



Artemisia campestris
ssp. *borealis*
var. *wormskioldii*

Taxonomic Review

Prepared for
U.S. Fish and Wildlife Service
Region 1

Prepared by

Joseph Arnett

January 17, 2012



Artemisia campestris ssp. *borealis* var. *wormskioldii*

Taxonomic Review

Section 6, Segment 64

January 17, 2012

Joseph Arnett

Rare Plant Botanist

Washington Natural Heritage Program Botanist

Introduction

The taxonomy of the genus *Artemisia* (Asteraceae) is complex, and the classification of the variety that is the subject of this review has not escaped the nomenclatural challenges of the genus. However, as difficult as resolving taxonomic questions may be, classification influences conservation priorities and affects allocation of funds for research and conservation activities (U.S. Fish and Wildlife Service 1983), and so it is important to develop and promote classification that most accurately reflects the genetic relationships among the plants of Washington.

This review examines a variety of *Artemisia* included in the most recently published regional flora (Hitchcock and Cronquist 1973) as *A. campestris* ssp. *borealis* var. *wormskioldii*. The original description of variety *wormskioldii* included arctic and montane plants (Hooker 1833, Piper 1906), but modern floras (Cronquist 1955, Douglas et al. 1998, Hitchcock et al. 1955, Hitchcock and Cronquist 1973, Hulten 1968, Welsh 1974) are consistent in limiting the application of var. *wormskioldii* to a narrowly distributed Columbia River endemic. Arctic and montane plants have been assigned to other taxa. The classification above the level of variety, and between *A. campestris* and *A. borealis*, has been repeatedly revisited and resorted; Hitchcock et al. (1955) include 12 synonyms under *A. campestris*. Cronquist included varieties *purshii* (=var. *borealis* in 1955), *scouleriana*, and *wormskioldii* together in subspecies *borealis* within *A. campestris* (Hitchcock et al. 1955, Hitchcock and Cronquist 1973, Cronquist et al. 1994). The Oregon Flora Project (OFP) checklist includes var. *wormskioldii* as *A. campestris* var. *wormskioldii* (OFP 2012).

In the recent treatment of *Artemisia* in the Flora of North America (FNA), Shultz (2006) does not include variety *wormskioldii*. In personal communications in 2006, she said that her omission was not because she regarded the taxon as invalid, but rather because she had not been able to examine it; she recommended that we continue to recognize the variety, if our familiarity with it indicates that it is distinct. She has kindly offered to review specimens of this variety, but unfortunately she has not yet had the opportunity to do so. Consequently, she has not recommended whether it should be placed in *A. campestris* or *A. borealis*. Both species, as treated in FNA classification, occur in Washington.

Preliminary examination of herbarium specimens at the University of Washington indicates that variety *wormskioldii* is intermediate between varieties *scouleriana* and *purshii* (according to Cronquist's 1973 nomenclature). With the montane variety *purshii* it shares the traits of larger involucre, dense spiciform panicles, low stature, and flowering time shortly after release from winter dormancy. With lower elevation var. *scouleriana* it shares habitat and identical leaf morphology, including sericeous pubescence. Using FNA keys, var. *wormskioldii* keys readily to *A. borealis* ssp. *borealis*. Overall, in my interpretation, variety *wormskioldii* appears much more similar to variety *purshii* than to variety *scouleriana*.

In 2007, the Washington Natural Heritage Program recognized Shultz's elevation of ssp. *borealis* to the species level and included this variety as *A. borealis* var. *wormskioldii* on the Washington State rare plant list and in the recently published *Field Guide to the Rare Plants of Washington* (Camp and Gamon 2011). This combination was the one in Hooker's original publication in 1833, but we no longer consider it valid because his circumscription included arctic and montane plants no longer considered to be part of variety *wormskioldii*.

Our present challenge is to recognize nomenclature, for variety *wormskioldii* and its other close relatives in Washington, that is consistent with both FNA and OFP, and which is also consistent with the characteristics of the plants we have observed in the field. We have found that it is not possible to do all three.

