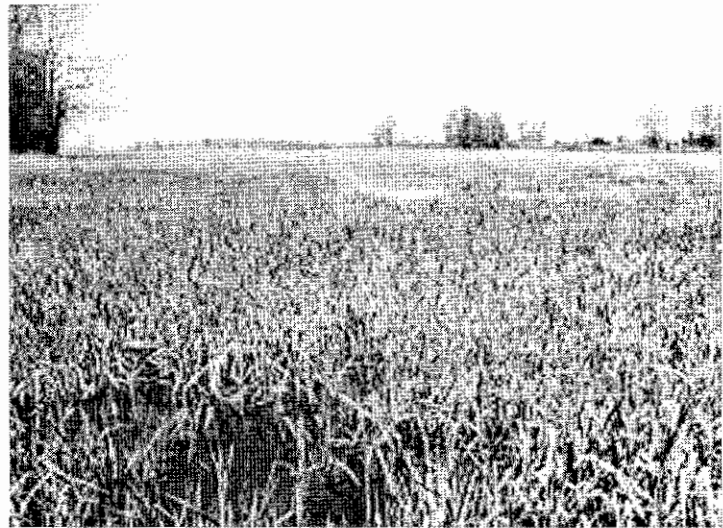
Although produced by and the responsibility of The Nature Conservancy, this document grew from a workshop co-sponsored by Metro, The City of Portland Parks, Natural Resources Division, The Society for Ecological Restoration, Northwest Chapter and The Nature Conservancy in February 2002. As well as extensive literature review and information taken from a previous Element Stewardship Abstract produced by The Nature Conservancy, data and field experience from numerous individuals went into this document. Funding for the production of this guide and the research that supported it were provided by: the Bureau of Land Management, For the Sake of the Salmon, the Northwest Service Academy, the Oregon Department of Agriculture, the Oregon Watershed Enhancement Board, The Nature Conservancy and the United States Fish and Wildlife Service. Thank you all.

Reed Canarygrass General Description

Reed canarygrass (*Phalaris arundinacea* - RCG) is a perennial, cool-season, rhizomatous plant in the grass family (Poaceae / Gramineae) (photograph 1). Its creeping rhizomes often form a thick sod layer, which can exclude all other plants (photograph 2). Its upright stems grow to 2 meters tall from the rhizomes, and its flat leaf blades measure up to 0.5 m long by 2 cm wide (photograph 3). RCG has open sheaths, hollow stems, small clasping auricles and membranous ligules (photograph 4). Its



Photograph 1. Individual stem with rhizome



Photograph 2. Dense infestations can exclude all other plants.

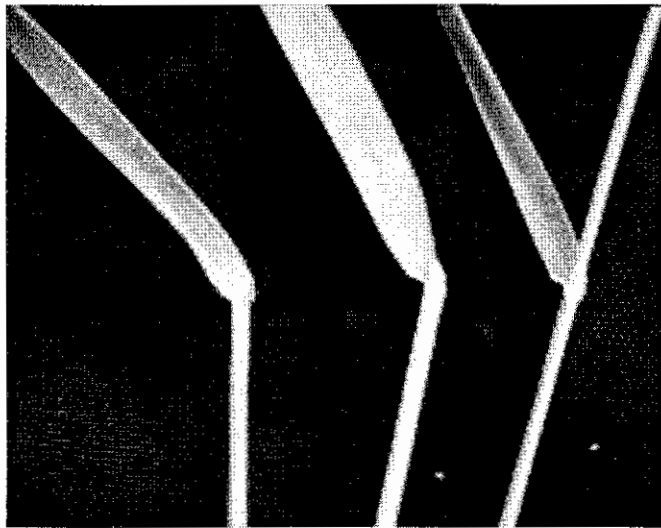
panicles (inflorescences) are compact and resemble spikes when immature, but become open and slightly spreading at anthesis. When in full bloom (May to June in the Pacific Northwest (PNW)), the inflorescences change in color from pale green to dark purplish, becoming straw colored when fruits have developed and dispersed (photograph 5).

