# Risk Assessment to State Rare Mountain Bugbane in Western Maryland


John B. Churchill
Appalachian Laboratory (University of MD Center for Environmental Science)

Sunshine Brosi
Frostburg State University

James Howell
Allegany College of Maryland



**ABSTRACT:**

Mountain bugbane is an herbaceous plant associated with eastern hemlock in the southern and central Appalachians. It is rare in Maryland (10 occurrences) (NatureServe 2010) and is restricted to the westernmost county. It is found with the vegetatively similar and more common black cohosh which is wild-harvested for many ailments including menopausal symptoms. Amidst development pressure and hemlock decline, incidental collection may increase the vulnerability of mountain bugbane. We used black cohosh monitoring data, from western Maryland state forests, and GIS layers ranking sites for accessibility and disturbance risk. Many sites are close to roads, trails and campsites. For example, of 139 black cohosh sites, 76 were within 100m of roads, 60 were within 100m of trails, and 7 were within 100m of campsites. This analysis provides recommendations to managers regarding permitting for herb collection, priority areas for hemlock woolly adelgid control, and limiting access to remote areas.


**INTRODUCTION:**

Black Cohosh (*Actaea racemosa* L.) grows wild in the Appalachian Mountains. It is used medicinally to treat symptoms of menopause. Specifically it treats vasomotor symptoms (vasodilation) known as "hot flashes" and is thought to be a suitable alternative to hormone replacement therapy which has been associated with breast cancer and heart disease. There is a market for wild-harvested black cohosh rhizomes and their collection is known from Maryland and several other states.

Black cohosh is morphologically very similar to mountain bugbane (*Actaea podocarpa* DC) which is categorized as "Rare" in Maryland and is ranked as "S2" (known from 6-20 occurrences). It is considered "Apparently Secure" globally but most states within the plant's range rank it between S1 and S4 with only Kentucky ranking it as "S5" (secure). Their similarity is perceived as a problem because inexperienced collectors are likely unable to distinguish between them and probably harvest the bugbane incidentally (NatureServe 2010). Another congener, Appalachian bugbane (*Actaea rubifolia* (Kearney) Kartesz) is similar in appearance but is not known to occur naturally as far north as our study area. Neither mountain bugbane nor Appalachian bugbane have any medicinal value. Our recognition of the rarity of the mountain bugbane and the potential damage to these populations led to an interest in calculating a Safety/Risk index quantifying the vulnerability to harvest at the 139 sites that were sampled.

The study area includes state forests in two physical provinces (the Allegheny Plateau and the Ridge and Valley). Forests in the Ridge and Valley province within the Central Appalachians (especially within our study area) are dominated by northern red oak (*Quercus rubra* L.), white oak (*Quercus alba* L.), and black cherry (*Prunus serotina* Ehrh.). Forests in this part of the Allegheny Plateau are dominated by sugar maple (*Acer saccharum* Marsh.), eastern hemlock (*Tsuga canadensis* (L.) Carrière), and American basswood (*Tilia americana* L.) but also have an abundance of northern red oak and white oak. Black Cohosh is widely dispersed throughout both provinces but mountain bugbane is limited to the Allegheny Plateau. Unlike black cohosh, mountain bugbane is found primarily in stands of eastern hemlock or mixed hemlock hardwood species composition.

Rare species, such as mountain bugbane, may have increased interest in western Maryland due to recent certification in sustainability through both the Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI). It is our hope that when presented with our recommendations, forest managers in the region will consider keeping any new trails or campsites away from relatively safe populations and will minimize forest disturbances in all of these areas whenever possible.