Taxonomic History

The following paragraphs give a brief summary of pertinent taxonomic treatments of variety *wormskioldii*:

1833. Hooker first described the taxon *A. borealis* var. *wormskioldii*. His circumscription included arctic and Rocky Mountain plants, as well as Columbia River shoreline and island plants collected by David Douglas.

1906. Flett included *A. borealis wormskioldii* in *Flora of the State of Washington*, referring to collections from the Olympic Mountains and Mount Rainier.

1948. Cronquist annotated a 1937 collection by Muenscher from the Olympic Mountains as *A. campestris* ssp. *borealis* var. *purshii*, indicating that he already regarded *borealis* as a subspecies of *A. campestris*.

1950. Cronquist placed variety *wormskioldii* in *A. campestris*, apparently taking it out of *A. borealis*, thus calling it *A. campestris* var. *wormskioldii*. His note from this date does not indicate whether the arctic and alpine species formerly within *A. borealis* remained there, or were also included in *A. campestris*.

1955. Cronquist placed varieties *borealis*, *scouleriana*, and *wormskioldii* in subspecies *borealis* within *A. campestris*.

1973. Cronquist reiterated the classification that he developed in 1955.

1994. Cronquist et al. included ssp. *borealis* as a subspecies of *A. campestris*. He refers to *A. campestris* ssp. *borealis* var. *scouleriana* (Cronquist 1994). In referring to *A. campestris* var. *scouleriana* he said: “Our plants, as here described, represent the var. *scouleriana* (Besser) Cronquist, which is widespread in the western North American cordillera. Variety *scouleriana* may be considered a part of the circumboreal subsp. *borealis* (Pall.) H.M. Hall & Clem”.

2006. Shultz split ssp. *borealis* (as it was conceived of by Cronquist) and placed plants that he included within that subspecies into two different species; variety *purshii* was placed within *A. borealis*, and variety *scouleriana* was placed within *A. campestris* ssp. *pacifica*. She did not include var. *wormskioldii* in her treatment.

2007. The Washington Natural Heritage Program recognized the FNA elevation of ssp. *borealis* to the species level and began using the name *A. borealis* var. *wormskioldii* for the Columbia River endemics (Washington Natural Heritage Program 2012). This returns to the name published in 1833, the only publication of this combination.

2012. The draft list for the Oregon Flora Project uses *A. campestris* var. *wormskioldii* (OFP 2012).

Table 1. Comparison of taxonomic treatments including *Artemisia campestris* var. *wormskioldii*

Hooker (1833)	Hitchcock et al. (1955)	Hitchcock & Cronquist (1973)	Shultz (2006)	Oregon Flora Project (2012)	Washington Flora Checklist (2012)
<i>A. borealis</i> var. <i>wormskioldii</i>	<i>A. campestris</i> ssp. <i>borealis</i> var. <i>wormskioldii</i>	<i>A. campestris</i> ssp. <i>borealis</i> var. <i>wormskioldii</i>	not included	<i>A. campestris</i> var. <i>wormskioldii</i>	<i>A. campestris</i> var. <i>wormskioldii</i>
	<i>A. campestris</i> ssp. <i>borealis</i> var. <i>borealis</i>	<i>A. campestris</i> ssp. <i>borealis</i> var. <i>purshii</i>	<i>A. borealis</i> ssp. <i>borealis</i>	not in OR	<i>A. campestris</i> var. <i>purshii</i>
	not in the range of the flora	not in the range of the flora	<i>A. borealis</i> ssp. <i>richardsoniana</i>	not in OR	not in Washington
	<i>A. campestris</i> ssp. <i>borealis</i> var. <i>scouleriana</i>	<i>A. campestris</i> ssp. <i>borealis</i> var. <i>scouleriana</i>	<i>A. campestris</i> ssp. <i>pacifica</i>	<i>A. campestris</i> var. <i>scouleriana</i>	<i>A. campestris</i> var. <i>scouleriana</i>

Discussion

Several problems arise with placing variety *wormskioldii* in *A. borealis*. The first is that if we recognize the FNA treatment of var. *scouleriana* as part of *A. campestris* ssp. *pacifica*, it places these two apparently closely related varieties in different species. The second problem with using *A. borealis* var. *wormskioldii* as circumscribed by Hooker (1833) is that he included arctic and montane plants not included in current understanding of the variety. A third, practical problem, is that using *A. borealis* is inconsistent with the usage of the OFP. Though believed to have been extirpated from Oregon, variety *wormskioldii* was historically collected in that state, and large efforts are currently underway to reestablish the taxon in that part of its historical range. If the two neighboring states refer to this taxon, which is of high conservation concern, by different names, it creates unnecessary confusion within the conservation community.

