

Controlling Himalayan Blackberry

(*Rubus armeniacus* [*R. discolor*, *R. procerus*])

in the Pacific Northwest

Although produced by and the responsibility of The Nature Conservancy, this document evolved 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, the data and field experience of more than 20 individuals went into this document. Special thanks go to Mart Hughes for his extensive contributions. Funding for the production of this guide and the research that supported it was 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 and the United States Fish and Wildlife Service. The Oregon Department of Agriculture provided friendly review. Thank you all.

Himalayan Blackberry Description

Himalayan blackberry (generally known scientifically as *Rubus discolor*, *R. procerus* or *R. fruticosus*, but technically *R. armeniacus*) is a robust, perennial, sprawling, more or less evergreen, shrub of the Rose family (Rosaceae). Leaves are large, round to oblong and toothed, and typically come in sets of three (side shoots) or five (main stems) (**photograph 1**). The most characteristic feature is probably the robust stems supporting large, stiff prickles (**photograph 2**).



Photo 1. Typical mature leaf



Photo 2. Robust stem with heavy prickles. Note small lateral bud.

The shrubs first appear as individual canes then groups of canes, gradually increasing to become great mounds or banks, with individual canes reaching up to 3 meters (**photographs 3 and 4**). Trailing canes spread up to 20-40 feet, frequently taking root at the tips. The white flowers and then the roundish, black and shiny 2 cm (less than 1 inch) fruit forms on second year (secondary) canes that grow off of first year canes (**photographs 5 and 6**). The fruit ripens from midsummer to autumn, late when compared with native blackberries.



Photo 3. Tangled mass of trailing canes

Origin and Habitat

Contrary to its common name, Himalayan blackberry (HBB) is a native of Western Europe. HBB was probably first introduced to North America in 1885 as a cultivated crop. By 1945 it had naturalized along the West Coast. HBB occurs on both acidic and alkaline soils, mainly in areas with an average annual rainfall greater than 76 cm (29 inches) at altitudes up to 1800 meters (6000 feet). It thrives and may form impenetrable thickets in wastelands, pastures, forest plantations, roadsides, creek gullies, river flats, riparian areas, fence lines, and right-of-way corridors. HBB thrives in moist but not true wetland soils, and tolerates a wide range of soil moisture.



Photo 4. Large dense thicket of Himalayan blackberry

Reproduction and Basic Ecology

Canes grow to a height of ~40 cm or more before they arch over and trail on the ground. Daughter plants may develop where first year canes touch the ground. Individual canes live only 2-3 years, yet reach a density of 525 canes per square meter. In less than two years a cane cutting can produce a thicket 5 meters in diameter. A large quantity of hard and dry litter and standing dead canes accumulate in old thickets (**photograph 7**).



Photo 5. Flowers



Photo 6. Ripened berries (black) and unripe (red)

The root crown on HBB can be up to 20 cm (8 inches) in diameter (**photographs 8 and 9**), from which many lateral roots grow. Roots have been recorded to a maximum depth of 90 cm (35 inches), and 10 m in length. Adventitious shoots (suckers) are occasionally formed on the roots and may emerge from a depth of 45 cm (18 inches). HBB also readily propagate from root fragments and cane cuttings.

HBB thickets can produce 7,000-13,000 seeds per square meter, and good seed crops occur nearly every year. When grown in dense shade, however, most species of blackberry do not form seeds.

Several authors have reported dispersal of HBB seeds by birds. Omnivorous mammals such as fox, bear or coyote also disperse seed. The prompt invasion of cutover lands by HBB indicates that the dispersed seeds remain viable in the soil for several years.

Although HBB seeds germinate mainly in the spring, few germinate the first spring after the seed is formed. In one study in Australia, HBB seedlings receiving less than 44 percent of full sunlight did not survive.



