

## Taxonomy in Conservation Biology: The Enigmatic Vancouver Island Beggarticks

### Abstract

During conservation status report work on *Bidens amplissima*, many plants were found that resembled *B. amplissima* but lacked the trilobed leaves ascribed to the species. Herbarium investigations revealed that most plants with this form had been identified as *B. cernua* because of this lack of trilobed leaves. However, these plants more closely resembled *B. amplissima* than *B. cernua* in other leaf and achene characters. Multivariate statistical analysis of morphological characters from herbarium specimens unambiguously separated them into two groups. One group was *B. cernua*, and the other, including all the unlobed and trilobed-leaved specimens, was *B. amplissima*. Recognition of unlobed *B. amplissima* has resulted in an increase in the number of localities for the species, a range extension for the species into Washington State with its addition to the flora of the United States, and loss of its endemic status in British Columbia. This discovery was important for assessment of the status of *B. amplissima* and has broad conservation implications. Our results highlight the need for careful review of the taxonomy of species, particularly within difficult taxonomic groups, when conducting status assessments. Primary data re-evaluation may be critical where status designation has implications for both landowners and governments, and where conservation and protection policies are presently evolving.

### Introduction

*Bidens amplissima* E. Greene (Figure 1.) (Vancouver Island beggarticks) is a rare annual member of the sunflower tribe Heliantheae, in the family Asteraceae. The flower heads range in width from 2.5-3.5 cm, and resemble small sunflowers, with numerous small disk florets in the center and 6-11 bright yellow, petal-like ray florets around the margin of the head. It is a wetland species that blooms in late summer and early fall, and is found primarily on sunny shorelines of ponds, creeks, and rivers, or in bogs, old riverbeds or willow swamps - habitats where water levels are high in winter and spring but low in summer. It occurs preferentially in sites used as resting and preening areas by waterfowl, which are probably the main dispersal agents. The one-seeded, dry fruits (usually called achenes, but also called cypselas because they are derived from compound pistils with inferior ovaries rather

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than from simple pistils with superior ovaries like most achenes) have barbed awns that cling to feathers, fur, and clothing. Sometimes the plant is found in places where the fruits may have been dispersed on people's clothing.

Vancouver Island beggarticks has been considered to be one of only two species of plants endemic to southwestern British Columbia. In addition, its status as a species has been questioned for a very long time. Most authors have considered it to be a hybrid, and many botanists have misidentified the unlobed leaf form as *Bidens cernua* L. (Figure 2.) (nodding beggarticks), a species that is widespread across most of North America and Europe.

Because Vancouver Island beggarticks has a restricted ecological and geographical distribution in the most populated and ecologically disturbed region of British Columbia, it has long been considered rare and potentially endangered in the province and in Canada. In 1999 and 2000, a Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report by two of us (Klinkenberg and Klinkenberg 2001) provided an assessment of the actual numbers and distribution of the species in Canada. During this work, we observed that many populations of *B. amplissima* contained individuals that lacked the key feature of trilobed leaves generally used to identify the species, and concluded that the taxonomic status of these would have to be determined. The essential question during the investigation of the species became: should these morphologically different plants be classified as *B. amplissima* or as the more common *B. cernua*, a determination given to similar plants by past collectors?

We report the results of a taxonomic literature search on *B. amplissima*, of extensive field collections and examination of living specimens, of examination of dried herbarium specimens and of a multivariate statistical analysis of morphological characters of these specimens. The result of this study changed our view of this species and painted a new distributional picture of it in North America.

### A Historical Perspective

The botanical study of Vancouver Island beggarticks began 161 years ago. Plants now considered *B. amplissima* were first named *B. cernua* var. *elata* Torrey & A. Gray in 1842. The California botanist E. L. Greene, who described many plants with slight differences as new species, named *B.*

*amplissima* in 1901 from a specimen collected by the Canadian botanist, John Macoun from along the “Somass” River on Vancouver Island. The genus *Bidens* was monographed by Sherff (1937), and his description and keys for *Bidens amplissima*, all written in Latin, were based on five herbarium specimens, all presumably from Vancouver Island, although two of the earliest ones have no recorded specific locality.

Sherff considered *B. amplissima* to be a hybrid, but did not suggest what the parent species might be. He quoted Wiegand, who had written that this taxon was intermediate between *B. cernua* and *B. comosa* on the one hand, and *B. cernua* and *B. frondosa* on the other. *Bidens comosa* (A. Gray) Wieg. is an eastern North American relative of the European *B. tripartita* L. and is considered by some taxonomists to be conspecific. It has small flower heads without any ray florets, and some tripartite (deeply 3-lobed) leaves. *Bidens frondosa* L. occurs across North America and has small flower heads without ray florets as well as compound leaves with three or more separate leaflets. Sherff distinguished *B. amplissima* from *B. cernua* - both of which have large flower heads with ray florets - primarily by two characters. The presence of some tripartite leaves, divided into three long lobes, and fruits with concave or flat, non-cartilaginous tips defined *B. amplissima*, while *B. cernua* had all leaves undivided and achenes with convex, cartilaginous summits.