Conversely, the main problem with placing variety *wormskioldii* in *A. campestris*, as circumscribed in FNA, is that it places this taxon in a different species from var. *purshii* (subspecies *borealis* in FNA), which appears to be a close relative; possibly closer, in our estimation, than var. *scouleriana*. Ken Chambers (personal communication), who has also studied these plants, expressed the view that variety *wormskioldii* appears to have been derived from alpine plants (based on stature and early flowering) and that placement of them in *A. campestris* only made sense to him if *A. campestris* also includes the other varieties of what Cronquist regarded as subspecies *borealis*.

Because variety *wormskioldii* appears closely related to both varieties *scouleriana* and *purshii*, based on Cronquist's classification and our own observations in the herbarium and in the field, it does not seem satisfactory to assign variety *wormskioldii* to either species, as delineated in Shultz (2006), if doing so separates it from apparently close relatives.

Nomenclatural Recommendation

The genetic relationships among the plants being here reviewed are not clear. As Shultz (2006) recognizes, the boundary between *A. borealis* and *A. campestris*, in the 2006 FNA classification, appears indistinct especially when they come into contact, and they may intergrade. Variety *wormskioldii* occurs precisely in that overlap, and we are not able to confidently place the variety in either species as presented in FNA. Consequently, we are most comfortable with returning to the last published treatment of these plants (Hitchcock and Cronquist 1973), recognizing his delineation of subspecies *borealis*, including varieties *scouleriana*, *purshii*, and *wormskioldii* in Washington. Under this treatment, our variety is referred to as *A. campestris* ssp. *borealis* var. *wormskioldii*. This name is consistent with the OFP use of *A. campestris* var. *wormskioldii*; the International Code of Botanical Nomenclature, Section 5, Article 24 (2007) requires only the specific name and the infraspecific epithet; inclusion of the full classification between species and the lowest infraspecific rank is permitted but not required. However, this treatment remains unavoidably inconsistent with FNA (Shultz 2006), which treats *A. campestris* and *A. borealis* as distinct species.

We don't presume that the centuries-long examination and revision of this genus is finished, and we look forward to subsequent revision of FNA to include variety *wormskioldii*. Our review does not address the relationship of the three Washington taxa with arctic taxa or others not found in the state; resolution of those relationships will have to be accomplished by researchers in a broader review of the genus.

Finally, although there is no formal process of adopting common names, nor do we recommend one (Arnett 2004), in this case we suggest that the common name "Wormskiold's wormwood" would be explicit in referring to these plants and would remain independent of future changes in understanding about the relation of these plants to either *A. borealis* or *A. campestris*.

Acknowledgements

Many thanks to the botanists who have communicated with me on this complex taxonomy: Ken Chambers of the Oregon Flora Project and Oregon State University, John Gamon of the

Washington Natural Heritage Program, David Giblin from the University of Washington, Stephen Meyers of the Oregon Flora Project, and Leila Shultz from the Flora of North America and the University of Utah. Their attention to this topic has enriched my understanding of it; however, any mistakes in interpretation are mine.

References

Arnett, J. 2004. What's in a name? On common names for plants. In *Walking in the Beauty of the World*. Washington Native Plant Society, Seattle.

Camp, P. and J. Gamon. 2011. *Field Guide to the Rare Plants of Washington*. University of Washington Press, Seattle

Cronquist, A. 1994. *Intermountain Flora, vascular plants of the intermountain west, U.S.A.* Volume 5, Asterales. New York Botanical Garden, New York. 30June1994.