Photo 7. Persistent stiff dead canes



Photo 8. Close-up of root crown with pink secondary shoots



Photo 9. Root crown with thick lateral roots

The slow growth of seedlings and their susceptibility to shading suggest that few seedlings would be expected to survive in dense pastures or forest plantations. Blackberry thickets are also poor sites for seedling development. Although seedlings show the potential for rapid growth under laboratory conditions, they grow much slower in the field and are easily outgrown by daughter plants (see above).

Ecological Threat

HBB readily invades riparian areas, forest edges, oak woodlands, meadows, roadsides, clear-cuts and any other relatively open area, including all open forest types. Once it becomes well established, HBB out competes low stature native vegetation and can prevent establishment of shade intolerant trees (such as Douglas fir, ponderosa pine and Oregon white oak), leading to the formation of apparently permanent HBB thickets with little other vegetation present. The resulting dense thickets can limit movement of large animals from meadow to forest and vice versa, reducing the utility of small openings and meadows as foraging areas. Although the fruit is widely consumed by native animals, and some butterflies use HBB, it is a poor functional replacement for a diverse native forest understory, meadow or riparian floodplain.

Control Summary

Large stands of HBB are difficult to control due their impenetrability and the plant's variety of reproductive tactics, but with proper management, infested areas can be restored to desirable vegetation. Control is usually a two phase process, removal of above ground vegetation, and killing or removing the root crowns and major side roots (not necessarily in that order). Mechanical removal, whether by hand or machine, or burning, are effective options for removing the above ground portion

of mature plants. There are six primary options for long-term (i.e. root) control:

- * Grubbing out the root crowns and major roots has proven to be effective but expensive.
- * Repeated cutting of aboveground vegetation can also be effective but is expensive and requires multiple years of treatment.
- * Foliar treatment of resprouted canes in the fall following summer clearing has proven effective in some cases.
- * Treating freshly cut stumps with appropriate concentrated herbicide.
- * Uncut HBB can be effectively treated in late summer or fall with broadcast application of a variety of herbicides including triclopyr (i.e. Garlon 3a and 4) and/or glyphosate (i.e. Round-up and similar products) or 2-4D combined with triclopyr (i.e. Crossbow). Although effective control can be achieved by this method, the extensive, standing, dry and hard canes then need to be removed to allow access for effective restoration.
- * Dense planting of shade producing vegetation is a long-term solution for some instances. Planted vegetation may need to be protected from being overtopped by HBB.

Mention of specific herbicides in this document are for illustration purposes only and do not constitute support for the use of one product over another. As always, follow all use and safety instructions on the label when applying herbicides. When in doubt, please contact your state Department of Agriculture or your local Soil and Water Conservation District for advice. The label is the law.

Manual / Mechanical Control Methods

General discussion

Manual control methods are highly selective and permit weeds to be removed with limited damage to surrounding native vegetation (although trampling can be an issue in some locations or situations). The Bradley Method is one sensible approach to manual control of weeds (Fuller and Barbe 1985). This method consists of hand removal starting in areas with lesser weed infestation and working towards the worst stands. This approach is effective at maximizing self-recovery of native vegetation.

Both manual and mechanical removal of above ground vegetation produces slash (i.e. dead cane fragments). If cutting occurs before seeds are produced it may be piled and left for cover for wildlife. Debris may be fed through a mechanical chipper and used as mulch. Mowing in particular, but also using a weed eater may actually mulch in place. Once dry, HBB canes can be easily burned. If left on site, take care to prevent vegetative reproduction from cuttings. Please note that mechanical treatment typically does not break down the dry, hard prickles of mature canes. If left in place, these prickles can represent a threat to bicycle and softer tractor tires as well as bare feet.

An advantage of mechanical / manual cane removal over foliar herbicides is that cane removal apparently does not stimulate sucker formation on lateral roots. For example, Amor (1972, 1974) provides evidence that herbicides such as picloram and 2,4,5-T are not considerably more effective than cane removal. Other literature and local research by the City of Portland Bureau of Environmental Services, City of Portland Department of Parks and Recreation Natural Resources Division and The Nature Conservancy (as well as anecdotal reports), however, have shown Garlon 3a (triclopyr amine formulation) and Roundup (glyphosate with a trademarked surfactant) to deliver effective control when applied to mature canes or resprouted stems in fall. Please see section on

chemical control below.