**METHODS:**

Searches for black cohosh were conducted in state forests in western Maryland and nearby Pennsylvania. Black cohosh sites were identified by auto and/or foot surveys in suitable habitat based on previous survey data (Howell 1979, Howell and Williams 1980) and expertise of the authors. Each site was required to have at least 15 black cohosh plants and to be at least 300m from adjacent plots. Large 15x100m plots were centered on the main plant populations except when plots would be bisected by roads. In these cases populations were located at the terminus of the plot. Within the large plots, all woody species greater or equal to 5cm dbh were recorded and all flowering and nonflowering black cohosh plants were counted. Average plant height was assessed for each plot. An assessment was also made regarding any fungal and insect damage present. Broad features of each site such as slope exposure, slope degrees, percent light exposure, and disturbance were measured at the central plot for each site and soil samples were taken close to the central population of plants. Within each large plot, three 5x5m plots were established with one directly in the center and two at opposite corners.. Percent soil moisture and pH measurements were taken at all three 5x5m plots and all woody stems less than 5cm dbh were identified to species and counted. Within the smaller 5x5m plots (in opposite corners), two 1x1m plots were established for measuring presence and percent cover of herbaceous species.

We generated random sites to compare with the known black cohosh sites. In some cases (about 15/139) random points were moved slightly to make them closer to roads (for ease of access in completing field work). This undoubtedly had some effect on the evaluation of Risk/Safety at the Random points.

We used a Euclidean Distance function to derive distance from roads, trails, and campsites. These and slope were combined to create an index of safety/risk of discovery. Slope was included with the rationale that steep slopes and difficult terrain would prohibit searchers from exploring certain areas. Both species will grow on steep slopes. Our assessment of the relative contribution to discovery risk was that slope was the most important factor, access from roads was secondary, while trails and campsites contributed even less. Each parameter was normalized using its maximum (max) value and then weighted by its perceived importance value. Importance sums to 100 percent. The index was therefore calculated as RISK/SAFETY = ((Slope/max * 0.5) + (roads/max * 0.275) + (camp/max * 0.125) + (trails/max * 0.10)). The grid was normalized again so that the index ranged from 0 to 100. The higher values of the index denote higher safety while lower values indicate risk. The index was a raster (GRID format) created using the raster calculator in the spatial analyst toolbar (ESRI, 2009).

We ran Zonal Statistics (ESRI, 2009) using the sites as the zone and the index grid as the value raster to get a value for each cohosh site and random site. We also ran Zonal Statistics using state lands as zones and the index grid as the value raster. Doing this made comparison of Risk/Safety at points, within state lands, and across the entire landscape (study area) possible. We also wanted to evaluate the relative contributions of slope, and distance to roads, trails, and campsites by looking at the distribution of values across the landscape.

**RESULTS:**

Risk/Safety at Black Cohosh sites and random sites was similar (Figure 1). Risk/Safety ranged from 3.8 – 51.7 at Black Cohosh sites and from 2.7 – 50.8 at random sites. As determined by the design of our Risk/Safety index, the landscape ranged from 0 – 100 and the mean value was 25.9 (Figure 2). The range within public lands was from 0.01 - 85.7 (Table 1).