Douglas, G.W., G.B. Straley, D. Meidinger, and J. Pojar. 1998. *Illustrated Flora of B.C., Vol. 1*. B.C. Ministry of Environment, Land and Parks and Ministry of Forests.

Hall, H. M. and F. E. Clements. 1923. The phylogenetic method in taxonomy: The North America species of *Artemisia*, *Chrysothamnus*, and *Atriplex*. Publ. Carnegie Inst. Wash. 326.

Hitchcock, C. L., and A. Cronquist. 1973. *Flora of the Pacific Northwest*. Seattle: University of Washington Press.

Hitchcock, C. L., A. Cronquist, M. Ownbey, and J. W. Thompson. 1955. *Vascular plants of the Pacific Northwest*. Part 5, Compositae, by Arthur Cronquist. University of Washington Press.

Hooker, W. J. 1833. *Flora boreali-Americana, the botany of the northern parts of British America. Volume 1*. London: H. G. Bohn. Accessed on-line 9January2012 at <http://www.biodiversitylibrary.org/item/13839#page/337/mode/1up>.

Hulten, E. 1968. *Flora of Alaska and Neighboring Territories*. Stanford University Press.

International Code of Botanical Nomenclature (the Vienna Code). 2007. Accessed online on 6December2012 at <http://ibot.sav.sk/icbn/main.htm>.

Ling, Y. R. 1982. On the system of the genus *Artemisia* L. and the relationship with its allies. Bull. Bot. Lab. N. E. Forest. Inst., Harbin 2: 1–60.

Ling, Y. R. 1995. The New World *Artemisia* L. In: D. J. N. Hind et al., eds. 1995. *Advances in Compositae Systematics*. Kew. Pp. 225–281.

Oregon Flora Project. 2012. Oregon Flora Project vascular plant checklist. Accessed online on January 4, 2012 at <http://www.oregonflora.org/checklist.php>.

Piper, C.V. 1906. *Flora of the State of Washington*. Contributions from the U.S. National Herbarium, *Artemisia borealis wormskioldii*. 11:587.

Shultz, L. 2006. *Artemisia*, in Flora of North America Editorial Committee, eds. 1993+. *Flora of North America North of Mexico*. 14+ vols. New York and Oxford.

Torrell, M., N. Garcia-Jacas, A. Susanna, and J. Valles. 1999. Phylogeny in *Artemisia* (Asteraceae, Anthemideae) inferred from nuclear ribosomal DNA (ITS) sequences. *Taxon* 48: 721–736.

U.S. Fish and Wildlife Service. 1983. Endangered and Threatened Species Listing and Recovery Priority Guidelines. Federal Register 48(184): 43098-43105. Available online at: <http://www.fws.gov/endangered/esa-library/pdf/48fr43098-43105.pdf>

Valles, J. and E. D. McArthur. 2001. *Artemisia* systematics and phylogeny: Cytogenetic and molecular insights. In: E. D. McArthur and D. J. Fairbanks, comps. 2001. *Shrubland Ecosystem Genetics and Biodiversity: Proceedings: Provo, UT, June 13–15, 2000*. Ogden. Pp. 67–74.

Washington Flora Checklist. 2012. Maintained by the University of Washington Herbarium at the Burke Museum. Accessed online on 9January2012 at <http://biology.burke.washington.edu/herbarium/waflora/checklist.php>.

Washington Natural Heritage Program. 2012. List of vascular plants tracked by the Washington Natural Heritage Program. April 19, 2011. Accessed 6January2012 at <http://www1.dnr.wa.gov/nhp/refdesk/lists/plantrnk.html>.

Welsh, S.L. 1974. *Anderson's flora of Alaska and adjacent parts of Canada*. Brigham Young University Press, Provo, UT.

Personal Communications

From Ken Chambers, March 7, 2011:

Dear Joe,

This is o.k. by me. We can always adapt the Oregon Flora treatment when it comes time to finalize the writing of that genus (that may be my future job, which I'm not looking forward to very much). Linking it with "*borealis*" is o.k., as long as it isn't made a simple variety of *A. campestris* without acknowledging the "*ssp. borealis*" connection.

