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Tree Biology and Proper Arboricultural Treatment of Pacific Madrone

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Abstract: One of the most common arboricultural treatments, pruning, is also one of the most misunderstood. Its significance in preserving the long-term health of woody plants, including madrones, is also poorly understood. When dead or living branches are removed properly, only branch tissue is injured. The "tree" itself is not. To prune properly, it is important to understand 2 key concepts: 1) compartmentalization (the process by which trees "wall off" injured tissue but do not heal); and, 2) natural target pruning. Compartmentalization has a direct relationship to natural target pruning as well as other aspects of tree care (including tree climbing practices).

Arboricultural treatments can benefit the health of Pacific madrone (*Arbutus menziesii*). Pruning techniques, construction site management and tree climbing procedures require knowledge of tree biology. This paper discusses major themes of tree biology and practical aspects of tree care based on my field experiences.

ARBORICULTURAL METHODS

Compartmentalization

Knowledge of tree biology expanded greatly over the past 30 years (Shigo 1977 and 1986). Trees (including madrones) do not heal wounds or pruning cuts but compartmentalize or wall off injured tissues from the rest of the tree. Trees establish boundaries that reduce the spread of pathogens to uninjured parts of the tree. These boundaries may fail over time due to internal and external causes (*e.g.*, inappropriate arboricultural practices).

Madrones are strong compartmentalizers with strong resistance to decay. I recently cut down a madrone 16 m tall with 3 stems 0.7 m diameter breast height that had been dead for several years. The stems had localized decay pockets and longitudinal cracks >3 cm deep and 18 cm long, but in general they were still sound. On some madrones (both dead and living), however, I noted more serious decay and cracking.

Root Systems

Tree roots often extend well beyond the drip line. They do not necessarily grow symmetrically around the tree. Most tree roots are within the top 1–3 m of soil. On many Seattle sites, particularly hillsides, soils are only 0.5–1.0 m deep and are usually underlaid with glacial till or clay. Fine absorptive roots are located in the duff or humus. They grow into overmulched areas. These roots are fragile and easily damaged. Some consider madrone a taprooted tree (M. Kruckeberg personal communication), and taproots are often crowded out by other roots as a tree matures (Harris 1992).

Natural Target Pruning

When pruning, improper cuts are a major cause of tree decline. Natural target pruning (Figure 13-1) is a proper pruning technique and its importance, and effect on overall tree health is described by Shigo (1986). Every cut made when pruning a tree is slightly different. There is no secret formula or set angle.. The correct cut is dependent on the configuration of the branch collar (a swollen area at the base of the branch that locks the branch to the tree). On a dead branch or a branch stub, the collar is the "knob" growing around it.

The branch bark ridge (BBR) forms in branch crotches. It indicates that growth is progressing normally (Figure 13-1). The collar sometimes extends beyond the BBR. These configurations are often very subtle on madrones, and trees should be studied before making cuts. The proper pruning cut is made at the edge of the collar so that only branch tissue is removed and the stem is not damaged. A wound or pruning cut closes as new wood is laid down. The injured wood (*i.e.*, the branch core) remains in the same place for the life of the tree. One of the strongest protection zones in the tree is at the branch-stem union (Shigo 1986); so, it is important to make the cut properly here.

A common arboricultural practice is crown thinning which promotes the penetration of light and air into the canopy (Pirone, *et al.* 1988 and Harris 1992). This permits drying of the leaves and bark which creates unfavorable conditions for the development and spread of diseases. This practice preserves the health of lower and interior branches. In the past removal of up to 33% of the living parts of the tree was acceptable, but today 10–20% is the more commonly accepted range for mature trees, including madrones. Since "tree food" is produced in leaves and to some extent in photosynthetic cells found in branches and stems, more canopy means a healthier tree.

On declining trees, and particularly madrones, removing living and healthy leaves or branches is not always beneficial; thus, there