### A Recent Perspective

Descriptions and keys in all more recent floras are based on Sherff’s monograph. For example, Cronquist’s description and key (Cronquist 1955) are condensed from Sherff (1937) and translated into English. Presumably influenced by Sherff, Cronquist suggested that *B. amplissima* might be a hybrid between *B. cernua* and *B. frondosa*. Cronquist’s key was slightly modified in Hitchcock and Cronquist (1973), where *B. amplissima* was called Vancouver Island beggarticks, and still considered endemic to Vancouver Island. Douglas *et al.* (1989) were the first to recognize that *B. amplissima* also occurred in the lower Fraser Valley on the British Columbia mainland. They examined many more specimens than previous authors, including specimens in the herbaria of the Royal British Columbia Museum in Victoria and the University of British Columbia (UBC) in Vancouver that neither Sherff nor Cronquist had seen. However, the key in Douglas *et al.* (1989) separated *B. amplissima* from *B. cernua* only on the basis of an erroneous ray floret length character and

tripartite versus simple leaves, implying that all leaves of *B. amplissima* were tripartite. They omitted the achene character used by Sherff and Cronquist. Lyons and Merilees (1995), mentioned that *B. amplissima* occurred both in British Columbia and Washington, although no localities in Washington were given, nor were any specimens mentioned that documented collection of the species in Washington. In the “*Illustrated Flora of British Columbia*” (Douglas *et al.* 1998), the description of *B. amplissima* is simplified from Cronquist (1955), but again excluded the achene difference from *B. cernua*. Douglas *et al.* (1998) still considered *B. amplissima* to be endemic to British Columbia.

Ganders *et al.* (2000) studied evolutionary relationships among several species of *Bidens* using DNA base sequences in the internal transcribed spacers of ribosomal genes. Among the species studied were *B. cernua*, *B. frondosa*, *B. tripartita* (in which they included *B. comosa*) and a population of *B. amplissima* growing beside a pond in Jericho Park, Vancouver. In this population of *B. amplissima* some plants had some tripartite leaves, but other plants that looked identical in every other way had only simple, unlobed leaves. Ganders *et al.* (2000) claimed that some populations of *B. amplissima* were polymorphic for plants with or without tripartite leaves. They also suggested that environmental factors might determine whether plants had some tripartite leaves or all undivided leaves. Small plants in this population tended to lack divided leaves, and in one dry summer no plants with tripartite leaves could be found, although two plants each had one leaf with a lobe on one side. Although Ganders *et al.* (2000) were the first to publish that *B. amplissima* had only undivided leaves, others had noticed this before. Several specimens in the UBC Herbarium, initially identified as *B. cernua*, had been re-identified and annotated as *B. amplissima* by G. G. Douglas in 1976. These specimens were from the lower Fraser Valley of British Columbia.

Ganders *et al.* (2000) found no differences that could distinguish among *B. cernua*, *B. tripartita* (= *B. comosa*), and *B. amplissima*. However, *B. frondosa* was quite different, so Cronquist’s (1955) suggestion is unlikely that *B. amplissima* originated as a hybrid between *B. cernua* and *B. frondosa*. The DNA data did not eliminate the possibility that *B. amplissima* originated as a hybrid between *B. cernua* and *B. tripartita* (= *B. comosa*). The achenes and tripartite leaves of *B. amplissima* are similar to those of *B. tripartita*, but the ray florets are like those of *B. cernua*, although slightly smaller, as might be expected in a hybrid between a species with large ray florets and one lacking

ray florets. To test this hypothesis requires additional genetic data to distinguish among *B. cernua*, *B. tripartita*, and *B. amplissima*, and to see if *B. amplissima* is intermediate between the other two.

No matter how it originated, *B. amplissima* seems to be just as distinct a species as *B. cernua* and *B. tripartita*, and no more variable than they are. The fact that these three species are so similar genetically, and that *B. amplissima* occurs wholly within an area that was glaciated only 13,000 years ago, suggests that *B. amplissima* speciated recently, probably since the last glaciation. A recent origin might also explain why it has not dispersed very far despite its seemingly excellent adaptations for long distance dispersal by waterfowl.