Hand Pulling

Firmly grabbing the stem near the ground surface and uprooting the root crown is the simplest control strategy. This method is most appropriate for seedlings or young plants. It is especially effective with single canes, and works best after a rain or where the soil is soft. The root crown of larger plants with multiple stems will resist hand pulling in most cases. Plants should be pulled as soon as they are large enough to grasp, and before they produce seeds. This technique appears to work best with shade suppressed canes in forest understory or first year plants.

Hand Hoeing

Plants can be controlled while small by hand hoeing, either by cutting off their tops or by stirring the surface soil so as to expose the seedlings to the drying action of the sun. The object of hoeing is to cut off weeds without going too deeply into the ground and doing damage to the roots of desirable vegetation. Obviously, this technique will only be useful during the maintenance phase.

Digging/Grubbing

The removal of root crowns and major side roots by hand digging is a slow but sure way of destroying HBB, and is the basis for most manual removal projects. The work must be thorough to be effective, and generally requires some follow up work because every larger root fragment left in the soil may produce a new plant. For most plants a claw mattock or pulaski/mattock is effective. The claw loosens the dirt around the root, and the plant is pulled out in the same way that a claw hammer is used to pull out nails. Unless large amounts of volunteer help are available, this technique is best suited for small infestations within areas dominated by native plants or where other methods are not practical or legal. In dense patches, and areas with few remaining native plants, immediate seeding with native grasses will help reduce subsequent invasion by other weeds and still allow follow-up treatment of surviving HBB with broadleaf killing herbicides (if desired). Expect an acre of heavily infested ground to require 300-1000 volunteer hours to clear.

Cutting

Manually operated tools such as brush cutters, weed-eaters, power saws, axes, machetes, loppers and clippers can be used. This is an important step before many other methods are tried, as it removes the aboveground portion of the plant. In areas with dense clumps of vines access to the root crown may not only be difficult, but dangerous where footing is uncertain. Of course, the larger the implement the faster you can cut, but with a lower degree of control for avoiding desirable vegetation. Removal of canes alone is insufficient to adequately control HBB unless it is repeated multiple times and over multiple years, as the root crown will simply resprout and produce more canes. If weed-eaters are used it is better to use one with a blade rather than string, although string-type weed cutters will work if no alternative is possible. For example, a typical crew of 10 is capable of clearing about 0.5 acres of dense HBB per day using a string type weed-eater. Production would likely be higher with a blade, though no workshop participants reported data.

Mechanical methods

Using mechanized equipment to remove aboveground vegetation is typically non-selective in that all vegetation on a treated site is affected. Mechanical control is however, highly effective and relatively inexpensive at controlling woody vegetation on gentle topography with few site obstacles such as root stumps, logs or rocks. Expect to pay roughly \$250-\$500 per acre depending on the situation.

Most mechanical equipment is not safe to operate on slopes over 30 percent. It is also of limited use where soils are highly susceptible to compaction or erosion, or where soils are very wet.

As with other methods of removing above ground vegetation, several cuttings are required before the underground parts exhaust their reserve food supply. If only a single cutting can be made, the best time is when the plants begin to flower. At this stage the reserve food supply in the roots has been nearly exhausted, and new seeds have not yet been produced. Without follow-up treatment after cutting or chopping with mechanical equipment, HBB may resprout from root crowns in greater density and overtop any planted vegetation.

Prescribed Burning

Although fire alone will not provide permanent control of HBB, large infested areas may be burned in order to remove the standing mature plants. In order to avoid burning during the riskiest time of the year, a pre-spray of herbicide(s) may be used to kill and desiccate the aboveground portion of the plants. Especially in areas with little or no ground cover except HBB, the canes may need to be partially mowed or chopped to help the fire carry. Used alone, this method will not prevent resprouting from root crowns.