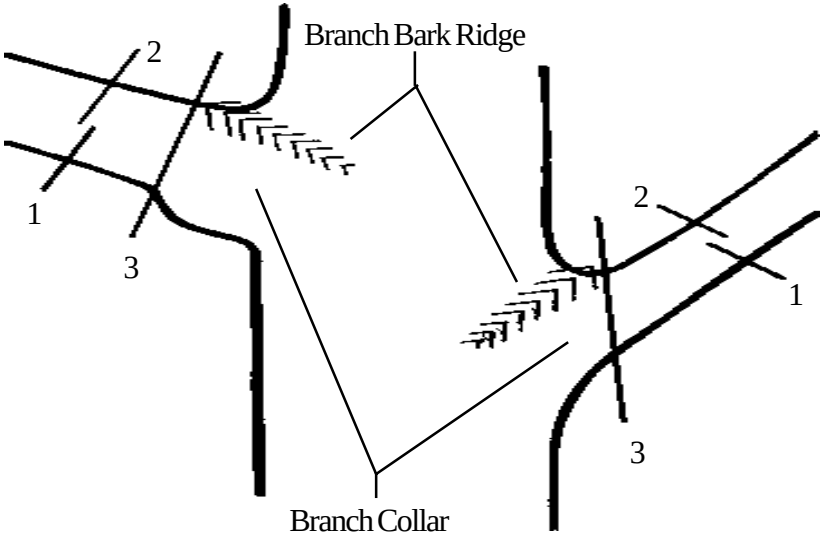

Figure 13-1. Natural target pruning (NTR) (3 cut method). First, stub off branch to prevent tears to the stem (cuts 1 and 2); then, remove the stub. The final cut (3) will be at the point where the branch meets the collar. Take care not to injure the collar. Do not play it safe and leave a short stub.

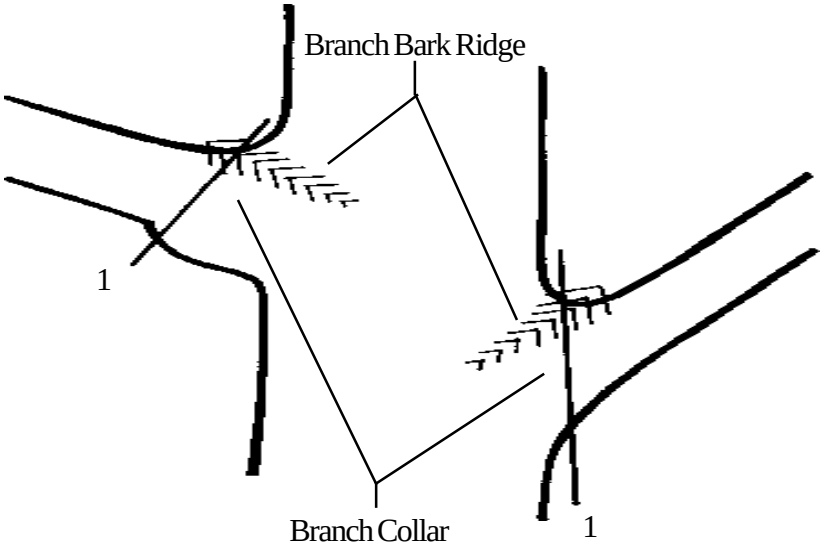

Figure 13-2. Flush cuts (1).

should be compelling reasons for doing so. Mitigation procedures can offset loss of healthy foliage and wood (*e.g.*, removal or pruning of adjacent, competing trees and understory vegetation). My recommendation for madrones is to remove only deadwood and/or branches with 85% or more leaf loss and to concentrate madrone pruning in the winter season. I advocate retention of some dead wood (or even the entire tree) when utilized by wildlife, if this does not create a hazard.

Flush Cuts

Flush cuts (Figure 13-2) remove all or part of the branch collar. Pruning cuts made behind the BBR remove part of the collar resulting in a partial flush cut. Such cuts damage the tree greatly. A complete flush cut that removes the entire collar (or the knob on a dead branch) causes even more damage. From the outside, it appears that the tree is fine because the cut closes quickly. Quick closure, however, leads to internal cracks (*e.g.*, Ram's horn). Under the right stresses, the tree cracks from inside out. Flush cuts also make the tree more susceptible to internal decay (Shigo 1986, Pirone, *et al*. 1988 and Harris 1992).

Included Bark

When included bark occurs between the stem and a branch, a seam appears (Figure 13-3). Over time, structural integrity of the stem-branch union weakens. Branches with included bark should be evaluated for: 1) potential hazard to people and property; and, 2) potential effect of failure on the health and structural integrity of the tree. If the hazard or damage potential is high and cannot be mitigated (*e.g.*, by moving the target or shortening the branch), then the entire branch should be removed. If the branch is retained, it can be monitored regularly.

Topping and Heading Cuts

Topping is a cut made between nodes (points where branches or buds meet the stem) of a tree or shrub (Figure 13-4). There is no correct way to make a topping cut. Response varies from species to species and among individuals within a species. It often causes accelerated decline of the tree (Shigo 1986, Pirone, *et al*. 1988 and Harris 1992). Decay often develops in the trunk and stubbed branches, even when cuts are angled to drain water away from the cuts. There is often complete or partial dieback at the leader to a major lateral branch, vigorous sprouting and development of multiple leaders. Often these are weakly attached and fail if they grow too large. Trees should never be retopped. They can sometimes be restored by selective removal or heading back of sprouts and new leaders, which will be either sprouts or upturned branches, if natural target pruning procedures are followed. Topping is not an acceptable practice.