Origin and Habitat

RCG is native to Eurasia. There is some debate as to whether RCG is truly native to the greater interior mountain west and the Pacific Northwest region. A study by Merigliano & Lesica (1998) determined from herbarium specimens collected prior to 1900, that RCG was indeed native to some river systems in Montana, Idaho, and Wyoming. Due to its agronomic potential, RCG trials and plantings began in Oregon as early as 1918 for pasture and erosion control. It is very



Photograph 3. Upright stems grow 2 meters tall.



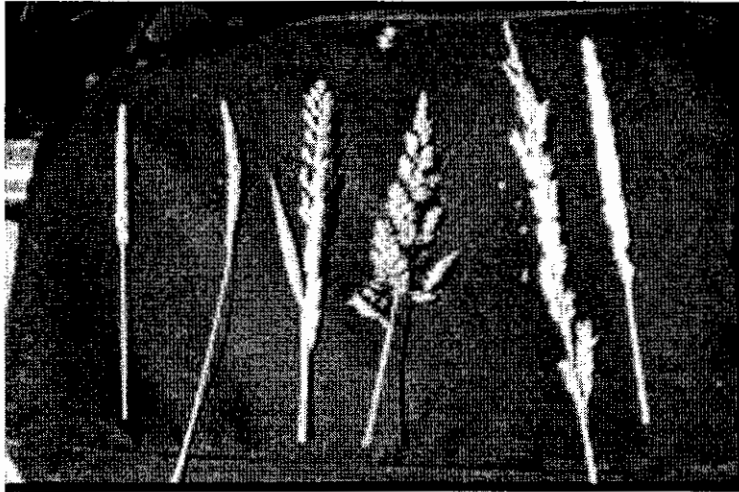
Photograph 4. Stems are hollow with open sheaths, small clasping auricles and membranous ligules.

likely that what is now abundant and invasive throughout many of the wetlands in the PNW are European cultivars of RCG specifically bred for high rates of growth, vigor, and adaptability to a range of environmental conditions.

RCG occurs in the PNW on both the west and east sides of the Cascades. It most commonly occurs in low elevation wetlands, wet ditches, along roadsides, and in river floodplains disturbed by past grazing or soil movement. RCG prefers seasonally or continually wet habitats and does not survive in dry uplands, but can tolerate prolonged periods of drought.

Reproduction and Basic Ecology

RCG can reproduce vegetatively by its rhizomes and rhizome fragments, as well as sexually by its abundantly produced seed. Although each inflorescence can produce approximately 600 seeds, it probably has a low successful establishment rate from seeds, especially within dense infestations.



Photograph 5. Inflorescences at various stages.



Photograph 6. New growth from rhizomes. Note the dense thatch from previous year.

Most plants and recurring populations of RCG are likely from rhizomes (photograph 6).

RCG rhizomes and dead stems and leaves can form a sod layer measuring over 0.5 meters thick. A few native plants may be able to survive within RCG infestations (*Eleocharis palustris*, *Typha latifolia*, *Veronica scutellata*, *Carex aperta*), but wetlands without RCG tend to have a much higher diversity of native species.

RCG seeds can be dispersed in animal fur, on human clothing or on automobiles (photograph 7). The most common vector for RCG seeds and rhizome fragments however, is probably dispersal by water. RCG seeds have a relatively low rate of germination, and do not germinate in dense shade. Seedlings are susceptible to prolonged flooding, prolonged drought, and do not appear to be highly competitive with perennial native species. Established populations can survive prolonged drought and can survive over one year of flooding, especially if parts of the plant are not submerged. Large plants can effectively compete and exclude almost all native plant species, provide little food for desirable wildlife, and will perpetuate itself for many years.

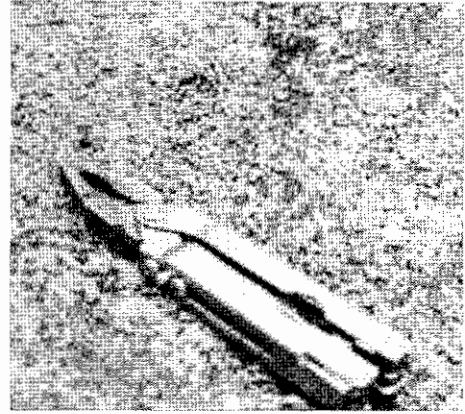
Control Summary

There is no immediate one-year “fix” to convert a RCG infestation into a native community, but much can be accomplished within 2 to 3 years. Continued monitoring and follow-up treatments will be required for up to 5 to 10 years to prevent reinvasion.