Let me know what Schultz says, after you hear from her on this. She has some kind of conception of "*borealis*" as a species. I did know it was upstream near Beverly--someone had told me that. I'm still interested in someone doing the DNA comparison that I mentioned.

Best wishes, Ken

On 3/7/2011 4:17 PM, Joe Arnett (DNR) had written:

Hi Ken,

Many thanks for your careful reply. We decided in our 2007 rare plant list revision to use the name *A. borealis* var. *wormskioldii*, based on Shultz elevating ssp. *borealis* to the species level in FNA, since var. *wormskioldii* was considered by Hitchcock and Cronquist as part of ssp. *borealis*. When the deadline for the rare plant book came, we did not feel that the issue was clear enough yet to warrant switching back to *campestris*. If I had been aware in 2007 that the Oregon Flora was going to keep this variety as part of *A. campestris*, I might have just used their combination. I don't see it to be the Natural Heritage Programs' role to make nomenclatural decisions, but rather to reflect the most credible and recent publications.

I share your view that var. *wormskioldii* appears to have an affinity with alpine plants, because of its stature and early flowering. You may not know that it has also been found upstream in the vicinity of Beverly, on cobbles along the Columbia that were likely scoured even in flooding in the 1900s, let alone the big Bretz floods. On the other side of this, the vegetative similarity to *Artemisia campestris* var. *scouleriana*, common all along the Columbia and far beyond, is striking.

Leila Shultz has offered to look at specimens of var. *wormskioldii* when she has the chance, and I will be interested in what she thinks. I will keep you informed!

At least, from a practical perspective, while the phylogenetic relationships remain to be determined, I don't think there is any confusion about which plants we are referring to when we use var. *wormskioldii*.

Again, thanks for your review of this,
Joe

From: Kenton Chambers [<mailto:chamberk@science.oregonstate.edu>]
Sent: Monday, March 07, 2011 3:09 PM
To: ARNETT, JOSEPH (DNR)
Subject: *Artemisia campestris wormskioldii* question

Dear Joe,

You'd written me back in Dec. 2010 about my opinion on naming the var. *wormskioldii* of the Columbia River islands, etc. I see that you have published the Washington Rare Plant Species booklet now, so you evidently did pick a name to use in that work. Our treatment for Oregon Flora uses *Artemisia campestris* var. *wormskioldii* (Bess.) Cronquist. The complete citation that I favor is *Art. campestris* ssp. *borealis* var. *wormskioldii*, but the Ore. Flora usually doesn't go for quadrinomials like this. The plants are clearly related to the taxon *borealis*, which is sometimes made a species of *Art.* and sometimes a subspecies of *Art. campestris* (the more inclusive view). In the treatment of *Art.* by George Ward in Abrams Illustrated Flora of the Pacific States (v. 4, p. 410-411), var. *wormskioldii* is made a synonym of *Art. c.* ssp. *borealis*; in the recent FNA treatment by Leila Schultz, var. *w.* is not accounted for at all, it appears.

The known location of this variety, right along the Columbia River at the east end of the Gorge, is most peculiar, as the variety could not have originated (evolved) in such sites. The river there was swept by the 400-foot-deep glacial Spokane (Bretz) Floods between 12,000 and 15,000 years ago. It had to have an origin elsewhere and its seeds washed in and deposited along the river in the last 12,000 years. Since it is closely related to *A. borealis*, in fact is nothing more than a minor variant of that taxon, and *A. borealis* is common in the higher elevation mountains of the Columbia River drainage farther upstream, my favored hypothesis is that seeds from these upstream elevations were carried down the river and chanced to lodge and form populations where the plants we call var. *wormskioldii* are found today. A nice molecular-systematic study for some student would be to compare the DNA of var. *worm.* with various ssp. *borealis* populations from the mountains of Washington, B.C., Idaho, and Montana. It might be possible to specify its closest current relatives among these populations.