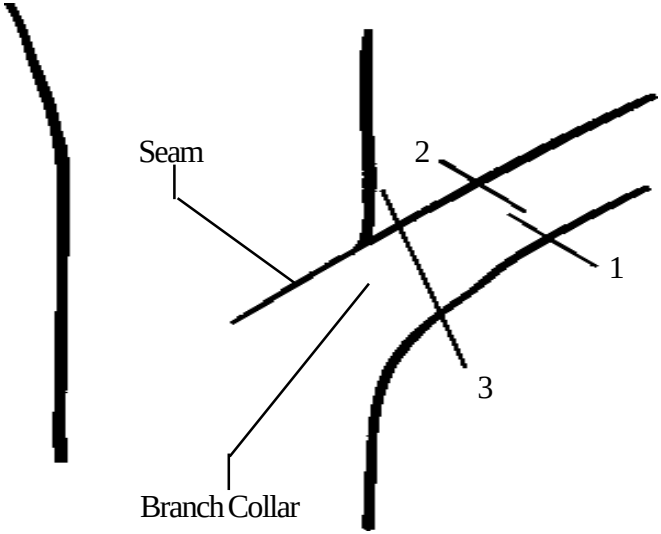

Figure 13-3. Included bark. This situation occurs at stem/branch unions, main branches/laterals and in multi-leader trees. Ideally, these situations should be corrected before the tree leaves the nursery. Follow natural target pruning procedures (the seam becomes the branch bark ridge for purposes of making cut 3).

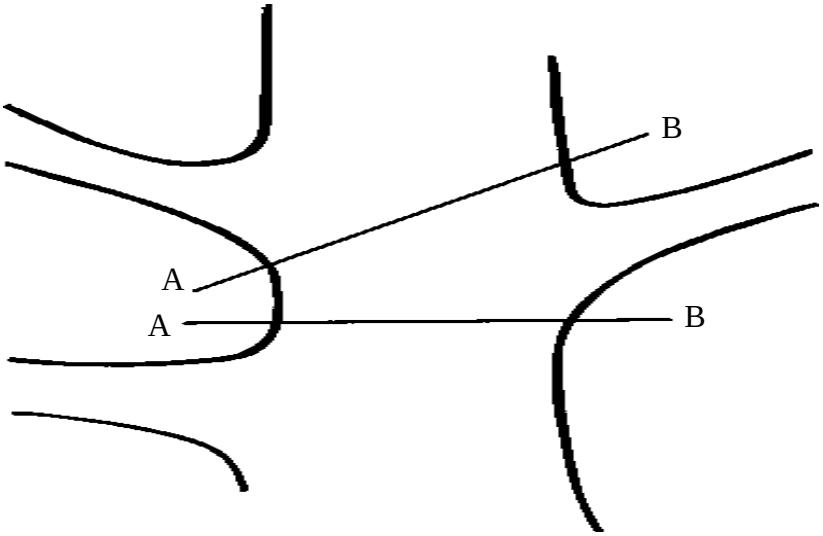

Figure 13-4. Topping cut. A cut (line AB) between points where branches or buds meet the stem.

Sometimes it is necessary to remove a leader of a multi-leader tree, reduce the height of a leader or shorten a branch. A heading cut is the appropriate procedure (Pirone, *et al*. 1988 and Harris 1992). The preferred heading cut on a stem or branch is to a branch or lateral at least half the diameter of the member being cut (Figure 13-5). Even when an acceptable heading cut is made, it may cause the same effect as a topping cut. The degree of damage and the tree's response depends on the tree's size, overall health, genetic makeup, species, location of the cut, environmental and cultural factors.

Root Pruning

Sometimes roots need pruning. Roots are often injured or exposed as a result of road-building and other construction activity. Broken and/or crushed roots are cut cleanly and never painted (Shigo 1986). Tears to root surfaces are trimmed to neaten the edges (Figure 13-6).

Torn Bark

Construction equipment and hand and power tools injure branches and stems. Torn bark on stems and branches is trimmed neatly, and all corners rounded, not pointed (Figure 13-6). Do not expand the wound into undamaged tissue to make a more "pleasing" shape (Shigo 1986).

Wound Dressings

Wound dressings (pruning paints) are of limited long term value in most tree care applications (Harris 1992, Pirone 1988 and Shigo 1986). They interfere with a tree's defensive processes. Products in some wound dressings can kill living tree tissues. Wound dressings retard the spread of specific diseases (Harris 1992 and Pirone 1988). Because of on my own field observations during the past 30 years and my review of the literature, I do not advocate the use of wound dressings.

Cavity Treatments

Drilling holes to drain cavities and digging decayed wood from cavities breaks boundaries between sound wood and altered or diseased wood. When boundaries are broken, pathogens spread from diseased wood to sound wood. The sound wood is then compartmentalized and energy reserves stored there are unavailable. In such a case, an apparently healthy tree can suffer quick and fatal decline.