To obtain long-term control, burning should be followed by:

- (1) herbicide treatment of resprouted canes, in the fall following burning
- (2) subsequent burning or cutting to exhaust the soil seed bank and underground food reserves, and/
or
- (3) revegetation with fast growing or shade tolerant native species.

Other considerations for the use of prescribed burning include the time and cost of coordinating a burn, the soil disturbance resulting from firebreak construction and mortality of fire sensitive native species. This method might be most effective on slopes, especially rocky slopes with a grass component to help carry the fire.

Control in Wetlands

Although HBB may grow in true wetlands (versus seasonally moist areas) this is a marginal habitat for the species. It appears that HBB invades wetlands by tip rooting of canes. In locations where crowns have been established in seasonally saturated soils cutting to ground level has been effective in controlling established crowns. It appears that the roots are not able to survive in anaerobic soils without the supporting canes. Cutting should be undertaken in late summer through early winter just before soil flooding occurs.

Managerial control/Shading

Planting fast-growing shrubs or trees or shade tolerant species may reduce or prevent HBB re-establishment, since the species is usually intolerant of shade. Grazing sheep and goats in areas where the mature plants have been removed has also controlled regrowth, but both are notoriously non-selective, meaning that it may also be difficult to simultaneously control HBB and establish native vegetation.

Sowing native plant species which have the potential to out-compete weedy exotics for important resources is sometimes possible. It may be necessary to continue controlling the HBB until the desired vegetation begins to form a closed canopy. In some cases shade tolerant plants (for example cedar or hemlock in this area) may be encouraged to take root among the unwanted vegetation, eventually out growing them.

However in most cases, HBB prevents the establishment of other native plants and must be initially removed. Following physical removal or burning of mature plants, root crowns must be treated to prevent resprouting. Alternatively, HBB may be manually removed from around individual desirable plants until they reach sufficient height (~15 feet or 5 meters). Seedlings of native plant species usually cannot establish fast enough to compete with sprout growth from untreated stumps.

Prescribed Grazing

Amor (1974) described the effects of grazing by various animals on HBB as follows: In an ungrazed area, 96% of the plants produced daughter plants; in areas grazed lightly by horses the number dropped to 11%; in areas grazed by cattle only 1% of all plants had daughter plants; and no plants had daughter plants in areas grazed by sheep.

In New Zealand, the recognized method of HBB control in the past has been the farming of large numbers of goats. Claims in the literature include that blackberry is readily eaten by goats throughout the year, even when there is an abundant supply of pasture and other plants. In many areas of California, the use of Angora and Spanish goats is showing promise as an effective control for HBB. They can negotiate slopes too steep to manage with machines and do not pose the environmental dangers of some herbicides.

Goats prefer woody vegetation over most grasses or forbs, although Angoras have a higher tolerance for non-woody species. Since goats will trample or browse virtually any vegetation within a fenced area, any desirable trees or shrubs must be protected. Experience has shown that goats are most cost-effective when used to clear or suppress brush regrowth of one to four years old rather than to do initial clearing of dense tall, mature stands of vegetation. When faced with mature brush, goats will defoliate twigs and strip off bark but will leave the plant's main superstructure intact.

Chickens, surprisingly enough, are known to effectively digest (and destroy) all weed seeds passing through their crops and can thoroughly graze back vegetation in areas of up to one acre in size. Releasing chickens into an area after the mature plants are removed allows them to scratch and peck out weed seeds and potentially to reduce the weed seed bank in the soil.

Biological control

The USDA has not supported the introduction of herbivorous insects to control HBB due to the risk these insects may pose to commercially important *Rubus* species. Research on this subject continues.

Chemical Control Methods

Carefully selected and applied herbicides offer a viable and relatively inexpensive choice for controlling HBB in some instances. Treatment with herbicides should be conducted cautiously for three reasons:

1. HBB often grows in riparian areas,
2. Some herbicides promote vegetative growth from lateral roots,
3. Used incorrectly, herbicides will do little more than top-kill HBB.