During field work for a COSEWIC status report on *B. amplissima*, Klinkenberg and Klinkenberg (2001) discovered many new localities for the species, as well as observing and collecting unlobed-leaved plants resembling *B. amplissima* at numerous localities in southwestern British Columbia. These often, but not always, occurred with typical tripartite-leaved *B. amplissima*. They also examined herbarium specimens of *B. amplissima* and *B. cernua* from herbaria in British Columbia, Washington, and Oregon, and determined that at least five specimens, labelled *B. cernua* in the herbaria of the University of Washington and Western Washington University, were actually unlobed-leaved *B. amplissima*. These included old collections from as far south as Seattle, as well as recent collections from lakes near Bellingham, Washington. These specimens provided evidence that *B. amplissima* did indeed occur in the Puget Sound region of Washington.

A total of 30 localities for *B. amplissima*, including unlobed-leaved plants, have been documented in southern BC (Klinkenberg and Klinkenberg 2001). This large number of localities for the species means that *B. amplissima* can no longer be considered an endangered species under COSEWIC definitions, but rather is a species of "special concern". The discovery of the Washington records also means that this species can no longer be considered endemic to British Columbia.

This finding made it important to test whether or not unlobed-leaved *B. amplissima* is really *B. amplissima*. We conducted a multivariate statistical analysis (Klinkenberg, Ganders and Klinkenberg, in preparation) of morphological characters from specimens of unlobed and trilobed *B. amplissima* and *B. cernua*. Analysis of 23 characters (including achene length/

width, petal length/width, leaf length/width, achene summits, etc.) on 54 mature specimens unambiguously separated the specimens into two groups. One group was *B. cernua*, and the other *B. amplissima*, which included all the unlobed and trilobed-leaved specimens. Hence, there is no doubt that the unlobed-leaved *B. amplissima* really is *B. amplissima*, and that *B. amplissima* differs from *B. cernua*.

Mature fruits (Figure 3.) provide the most reliable differences. As noted by Sherff and Cronquist, those of *B. amplissima* have concave or flat, non-cartilaginous summits while those of *B. cernua* have convex cartilaginous summits. The shape of fruiting heads is different and particularly noticeable on pressed specimens. They are hemispherical in *B. amplissima* and globular to almost circular in *B. cernua*. Mature fruits of *B. amplissima* extend beyond the involucre and chaffy receptacular bracts of the head but usually do not do so in *B. cernua*. The species can also be distinguished by their leaves. Leaves of *B. amplissima* taper distinctly from the widest point to the base and apex, whether or not they are unlobed or sometimes tripartite. Those of *B. cernua* are never lobed and are strap-shaped, with nearly parallel sides for much of their length.

Several other characters usually differ between the species. Flower heads of *B. amplissima* are always erect, but the largest are usually nodding in *B. cernua*. Ray florets are usually shorter in *B. amplissima* than in *B. cernua*, but there is considerable variation on the same plant in both, with lateral heads normally smaller with smaller ray florets. This and other quantitative characters, like lengths and widths of parts, are often different, but size characters are usually affected by environment to a considerable degree and do not always separate individual specimens.

### Conclusion

It is sad in a way that British Columbia has lost one of its few endemic species. But it is not surprising that a species that occurs within metres of the international boundary, and is so easily dispersed by ducks and other waterfowl, also occurs in Washington State. Ecologically, the Puget Sound region of Washington and southwestern British Columbia are very similar. The international boundary arbitrarily divides this rather uniform floristic region. Vancouver Island beggarticks is still endemic to a rather restricted geographical area, from Seattle, Washington, to southern Vancouver Island

and the Lower Mainland of British Columbia.

From the above, it is clearly important that the taxonomy of proposed endangered species be subject to critical review. Primary data re-evaluation may be critical for conservation where status designation has implications for both landowners and governments, and where conservation and protection policies are presently evolving. In many cases there has never been a critical study of the taxonomy of rare species, and the fact that they have been accepted as species for many years does not necessarily mean that they have been correctly interpreted. In the case of *Bidens*, Sherff's taxonomic treatment has been shown to contain many flaws, and everyone who has studied *Bidens* experimentally has made major changes to his interpretations of species (Ballard 1986; Ganders and Nagata 1990; Ganders *et al.* 2000; Gillett and Lim 1970; Hart 1979; Roseman 1986). *Bidens cuneata* Sherff was one of Sherff's many "species" based solely on leaf characters, and supposedly endemic to the hot, dry summit of Diamond Head in Honolulu, Hawaii. It was listed as endangered by the U. S. federal government. However, when grown in a cooler, wetter environment, the leaves changed, and were identical to *Bidens molokaiensis*, which it resembled in every other way. After the two were synonymized (Ganders and Nagata 1990), there were tremendous bureaucratic barriers to have it officially delisted from the U. S. Endangered Species List. It would be good to prevent this by recognizing the important role that even preliminary taxonomic investigations can play in conservation biology and endangered species protection.

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