Protection of Root Zone

There are ways to protect roots when bucket trucks or other heavy equipment are brought on site to improve access for tree work or for construction activity. Plywood panels (minimum thickness 2 cm), boards (5 x 25 cm) and/or pads of joined timbers are used to form temporary protective mats over the root zone. Coarse bark or chip

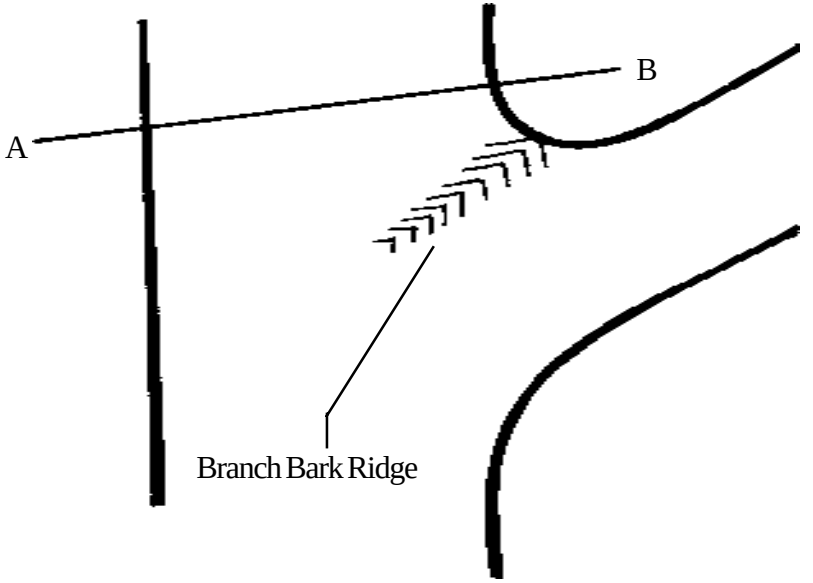

Figure 13-5. Heading cut. The preferred cut (AB) on a stem or branch is to a branch or lateral at least half the diameter of the main stem or branch.

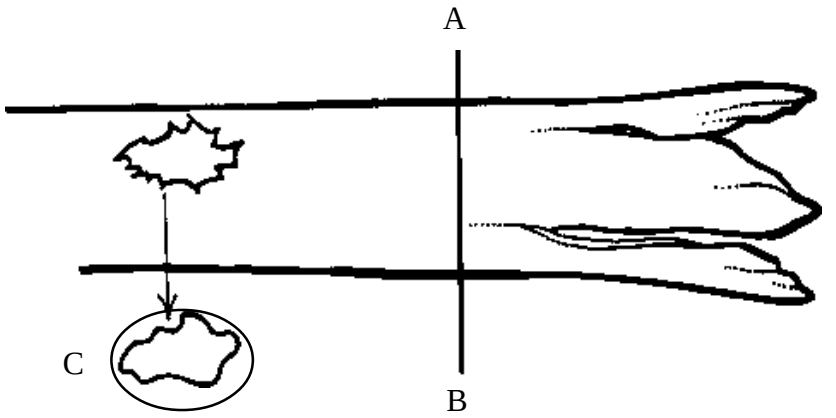

Figure 13-6. Pruning damaged roots. Make clean cuts (line AB) to remove broken, cracked, or crushed parts. Trim torn areas neatly, but do not expand the wound into undamaged areas. Make all corners rounded, not pointed (C). Note—injured stems and branches should also be treated in this manner (C).

mulches are also used. Fencing placed 2–3 m from the trunk help to protect the trunk and root crown (Harris 1992).

Basic Climbing Guidelines

Arborists pruning living trees, particularly madrones, should not use spikes (*i.e.*, gaffs or spurs) as climbing aids except to rescue an injured worker. Spikes cause irreversible damage (Shigo 1993). Work boots, climbing ropes and other gear can also injure stems and branches. Ropes, ladders or aerial lifts are used to enter trees. A climber's rope is recrotched frequently to reduce tree injury, or pulleys are attached at key crotches to permit extended working time from those stations. Pulleys reduce wear and tear on crotches when lowering heavy pieces of the tree. Even on large diameter branches and trunks, easily damaged smooth or paper-thin bark often occurs. By following these basic guidelines, arborists minimize incidental injury to and help preserve the health and longevity of Pacific madrones.

CONCLUSIONS

Madrone is a valuable natural and cultural resource. Damage from improper arboricultural practices (whether sustained by the above-ground or below-ground parts of a tree) may take years to cause death or hazardous situations. It is essential for practitioners to develop knowledge of tree biology. Proper arboricultural treatments make a positive contribution to the preservation of this valuable and attractive tree.

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