Reed canarygrass is difficult to control due to its persistent rhizome system and its ability to reproduce both vegetatively and sexually. However, depending on available time and resources, even highly infested areas can be restored to more desirable vegetation. Be sure to use an adaptive man-

agement process to determine your management objectives, to develop your work plan, and to be able to continually update that plan as results of your management actions become apparent. The successful restoration of your wetland system from RCG will likely involve five steps:

1. The control/removal/kill/local eradication of the existing RCG plants and rhizome system.
2. Exhausting the RCG seed bank.
3. Depending on how long the RCG infestation has been in your site, active restoration (replanting or reseeding of desirable vegetation) may be required. If your RCG infestation has not been at that site for over 5 to 10 years, there may be enough of a remnant native seedbank to allow passive restoration.
4. Prevention of new seeds or stem fragments from entering your managed area, and/or changing those conditions that facilitated RCG invasion in the first place.
5. Finally, continued monitoring and follow-up treatments are necessary for lasting results.



Photograph 7. Each inflorescence can produce up to 600 seeds.

There are a variety of methods available for the control of RCG. Which method or combination of methods you choose will depend ultimately on your management goals and objectives (are you trying to fully restore a Puget Sound wetland or just add structural diversity to a Willamette Valley riverbank?). Also, how many resources you are willing to invest and for how long, what resources do you already have available, and the size, distribution, and location of your RCG infestation will all determine which option you should choose to manage RCG. Unless you only have a few small isolated patches, the long-term successful management and control of RCG will require a multi-year commitment.

Prevention

Prevention of new invasions is the most efficient and cost effective method of invasive species management and control, and the prevention of new RCG infestations are no exception to this rule. Maintaining a healthy community of native or otherwise desirable plants, taking care to not disperse RCG seed or propagules, and carefully monitoring your managed area periodically (especially along roadside ditches and other disturbed areas) and eradicating small RCG populations as soon as possible and in neighboring lands can greatly benefit your RCG management efforts.

Another prevention method is to work to change those environmental conditions that allowed RCG invasion in the first place. Recent research completed from Wisconsin and Minnesota have shown that when levels of available soil nutrients (namely nitrogen) are reduced via carbon enrichment, a native sedge, *Carex hystericina*, is able to competitively suppress the growth of RCG. Sustaining a mosaic of microtopographies (by preventing sediment accumulation) facilitates native species richness, and maintaining complex herbaceous canopies also work to prevent RCG infestation, since RCG seed germination is dependent on amounts of light penetration.

Manual & mechanical methods

Digging

Isolated plants or small patches of RCG can successfully be removed by digging out and removing the entire root mass. Removal is easiest when the soil is moist. Be sure to remove all rhizomes and roots, as small rhizome fragments can resprout. Properly dispose of plant material, since rhizomes and stems can develop new roots if inundated, or if kept in contact with moist ground. Be sure to follow-up to catch any resprouted stems.

Mowing/Cutting

Mowing or cutting (using a mower, brush cutter, weed eater, tractor-drawn mower, machete, etc.) by itself will not kill RCG. In fact, if RCG is mowed only once or twice per year, it actually stimulates additional stem production. Continued mowing (5x or more per year) for 5 to 10 years is reported as successful in controlling RCG, but this has not been demonstrated on a large scale in the PNW.

Mowing can be used in combination with another control method, such as followed by a herbicide application, for good control. Additionally, mowing prior to or at the onset of flowering can eliminate seed set for that year. So, you can choose to mow RCG for several years to eliminate the seed bank, and then a final mow followed by herbicide application to eliminate mature RCG. Mowing can also facilitate the installation of shade cloth, or be used as a pre-treatment for tillage, since it will remove or break up the thick layer of dead litter.