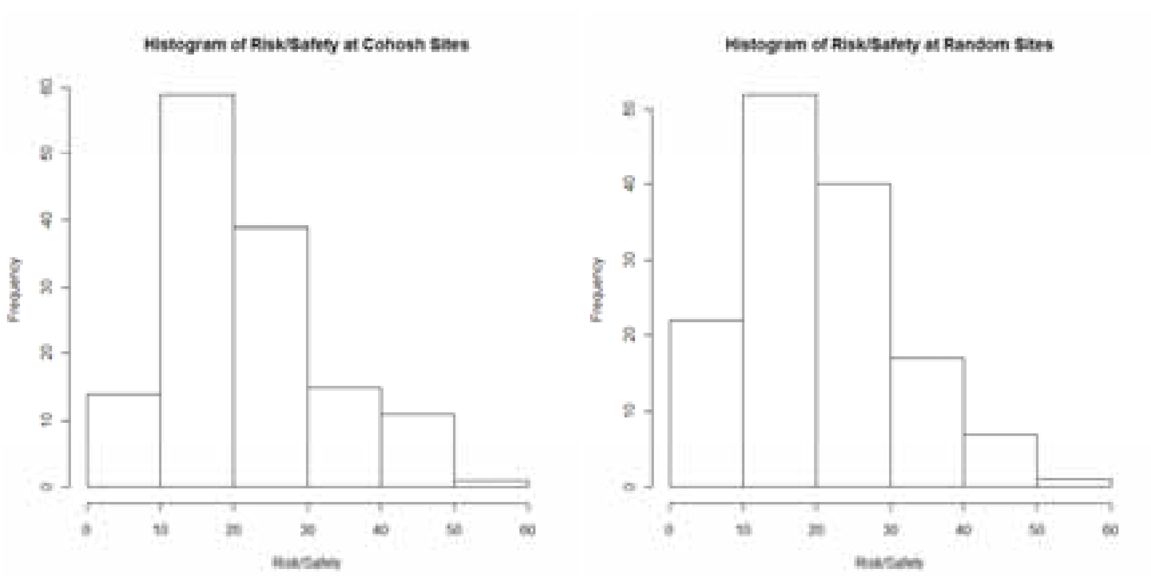


Figure 1. Histogram of Risk/Safety at Cohosh and Random sites.

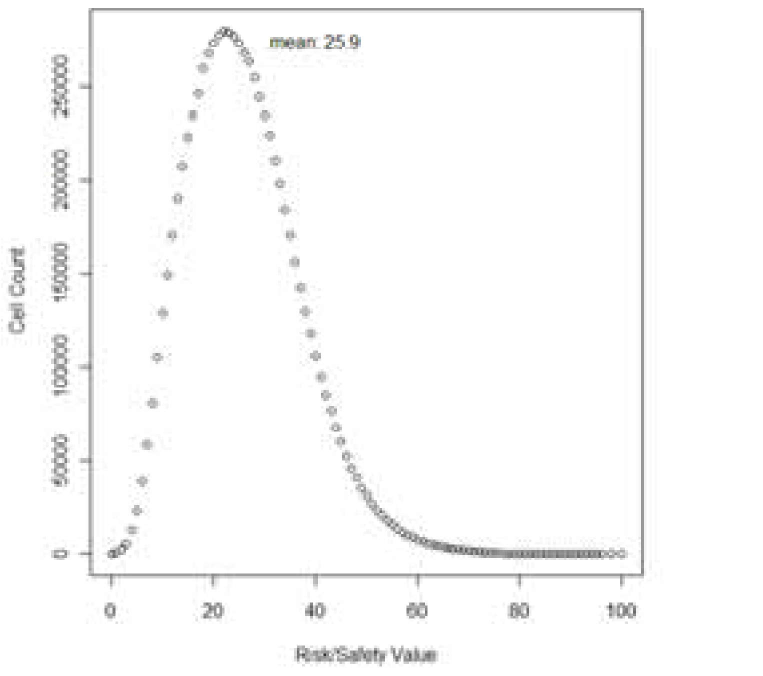


Figure 2. Distribution of Risk/Safety across the landscape (covering the entire study area).

| Forest/Park Name | Area Ha | min | max | mean | sd |
|---|---|---|---|---|---|
| Garrett State SF | 2655 | 8.13 | 61.32 | 21.87 | 7.74 |
| Green Ridge SF | 18825 | 0.15 | 85.55 | 23.20 | 10.52 |
| New Germany SP | 263 | 0.61 | 34.43 | 16.16 | 7.55 |
| Ohiopyle SP | 7736 | 5.86 | **85.73** | 32.75 | 12.82 |
| Potomac SF | 4213 | **0.01** | 61.68 | 23.39 | 10.67 |
| Rocky Gap SP | 1161 | 7.01 | 78.37 | 31.86 | 14.04 |
| Savage River SF | 21698 | 0.08 | 71.59 | 25.43 | 12.43 |

Table 1. Area in hectares, max, min, mean, and standard deviation of Risk/Safety in public lands throughout the study area.

The percentage flowering was similar at sites with variable levels of Risk/Safety (point spread appears uniformly distributed; Figure 3). Note that 43 values of % flowering are zero (32 below and 11 above the midpoint of the range of values). Three of the 139 points were excluded from the analysis of percentage flowering because the reported values of flowering and non-flowering plants were in error.