Herbicides may be applied non-selectively (broadcast applications) or selectively (spot treatments). Both types of treatments have advantages and disadvantages and will be discussed separately.

More detailed information on management of common weeds is available in such publications as the PNW Weed Handbook or the USDA Herbicide Handbook (updated annually) and will not be comprehensively covered here. Publications such as these give detailed information on nomenclature, chemical and physical properties of many herbicides, use recommendations and precautions, physiological and biochemical behavior, behavior in or on soils, and toxicological properties for several hundred chemicals.

Always read and follow usage and safety directions found on the manufacturer's label. The label represents the legal limits of herbicide use. Please contact your state Department of Agriculture or local Soil and Water Conservation District if you are unsure if what you want to do conforms to current law.

Important note to herbicide users: NOAA-Fisheries has approved only glyphosate in the Rodeo (Dow) or Aquamaster (Monsanto) type formulation (no surfactant added) with LI-700 as the surfactant for use within the 100 year floodplain of rivers and creeks with salmonids. You probably need to consult with NOAA if you receive federal funding or have endangered species act fish issues at your work site. Check with your grant coordinator or NOAA to be certain.

Broadcast Application

Broadcast herbicide applications, or the spreading of an herbicide over an entire area, can be effective where the weed infestation is very dense and needs to be killed and desiccated prior to burning. It can also be applied effectively to plants that are resprouting following the initial removal of the aboveground vegetation.

Comment to herbicide users — Broadcast application of herbicides has become the mainstay of many weed control efforts. This may be due to the idea that it is a “quick fix” method of eradicating undesirable vegetation. Some herbicides, such as glyphosate however, are non-selective and kill both desirable and undesirable vegetation. Those species or individuals which survive treatment may, after repeated sprayings, form an herbicide-resistant vegetation cover, thus creating a more difficult long-term problem. Such broadcast spraying may also kill off remnant native plants, increasing the need for planting in restoration areas.

General herbicide treatment advice

Treatment timing is vitally important to herbicide success. In almost all cases, herbicides should be applied only when the plants are in full leaf (annual plants can often be effectively treated earlier). Results are generally poor if the plants are sprayed prior to this stage. Although some literature suggests the best results on deep-rooted perennials occur when plants are sprayed at flower bud stage, after flowering or even seed-set, local experiments suggest that the ideal treatment timing depends on the specific treatment being undertaken and the chemical chosen. For HBB it is best to spray in late summer or fall, especially if glyphosate is being used. The effectiveness of all foliar applied herbicides will be reduced significantly if the plants are badly moisture-stressed.

With all herbicides, complete coverage of all canes and leaves, including those growing from suckers away from the main bush, is essential for maximum effectiveness. Use of appropriate adjuvants (additives including surfactants, penetrants, sticker-spreaders, etc.) can greatly enhance herbicide effectiveness. Regrowth of HBB after slashing, burning, or grazing should be at least 18 inches (500 mm) high before herbicide application. Finally, more is not better. For effective control of deep-rooted perennials it is often better to keep the herbicide rate low, so above ground plant tissue does not die before the herbicide can be translocated deep into the root system.

In applying herbicides it is recommended that a dye be used in the chemical mixture to mark the treated plants and thus minimize waste.

Review of published literature and local knowledge on herbicide treatment choices for broadcast application (*A more detailed and well-referenced review is available on TNC's wildland weed website: tncweeds.ucdavis.edu*)

Many herbicides have been used in an attempt to control HBB with varying degrees of effectiveness. Picloram (Tordon) is effective, but one application may not always be sufficient. Although Picloram suppresses cane regrowth, it stimulates the development of adventitious shoots. Foliage spraying is more effective in the summer than winter.