Tillage/Cultivation

The use of large tillage machinery can successfully eliminate RCG if combined with a proper flooding regime. The USFWS Refuges at Ridgefield (near Vancouver, WA) and Finley (near Corvallis, OR) have successfully used a combination of tillage + flooding to convert large RCG infestations into native wetland habitats. This method, however, requires the use of large, expensive equipment, and requires the ability to manipulate water levels. Additionally, use of tillage to manage RCG assumes that you have no species or communities of concern that you are trying to preserve at the site. If you are working in a sensitive area or in a relatively intact native system, this may not be a viable option.

The purchase of the large tillage equipment (48-inch tillage plates and tractor) can be prohibitively expensive, but it may be available locally for rental or borrowing.

To eliminate large, dense RCG infestations using tillage + flooding, you should till through the RCG sod layer as soon as it is possible in the field season (usually, as soon as it is dry enough). The initial tillage may require several passes of the equipment, since the RCG sod layer may be thick and tough. Let the exposed stems and rhizomes dry-out. You will need to till several times during the field-season to break-up and dry all rhizome fragments (until you have nothing left but broken-up clods of soil). Finally, when the winter flooding begins, close floodgates and keep the entire area inundated at least 18 inches deep through late spring (late May-June) the following year. This combination of methods will eliminate large infestations of RCG, but follow-up (i.e. spot herbicide treatment with a backpack sprayer) will still be required for several years, since some RCG plants will survive or will invade the site. Active restoration will be necessary if a remnant seed bank does not exist.

Flooding without tillage

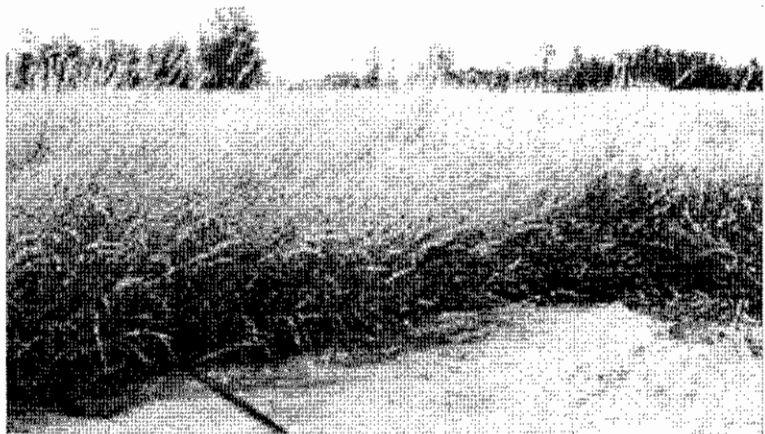
Controlling the hydrology of the site to lengthen the time an area spends totally submerged may be a viable control strategy if you have control over the hydroperiod of your site. Local experiments are underway using this technique by the USFWS at the Sandy River Delta and by the Port of Portland at the Vanport wetlands along the Columbia River. Other treatments will be necessary along the edges of the flooded zone.

Prescribed Fire

Burning generally does not kill mature RCG, and similar to occasional mowing, actually appears to stimulate additional stem production unless the fire burns through the entire RCG sod layer down to the mineral soil (which in turn, may create other problems). In most cases, RCG remains green long into the season, and so does not burn very hot. In the PNW, prescribed fire can only occur in the fall, and burning RCG in fall does little to control it. Herbicide treatment prior to burning can facilitate a prescribed fire, especially outside of typical "fire seasons." Prescribed fire can however, be used as a pretreatment to tillage, shade cloth, or prior to herbicide application for good results, since the fire will remove the aboveground dead litter and standing vegetation. Burning for several years in a row is generally not possible because of lack of fine fuels after the first-year burn.

Solarization, Shade Cloth, & Mulching

Solarization (essentially baking under clear or black plastic) or the use of a thick woven geotextile shade cloth can be used to eliminate RCG. In dense areas of patchy RCG growth this method can provide specific, targeted control (photograph 8). In areas where RCG is mixed-in with desirable species, the kill of those desirable species may or may not be an option. Also, the use of certain materials for this method depends on your overall management goals. There are reports from the Puget Sound region of good RCG control by using several layers of cardboard covered by 4 to 6 inches of wood mulch.



Photograph 8. Shade cloth provides specific, targeted control.