It is strange that none of the past taxonomists dealing with this variety have commented on its location in a flood-swept part of the Columbia River--but then, botanists may not have been alert to the significance of past massive flooding on the river, when it comes to plant species distributions. Recent molecular studies by Keith Caroly at Reed College, on species such as *Delphinium nuttallii*, do involve consideration of the floods' effect on present-day distribution of identified DNA haplotypes of the species.

So this is my *Artemisia* lecture for the day, which you can file away for future consideration.

Best wishes, as always,

Ken

From Stephen Meyers, Oregon Flora Project, 18October2010:

It has come to my attention, through Kelly Amsberry of the Oregon Department of Agriculture, that there is some confusion (particularly in Washington) over whether populations of *Artemisia* in the Columbia River Gorge area should be referred to as *Artemisia borealis* var. *wormskioldii* or *Artemisia campestris* var. *wormskioldii*.

Perhaps a brief history of *A. borealis* and *A. campestris* and variety *wormskioldii* will clear up this confusion.

Both *A. borealis* and *A. campestris* are valid species recognized by most modern floras. As one might ascertain from the authorities of these species *A. campestris* (described by Linnaeus) is the older species name and *A. borealis* the more recent (described by von Pallas.)

Artemisia borealis and *A. campestris* are closely related and likely sister species. As a result of their close relationship some workers, in the past, have demoted *A. borealis* to a variety of *A. campestris*.

It was, however, during a period of time in which *A. borealis* was considered a species, that variety *wormskioldii* was described as a variety of *A. borealis* by Hooker (1833).

Due to the subsequent and numerous reclassifications of *A. borealis*, since the time of the original description of variety *wormskioldii*, that this later taxon has been referred to by several names, including *A. borealis* var. *wormskioldii*, *A. campestris* var. *wormskioldii*, *A. borealis* f. *wormskioldii* and *A. campestris* ssp. *borealis* var. *wormskioldii*.

Taxonomic clarity and nomenclatural correctness was finally brought to this taxon by Cronquist in 1950. Cronquist determined that Hooker had mistakenly assigned variety *wormskioldii* to *A. borealis*, when it should have been assigned to *A. campestris*. Thus, the correct name for this taxon is *A. campestris* var. *wormskioldii*.

The original and most recent (excluding FNA) descriptions for this taxon can be found in the following publications:

Artemisia borealis Pall. var. *wormskioldii* Besser in Hook. -- Fl. Bor.-Amer. (Hooker) 1: 327. 1833.

Artemisia campestris L. var. *wormskioldii* (Besser ex Hook) Cronquist -- Leaflet. W. Bot. 6: 43. 1950.

Excerpts from Key References

From Hooker, W. J. 1833, pp. 326 & 327.

22. *A. borealis*; herbacea cespitosa villosa-sericea vel glabra, calathidibus spicato-racemosis rarius paniculatis hemisphericis, periclinii squamis ellipticis scariosis, caule simplici, foliis (exceptis summis) petiolatis, radicalibus lineari-lanceolatis integerrimis, apice 3-5-fidis pinnatisectis bipinnatisectis imo supra decomposito-sectis, laciniis lanceolatis linearibus vel filiformibus, caulinis bipinnatisectis pinnatisectis 5-fidis vel linearibus integerrimis.-*Pall. It. v. . App. n. i29. t. H. h.f. 1. Less. in rShechtend Linna, v. 6. p.*
211. *Bess. Dracunc. MSS. Rich. in Frankl. 1st Journ. ed. 2. App. p. 80. Hook. et Arn. in Bot. of Beech. Voy. v. 1. p. 125.-a. Purshii*; sericea, cinerea; la radicalia lineari-an-ceolata integerrima, vel apice 3-5-fida: caulina et floralia linearia: cauthia inferiora pedunculata, superiora subsessilia; periclin squamne villosS, medio , flos nudi. Caulis adscendens 6", violaceus, superne villosissimus. *A. spitham P , . Am. v. 2. p. 522*; folia prioris glabern: caulina imo floralia inferiora 5--fd; athidia omia subsessilia, periclinii squama glabre, medio virides. Caules erecti vel liqui, 3-5, violacei, basi pedicellique ab-villoi.- . rWormskoldii. (Bess. Monog Art. ined.) incana, subsericea: folia radicalia longe petiolata -5-fida, laciniis 3-2-fidis, rarius 5-fidis vel indivisis, lineari- lanceolatis 5") caulina inferiora iis similia, minora et brevius petiolata: floralia 5-3-secta vel simplicissima linearia: calathidia racemosa, e singula axilla gemina, altero subsessili, peduculi infimi 2-3-flori; periclinii squamoe medio fusae, flosculi & apice pilosuli. Caulis 15".