Fosamine is not as effective as Picloram at killing mature HBB, but is more effective in controlling regrowth. Neither Fosamine nor glyphosate provide long-term control of HBB (**Editors note:** results with glyphosate appear to be greatly influenced by treatment timing). HBB control has also been accomplished with Dicamba, Imazapyr, triclopyr ester and amine and 2,4-D. Crossbow (a 2,4-D - triclopyr ester combination) has widespread renown as a blackberry killer. Triclopyr amine alone is found in many products labeled for control of blackberry and other perennial plant species and has proven effective in local trials conducted by the City of Portland.

The Multnomah Soil and Water Conservation District reports success using Roundup (glyphosate with a trademarked surfactant by Monsanto) at standard label rates in a fall application. They did not find earlier treatment timings to be effective. Representatives from Monsanto recommend a 2:1 tank mix of glyphosate (Round-up) with triclopyr (Garlon 3a), with Round-up rates at 2% or less and Garlon 3a rates at 1% or less. Be sure to add most of the water to your tank mix of glyphosate before adding the Garlon 3a to avoid incompatibility problems.

Spot Treatment Application Methods

Spot application methods consist of various techniques for careful spraying or manually applying herbicides to individual plants, such as stump resprouts, or to small clumps of plants. These methods are highly selective and are most efficient when the total area to be treated is relatively low.

Jones and Stokes Associates (1984) reviewed a variety of spot chemical techniques. The following is an excerpt from this report, listing techniques in order of increasing possibility of herbicide exposure to the environment or to humans in the vicinity of treated plants. They did not include spot-spraying. If they had, it would likely have been last (i.e. highest risk).

1) ***Stem injection:*** Herbicides are injected into wounds or cuts in the stems or trunks of plants to be killed. The herbicide must penetrate to the cambial tissue (directly beneath stem surface) and be water-soluble to be effective. The chemical is then translocated throughout the plant and can provide good root kill.

2) ***Cut stump treatment:*** Herbicides are directly applied to the cambial area around the edges of freshly cut stumps. Application must occur within 5-20 minutes of cutting (sources from New Zealand, Tasmania and Australia recommend treatment as soon as 30 seconds after cutting) to ensure effectiveness. Late spring may be the best season to do this. In early spring sap may flow to the surface of the cut and rinse the chemical off. At other times of the year translocation is too poor to adequately move the chemical throughout the plant. Applications may be made with backpack sprayers, sprinkling cans, brush and pail, or squeeze bottles. Picloram should not be used for this technique as it is known to “flashback” through root grafts between treated and untreated plants and may damage the untreated individuals.

3) ***Basal/Stem sprays:*** High concentrations of herbicides in oil or other penetrating carriers are applied, using backpack sprayers, to the basal portion of stems to be killed. The oil carrier is necessary for the mixture to penetrate bark and enter the vascular system. This method gives good root kill, especially in the fall when vascular fluids are moving toward the roots. This method may be easier to use with small diameter stems than the two previous techniques.

Spot treatments proven to work in the PNW fall into three categories:

1. Spraying isolated clumps of mature blackberry as described above
2. Spraying resprouted stems (18 inches) following initial clearing
3. Treating root crowns immediately following cutting

Cost of HBB Removal

Broadcast herbicide application: Expect to spend at least \$250-\$300 / acre to spray blackberry. This will include herbicide and the labor cost for a licensed applicator. If some pre-spray manual clearing is necessary, that will increase the cost.

Tractor clearing: \$250 -\$500 acre.

Spot herbicide application: Expect to spend up to \$250-500/acre depending on the difficulty of the terrain and the amount of herbicide needed.

Cut stump treatment: Cost of clearing plus time to do stump treatment, see above and below.

Hand digging root crowns: Allow 300 -1000 hours per acre depending on terrain and density. Adjust up or down based on the vigor and dedication of the diggers.

Weed-eater clearing of dense thickets: Up to \$1000 / acre

Hand clearing (machete, loppers, etc...) dense thickets: More than \$1000 / acre. Youth crews and inmate crews can generally clear about 1/4 - 1/2 acre per day. Typical costs range from free to \$500 / day for a group of 8-10 individuals.