The addition of these materials into your site may or may not be acceptable. Excellent control of RCG can also be accomplished by using a thick woven plastic fabric (Mirafi(r) or Amoco(r) brands), held in place by 7-inch gutter spikes and washers and duck-bill tree anchors. The fabric is kept in place for over one year (over an entire growing season), even under inundation. This method will kill all plants under the cloth. Revegetation or reseedling is generally necessary with this method.

Shade cloth is initially expensive (approximately \$400 per 12 ft x 350 ft roll), but can be reused several times, and this method does not require follow-up visits during treatment. Mowing prior to

the installation of shade cloths greatly facilitates installation. Small patches can likely be treated using black plastic bags, if they are kept in place for the entire duration, the edges are tacked-down firmly, and the bags do not shred.

Grazing

Grazing alone does not control RCG. It is likely that much of the RCG present in the PNW today comes from European cultivars planted purposefully for pasture, so grazing has little to no negative impact on the growth and survivorship of RCG. Cattle prefer RCG when stems and leaves are young and succulent, but do not prefer it once stems become old and tough. Goats and sheep will graze on RCG. Grazing can be combined with another treatment method (followed by tillage, herbicide, shade cloth), for good control.

Biological Control

There are no known biological control agents for RCG.

Chemical Control Methods

RCG can be successfully controlled by the proper use of herbicide. Small stands or clumps of RCG can be effectively killed with one application, but large infestations will likely require several applications over several years to be effective. Since RCG frequently grows in wet areas, only aquatic-approved herbicides are allowed in many situations. As with all herbicide use, be sure to read and follow all label instructions and to abide by all state regulations. Glyphosate (Rodeo(r), Aquamaster(r), or Glypro(r) among others) applied in a 2% solution (1.08% active ingredient (a.i.)) with a nonionic surfactant works well to kill RCG. Glyphosate is a non-selective herbicide that kills or injures nearly all plant species. Glyphosate is also available in many other formulations (e.g. RoundUp(r)). These work well to kill RCG, but are not labeled for aquatic use, so be aware of the areas where you plan on applying herbicide. Sethoxydim (Vantage(r)) is a grass-specific herbicide that has been used to kill RCG with some success in the PNW, but it is also not labeled for aquatic use.

Always follow all herbicide label instructions and directions! Non-target organisms that come in contact with the herbicide may be injured or killed. If you have questions about herbicide choice or whether your use is legal, please contact your state Department of Agriculture or local extension agent.

Depending on the size and distribution of your infestation, the herbicide can be foliar-applied using a dripless wick applicator, backpack sprayer, or boom sprayer (please visit <http://tncweeds.ucdavis.edu> for a full discussion of herbicide application tools). Herbicide should be applied to foliage during the growing season. Application in the PNW can occur in mid-summer (just prior to summertime dormancy) or preferably in late fall (just prior to frost and wintertime dieback). It is recommended to apply herbicide at these times, since it is speculated that these are the times of year when RCG is most actively translocating carbohydrates (along with the herbicide) down into the root system.

You may also combine an herbicide treatment with another control treatment for good results. First, eliminate the aboveground dead litter by mowing or burning, then allow the RCG stems and leaves to

regrow to boot height. This helps obtain better herbicide coverage and reduce total herbicide use, since you are spraying only living green RCG that is 12" tall vs. 6' tall stems mixed with old dead leaves. Follow-up monitoring and treatment is necessary for several years to ensure complete kill.

Restoration/Competition

Planting fast-growing shrubs or trees may eventually eliminate RCG since it is intolerant of year-round shade, but depending on your management goals and objectives, this may not be a viable option. In the Puget Sound region where forested wetlands are common, planting native evergreen trees (*Pseudotsuga menziesii*, *Picea sitchensis*) may be desirable and can successfully shade-out and eliminate RCG. One way to add conifers into a RCG dominated system is to cut holes into large downed woody debris, and plant the conifer seedling into that hole. If planting trees directly into the RCG wetland, the trees will do better if the RCG is kept mowed, or if the trees are planted on top of soil mounds.