HAi. Labrador. Koklmeister. Dr.Morrison. Arctic Shores of North America . Dr. Richardson.

Rocky Mountains. Drumond.--y. Columbia River and Islands, North-West America. Douglas. Dr. Scouler. Kotzebue's Sound. Messrs. Lay and Collie.

There are still some specimens in my collection, which, from the extreme difficulty in characterizing the species of this Genus, and the want of more perfect individuals, I am obliged to leave undetermined. Mr. Pursh gives the " *A. Chinensis*; foliis inferioribus cuneiformibus obtusis trilobis, superioribus linearibus obtusis, floribus globosis pedunculatis cernuis," (Willd.), as a native of the North-West coast, upon the authority of Mr. Lambert's Herbarium. I possess the true plant, gathered in Kamtschatka by Chamisso, but I have seen no American specimens. (H.)

From Shultz 2006;

Subgenus *Dracunculus* is clearly distinguished by molecular differences. Molecular analyses have helped define subgenera but have not clarified relationships between closely related species. The morphologic characters useful in distinguishing species tend to be variable and are often hard to assess (i.e., the sexuality of microscopic florets). Users of the keys will meet with frustrations; descriptions of subgenera and illustrations will help in defining the major groupings of species.

Molecular studies define subg. *Dracunculus* as a major clade that is ancestral to the majority of *Artemisia*.



Figure 1. Scan of herbarium specimen of *Artemisia* collected by Suksdorf in 1896. Note the annotation by A.C. (I assume this is Arthur Cronquist) as *A. campestris* ssp. *borealis* var. *wormskioldii*.

Artemisia specimens examined at the University of Washington Herbarium at the Burke Museum (WTU) January 2012 by Joe Arnett

collector	number	label species	Annotation 2012	collection date	exam date	collection location	plant height (cm)	herbage pub.	invol (mm)	invol pubescence	inflorescence	notes
Arnot, M	681	A. campestris ssp. borealis var. scouleriana	A. campestris ssp. borealis var. scouleriana	25Aug1993	5Jan2012	Chelan	55	sericeus	3.5	glab	widely br pan	
Calder, J.A. and Savile	11944	A. campestris ssp. borealis var. scouleriana		17Aug1953	11Jan2012	Kinbasket Lake BC	58	sericeus	4-4.5	glab	moderately narrow pan	large invol and intermediate infl more like A. borealis, but size more like var. scouleriana
Denton	3371	A. campestris		19July1973	5Jan2012	Deer Park, Olympics						look like A. borealis
French, B.	07-17	A. campestris ssp. pacifica	A. campestris ssp. borealis var. scouleriana	21Sept2007	5Jan2012	Castle Is	70	sparsely sericeous	3	glab	broad pan	pan is robust, thick
Gardner,	sn	A. canadensis	A. campestris ssp. borealis var. scouleriana									
Hitchcock	20449	A. campestris ssp. borealis var. wormkioldii	A. campestris ssp. borealis var. wormkioldii	28May1955	5Jan2012	Mouth of John Day R	18	sericeus	4	glab	spiciform pan	
Hitchcock	10565	A. campestris		10Oct1937	11Jan2012	Port Townsend beach		nearly glab		glab	broad pan	
Kemp	sn	A. campestris ssp. borealis var. wormkioldii	A. campestris ssp. borealis var. wormkioldii	6-7-1983	5Jan2012	Miller IS	25	sericeus	4	glab	spiciform pan	I presume date is June 7