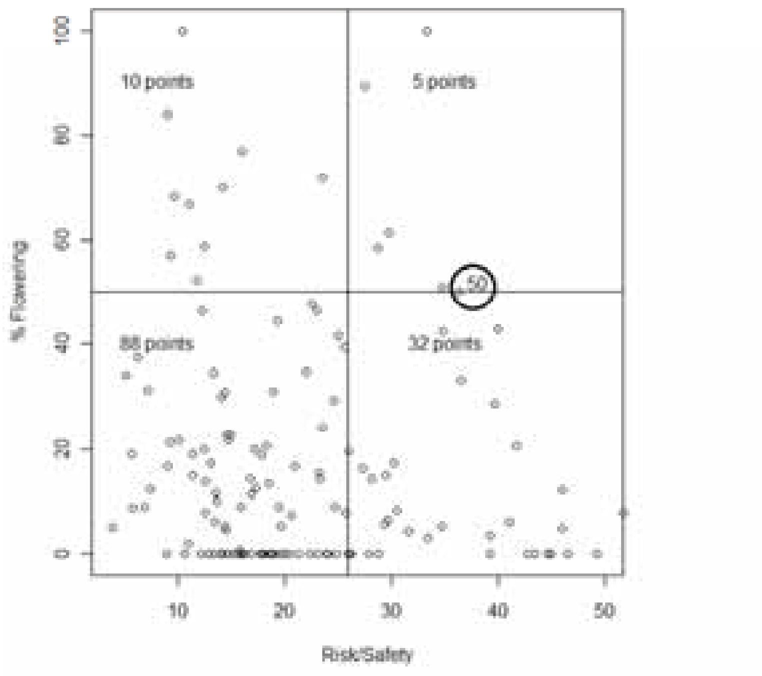


Figure 3. Percent of plants flowering at each site by Risk/Safety. One site (circled) was exactly 50% and was therefore not counted in either of the upper left or lower right quadrant.

Breaking down the Safety/Risk grid into its component parts confirmed that slope throughout the landscape is low relative to distance to roads, trails, and campsites (Figure 4). Range of values for degree slope in the landscape was 0 – 58.9 (percent slope 0 – 165.8). The range for distance to roads was 0 – 55,935.5 while that for distance to trails was 0 – 78,531.9 and distance to campsites was 0 – 96,764.8.