In the Willamette Valley however, native wet prairies did not have a large conifer component, and the addition of coniferous trees into this system may be undesirable. Because RCG can survive under the deciduous canopy of cottonwoods (*Populus trichocarpa*) and Oregon ash (*Fraxinus latifolia*), the planting of these trees and other native shrubs alone (*Spiraea douglasii*, *Sambucus racemosa*) are not likely to be successful at fully eliminating RCG. However, the City of Portland Bureau of Environmental Services reports success with planting high-density cottonwood or alder. Where they have reached a closed canopy by year five, they report almost near eradication of RCG. While this is not true eradication, it is enough to allow success in moving the site into an artificial conifer succession stage and to try to establish some native forbs.

Creating a dense herb layer may be able to exclude RCG, once it is firmly established. Native grasses, sedges and rushes such as *Beckmannia syzigachne*, *Eleocharis palustris*, *Carex densa*, *C. feta*, *C. unilateralis*, *Juncus oxymeris*, *Deschampsia caespitosa*, and *Agrostis exarata*, along with a native forb component (*Myosotis laxa*, *Plagiobothrys figuratus*, *Veronica scutellata*) may work to exclude RCG in some situations in the Willamette Valley. Further, a complex herbaceous canopy can work to prevent RCG seed germination.

The likeliest scenario for successful exclusion of RCG using native species is habitats that are marginal for RCG in the first place, i.e. those that are submerged for much of the year.

In the transitional zone between the emergent plant community and the upland, where we find the most difficulty with RCG in the Portland Metro region, native sedges, grasses and other emergent species have difficulty in holding their own against RCG. The City of Portland Bureau of Environmental Services suggests those areas are most easily managed by planting either one of the two following strategies:

- 1) live stakes- living branch sections from adapted trees/shrubs like willow, dogwood
- 2) shrub clusters- first scalp the sod off the top of an area about 5' by 3', then plant a cluster of shrubs- we generally use 10 for each cluster, then mulch well with a coarse grained mulch which will keep RCG from coming up from the bottom but also prevent broadleaf weed invasion from the top

Best Management Practice Recommendation

The best management approach to use will depend on your overall management goals and objectives, the size, distribution and location of your RCG infestation(s), your capability and willingness to use herbicides (or not), and your available resources (staff and volunteer time, money, equipment, etc). The following recommendations are not necessarily the best management methods for every situation, nor are they presented in an order of preference. The methods listed below have however, been used with some success in the PNW. Also, every method will require follow-up monitoring and treatment (including replanting native species if necessary) to ensure the long-term success of your treatments.

Scattered individual plants or small patches in healthy native vegetation

1. Dig out using a shovel
2. Spot-spray or wick with herbicide
3. Spot flame with a propane torch (only works for seedlings or young individuals)

Distinct patches of RCG within a matrix of native vegetation

1. Dig out using a shovel (depends on size)
2. Cover with shade cloth (may be preceded by mowing)
3. Mow (to eliminate seeds), then spot-spray or wick with herbicide
4. Spot-spray or wick with herbicide

Large patches (up to several acres) of RCG with scattered native vegetation

(Which method you choose will depend on how much you want to keep your native vegetation)

1. Mow then cover with shade cloth
2. Mow then herbicide (wick, spot-spray or boom)
3. Herbicide using appropriate application technique
4. Spot-burn then spot-spray regrowth
5. Cover with shade cloth (may be preceded by a mow treatment)

Large (hundreds of acres) monocultures of RCG

1. Mow using large mower, herbicide spray using boom sprayer
2. Prescribed burn, then herbicide spray using boom sprayer
3. Tillage and flooding

Additional Resources

There is much literature on RCG. Most of this literature details the use of RCG as a pasture grass or the development of various cultivars, but there are increasing numbers of studies on the biology, ecology, and how best to eliminate RCG. The following websites and references should get you started:

<http://tncweeds.ucdavis.edu>

<http://tncweeds.ucdavis.edu/esadocs/phalarun.html>

The Nature Conservancy's weed website: Chock-full of information on weed control methods, techniques, photos, and information on the biology and management of many wildland weeds, including reed canarygrass!

http://216.119.67.178/rcgrass/rc_docs.htm

Clay Antieau (City of Seattle) has been maintaining the RCG Working Group website page at the Society of Ecological Restoration's website. It contains Clay's own paper on the Biology and Management of RCG in the Pacific Northwest, as well as the proceedings for RCG meetings over the past few years.

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