Kemp	sn	A. campestris ssp. borealis var. scouleriana	A. campestris ssp. borealis var. scouleriana	6-7-1983	5Jan2012	Miller IS	30 (broken off)	sericeus	3.5	glab	widely br pan	infl only
Kemp	80099	A. campestris ssp. borealis var. scouleriana	A. campestris ssp. borealis var. scouleriana	27Aug1980	5Jan2012	W of Maryhill bridge	55	sericeus	3	glab	somewhat spreading pan	
Kemp	sn	A. campestris ssp. borealis var. wormkioldii	A. campestris ssp. borealis var. wormkioldii	10-5-1983	5Jan2012	Miller IS	20	sericeus	4	glab	spiciform pan	I presume date is May 10
Komarkova	236	A. borealis ssp. purshii		20July1976	5Jan2012	Barrow	21	long dense pub	4	pub	spiciform pan	annotated to A. campestris var. borealis
Krajina	sn	A. campestris		28Aug1950	11Jan2012	Mara Lake BC						Ann. In 1990 to A.c. ssp. b var. scouleriana, but looks atypical. Lvs most all basal, narrow and fascicle, nearly glabrous, plant only 25cm,
Mastro-giuseppe	6649	A. campestris ssp. borealis var. scouleriana	A. campestris ssp. borealis var. scouleriana									Lvs still pubescent but nearly glab
Muenschner	11042	A. campestris ssp. borealis var. purshii		15July1937	5Jan2012	Clallam Co, Blue Mt	25	sericeus	to 4	sericeus, or longer pub	spiciform pan	Determined by A. Cronquist in 1948; red tipped corollas and pub invol are distinctive, otherwise looks like wormskioldii. Overall pub slightly longer and coarser than wormskioldii

Naas	5547	A. campestris ssp. borealis var. scouleriana	A. campestris ssp. borealis var. scouleriana	17Sept1989	5Jan2012	Loomis, OK Co	40 (broken off)	sericeus	3.5	glab	spiciform pan	corollas with red cast; narrow inflorescence not usual for scouleriana, longest pan br is 1.5cm
Nicely, N	57	A. borealis		5June1970	5Jan2012	Alaska						look like A. borealis
Peck	13753	A. campestris var. spithamea	A. campestris ssp. borealis var. wormkioldii			In rocks and sand, 10 miles above the Dalles	17	sericeus	4-5	long sparse pub middle of bracts	spiciform pan	Annotated to A. campestris ssp. borealis var. wormkioldii by N. Arnot 11-1-90
Porsild & Breitung	9489	A. borealis		14June1944	5Jan2012	Yukon	18	sericeus, longer pub than usu	2.5, in bud	glab	spiciform pan	
Suksdorf	2686	A. borealis	A. campestris ssp. borealis var. wormkioldii	23April1896	5Jan2012	Sandy river bank, Bingen	35	sericeus	4	gen glab	spiciform pan	Annotated as A. campestris ssp. borealis var. wormkioldii by A.C. 1951
Suksdorf	2685	A. borealis var. Wormskioldii	A. campestris ssp. borealis var. wormkioldii	27May1896	5January2012	Sandy river bank, Bingen (rare)	26	sericeus	4	gen glab, occ sparse pub	spiciform pan	Some bracts with reddish cast
Suksdorf	2684	Artemisia canadensis		14Sept1895	5Jan2012	bottomland, Bingen	90	sericeus	3-3.5	glab	somewhat long branched pan	Annotated to A. campestris ssp. borealis var. scouleriana by R. Taylor
Thompson	561	A. spithamea		21July1938	5Jan2012	Marble Mts BC						look like A. borealis

Thompson	11022	A. spithamea		21July1934	5Jan2012	Mt Constance, Jefferson Co WA							look like A. borealis
Thompson	9936	A. spithamea		18Aug1933	5Jan2012	Marmot Pass, Jefferson Co WA							look like A. borealis
Walker	286	A. campestris ssp. borealis var. scouleriana		10Sept2004	11Jan2012	Ebeys Landing	80	sparsely sericeous	3-4	glab	broad pan		