Best Management Practice Recommendation

There is no single “best” practice. The management approach that is best for you will depend on your situation, objectives, finances and willingness or ability to use herbicides. The following recommendations are an attempt to balance cost and human and environmental safety. Note that crossbow herbicide is not recommended due to concerns that the environmental effects of 2-4D are greater than either glyphosate or triclopyr.

Scattered individual plants in healthy native vegetation

Hand cutting aboveground vegetation with loppers or pruning shears and either digging out root crowns or treating freshly cut root crowns with 50% Garlon 3a. For smaller plants it may be possible to uproot the root crown by pulling the stem. Replanting with natives is probably not necessary in most locations.

Small to moderate patches of HBB within a matrix of native vegetation

Hand cut aboveground vegetation using “weed-eaters,” machetes, loppers or pruning shears. Follow up treatment of either treating freshly cut stumps with 50% Garlon 3a or spot spraying resprouted canes between late September and early November with 2-3% Garlon 3a and 1% non-ionic surfactant or a 2% glyphosate - 1% (or less) triclopyr mixture with surfactants as described above. If using only glyphosate, use at the rate recommended on the label (2%) and apply as above. Replanting is probably necessary for patches dense enough to have excluded native vegetation. Hand removal of roots may be viable for small sites if volunteer hours are freely available.

Large patches of HBB with scattered native vegetation

Clear mature vegetation using weed-eaters or similar power tools prior to seed set. Spot-spray

resprouting canes at about 2 feet in height with herbicides as above in late summer or fall. If native vegetation is especially sparse and the site is tractor accessible, it may be cheaper to mow indiscriminately and do additional replanting rather than work carefully to protect a few individuals of native species. In any case, replanting with appropriate native species is probably essential for successful restoration.

Monocultures of HBB

Use appropriate size of mower or weed-eater to remove aboveground vegetation. Follow-up spray resprouted stems with Garlon 3a (or combine with glyphosate-based herbicides) as described above. Replant with appropriate native vegetation (**Note:** For large patches, especially on hills it is important to quickly establish ground cover to prevent erosion and increases in other weed species. The best way to do this is to seed with a native grass or if none are available, a truly sterile annual non-native grass.) In areas where drift is less of a consideration, it may be more effective to spray herbicides on the (large) mature blackberry plants then mow the dead canes.

Treatment in riparian areas

Riparian areas, especially those adjacent to fish bearing streams, call for extra caution in the use of herbicides. Spraying with Garlon 3a should only be done where drift will not contact the water **AND** during an extended dry period where the herbicide will not be moved through the soil into the water. Use glyphosate based herbicides or stump treatment over foliar application of Garlon 3a whenever possible. Please also see section above on treatment in wetlands.

Note: Although Garlon 3a has a limited aquatic label (not valid in NY or CA) and breaks down fairly quickly, unlike glyphosate, it does have some potential for moving through soil. Due to a lack of data on sub-lethal effects to salmonids, it has not been approved for use within the 100 year floodplain by NOAA-Fisheries.

Additional Resources

There is a huge literature on HBB control from the U.S., but even more so from Australia and New Zealand. The following articles and websites should get you started:

tncweeds.ucdavis.edu

The Nature Conservancy's weed website. This site contains a full Element Stewardship Abstract on HBB with details on herbicide choices and a full bibliography. The site also has useful information on tools for weed control.

www.pesticide.org/blackberry.pdf

Northwest Coalition for Alternatives to Pesticides. This document outlines manual control strategies. The NCAP in general has lots of information about alternatives to pesticide use. A word of warning however, because of their "political" agenda, their literature review sometimes presents research data out of context.

www.dpiwe.tas.gov.au/inter.nsf/WebPages/RPIO-4ZW2MF?open

Government of Tasmania (Australia). This document reviews their state of knowledge for blackberry control including mechanical, grazing and herbicides.

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