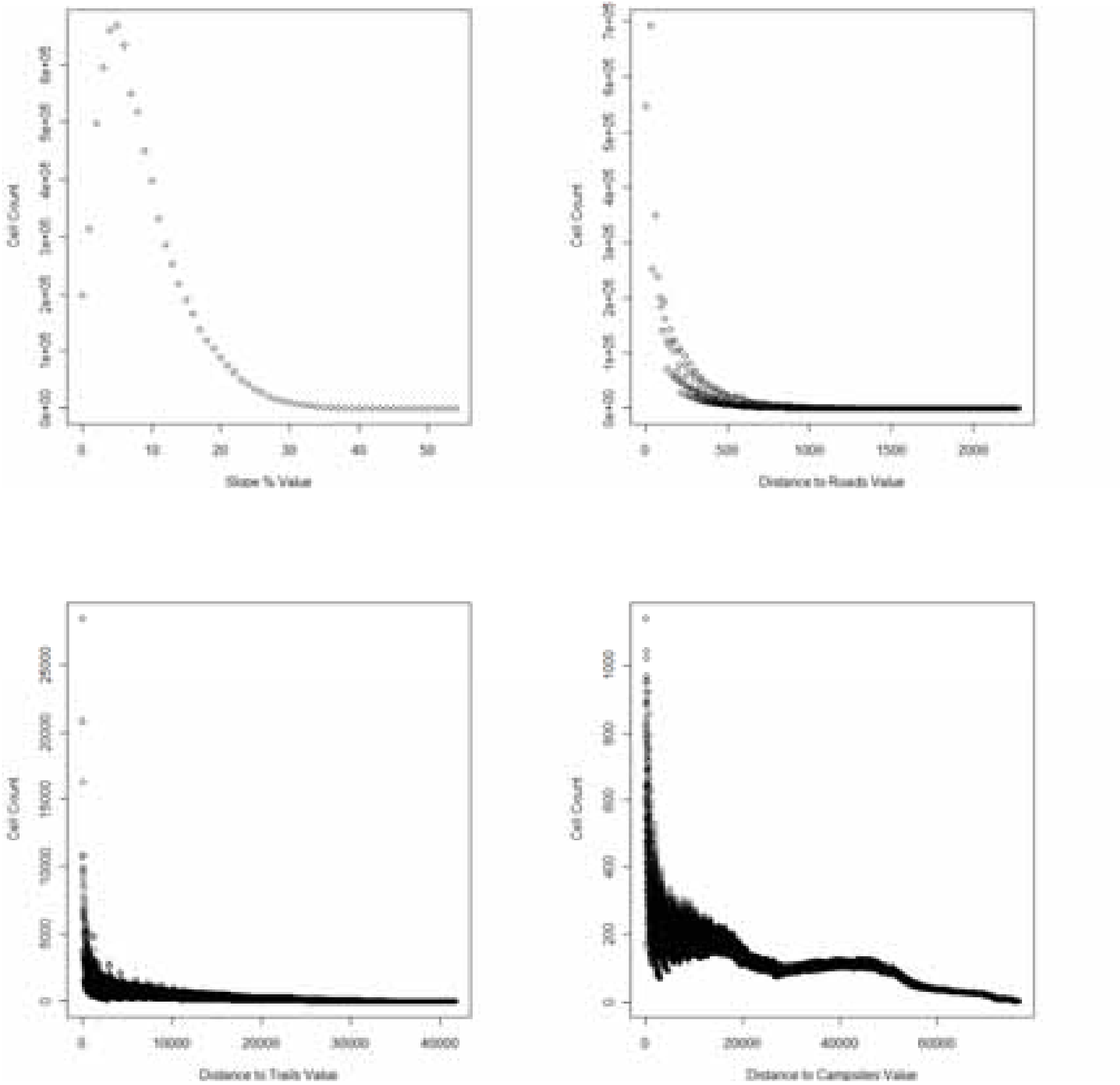


Figure 4. Distributions of slope and distance to roads, trails, and campsites.

Seventy-six, 60, and 7 of the 139 sites were within 100m of roads, trails, and campsites respectively. Within 200m the numbers were 90 (roads), 64 (trails), and 16 (campsites). Moving to 300m, there were 98 sites near roads, 69 (trails), and 24 (campsites). Within 400m 110 (roads), 73 (trails), and 27 (campsites). Finally within 500m 120 sites were near roads, 79 (trails), and 32 (campsites).

Not all parks and forests had campsites and trails (or we didn't have the data). We didn't find any data for campsites at Ohiopyle State Park in PA but we did have 21 campsites in Potomac State Forest, 82 in Savage River State Forest, and 84 in Green Ridge State Forest. Trails were available for most areas and we did have data for a rail trail that goes right through Ohiopyle State Park and the 3 sites nearby at Confluence, PA.

**DISCUSSION:**

It appears from looking at the Risk/Safety data across the landscape that most areas have a relatively high area of risk because few areas are well insulated from roads. Even though slope was the largest factor in the index, most areas have a relatively low degree of slope.

Plant populations within large parks and forests with a lot of protected forest land like Ohiopyle State Park and Savage River State Forest were generally more protected as shown by higher average and maximum Risk/Safety values. Rocky Gap State Park (a smaller area) also had relatively high values. Many smaller areas had lower values especially New Germany State Park (Table 1).

Risk evaluation is potentially useful information but it is a difficult model to evaluate and/or validate without data on how easily discoverable the populations are. One way to test the Risk/Safety index would be to have a student who can identify the plant but is unfamiliar with the black cohosh sites search these general areas and report back on which populations were found. Unfortunately we do not currently have any data on how discoverable these populations are but the index presents a plausible starting point for assessing risk.

The authors suggest a change in status in Maryland of mountain bugbane from rare (S2) to threatened (S1). An increase in protection is warranted due to current limited number of populations, range restrictions to a single county in Maryland, potential exploitation through misidentification with an increasingly valuable medicinal herb, as well as a reduction in habitat due to the hemlock woolly adelgid. Control of hemlock woolly adelgid should be concentrated around existing mountain bugbane populations.

**LITERATURE CITED:**


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