



Corispermum species
in Washington State

**A Preliminary
Taxonomic Review**

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

Prepared by

Joseph Arnett

April 27, 2012



***Corispermum* (bugseed)
(Chenopodiaceae)**

**Preliminary Review of the Taxonomy
and Status of Washington State Species**

April 27, 2012

Prepared for:

U.S. Fish and Wildlife Service
Western Washington Office
Region 1
Section 6, Segment 65

by

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I also want to offer a special thanks to the many botanists working in the field, who noticed and collected specimens of these somewhat inconspicuous plants; and especially to Sergei Mosyakin, whose pioneering work with *Corispermum* alerted western botanists to the realization that plants we had been regarding as nonnative weeds are indeed native species, including some that are extremely rare.

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Introduction

“*Corispermum* is known as one of the taxonomically most problematic genera in Chenopodiaceae...”

Sukhorukov (2007)

The *Corispermum* (bugseed) flora of the Pacific Northwest remains inadequately studied, and herbarium studies, upon which the taxonomy of this group has been based, are not yet supported by experimental or field studies (Mosyakin 2003). In 1995, Mosyakin described several new species of *Corispermum* (Chenopodiaceae) in North America and reviewed other previously described species (Mosyakin 1995). According to the recent *Flora of North America* treatment (Mosyakin 2003), four of these species - *C. americanum* (Nuttall) Nuttall var. *americanum*, *C. pacificum* Mosyakin, *C. pallidum* Mosyakin, and *C. villosum* Rydberg - are reported as native to Washington, and two more - *C. hookeri* Mosyakin var. *pseudodeclinatum* Mosyakin and *C. pallasii* Steven - are reported from nearby in British Columbia and may also occur here. Since the time when they were first collected in the state, in the 1800s, these plants had all been regarded as recent introductions of two Eurasian weeds, *C. hyssopifolium* Linnaeus and *C. nitidum* Linnaeus. Mosyakin (2003) reports that he has not seen unquestionable specimens of either of these Eurasian taxa in North America. Recognition of their native origin has necessitated the annotation of essentially all of the specimens of *Corispermum* collected in Washington, and it has led to re-evaluation of the distribution and rarity of these species.

At the present time, one native species, *C. pallidum*, known only from Grant County, Washington, is considered likely to have become extinct. It has not been observed since 1953. Results of field searches for that species are presented in Arnett et al. (2008). The report offered here is broader in scope and examines the taxonomy and status of all *Corispermum* species in Washington State.

Methods

This review is based on current *Corispermum* literature (Mosyakin 1995 and 2003, Sukhorukov 2007), and examination of *Corispermum* specimens at the University of Washington herbarium at the Burke Museum, in addition to specimens on loan from Harvard University, Washington State University, and Oregon State University. While traveling in New York and Boston, I was also able to examine *Corispermum* specimens at the herbaria at the New York Botanical Garden and Harvard University. Notes on each specimen examined are shown in Appendix A. Loaned European specimens of *C. hyssopifolium* and *C. nitidum* illustrated the characteristics of these non-native species and provided comparisons with native taxa. Many of the specimens that I examined from northeastern North America had been annotated by Mosyakin, and having these reference specimens clarified characteristics of some taxa.

The strongest limitation on this work, in addition the complexity of the genus, was that very few western specimens that I could examine had been annotated by Mosyakin: a single specimen of *C. villosum*, two of *C. pacificum*, a putative hybrid between these two, and a single specimen of *C. pallidum*. Added to the paucity of annotated western specimens has been the small numbers of collections of some taxa. I had access to a single western collection of *C. pallasii* and a single specimen overall of *C. hookeri*.

The small numbers of *C. americanum* also presented a challenge. I regarded a single collection by Suksdorf (#3675) as representative, but it was quite different in inflorescence shape than any other Washington collections, and using this as a standard may have obscured my understanding of the morphological variation in the species. Scans of specimens from the Missouri Botanical Garden were helpful in representing variation in inflorescence, but without the physical specimen in hand it was not possible to examine the fruits. The specimens of *C. americanum* at the New York Botanical Garden herbarium, annotated by Mosyakin, gave more information on the challenges of this species and the closely related *C. pallasii*; annotations of several of these specimens by G. Yatsjievych, in which he questioned Mosyakin's use of this nomenclature, demonstrated that I was not the first to puzzle on this group of plants.

Based on these limitations of reference material, the interpretation and keys presented here must remain preliminary, based on my best effort to correlate published descriptions with the specimens that I had available for study. I hope that the information here will be useful in illustrating the need for further study and for additional specimens of the poorly represented species.

Notes on Morphology

Corispermum species are typically inconspicuous plants, with small, indistinct flowers; with the exception of *C. pallidum*, their fruits, necessary for confident identification, mature in late summer or early fall. This phenology, in habitats that are often studied in the spring flowering season, may have contributed to the paucity of collections. In general, the characteristics of the fruit are the most prominent features and those most referred to in the keys: dimension, shape (whether flat or planoconvex), color (dark green or black vs. pale reddish-brown), sculpting of the abaxial surface (warts and reddish spots or not), and the characteristics of the wing formed by the pericarp around the fruit (width, thickness and transparency, shape of the apex). The shape of the inflorescence (whether congested or spaced along the stem) may also be diagnostic.

However, as Sukhorukov (2007) points out, variability in these characters, particularly the wings and whether the inflorescence is condensed or interrupted, has resulted in varying species concepts. Sukhorukov (2007) referred to using fruits from upper, middle, and lower parts of the inflorescence because of the possibility of heterocarpy, which points out the difficulty in using identification keys based on these features. At least one specimen of *C. hookeri* (Lomer 4671) included proximal fruits that had warts and prominent spots, while the distal fruits on the same stem were without either marking and were overall smaller. Sukhorukov (2007) observed that the warts could be present or not

in the majority of species; they develop when the outer periderm layers become detached from each other and form cavities that develop into whitish warts.

I found that the width of the fruit relative to the length was a useful measure for comparing fruit shape, so I calculated this ratio for many specimens that I examined, and used these values to compare with the measurements reported by Mosyakin (2003). These values are included in Table 2.

Notes on Classification

Table 1 summarizes the different taxonomic groups in which Mosyakin (1995) and Sukhorukov (2007) placed the *Corispermum* species discussed in this report. Mosyakin divided *Corispermum* into what he called “species groups” or “species aggregates”, while Sukhorukov (2007) placed *Corispermum* species into 13 “groups”, based on similarity of fruit structures; Table 1 summarizes how they grouped species occurring, or potentially occurring, in the Pacific Northwest.

The differences among the classifications illustrate the complexity of the group, the indistinct boundaries between species and groups of taxa, and the preliminary degree of study of North American *Corispermum*.

Table 1. Summary of classification of *Corispermum*. Non-native taxa are included in parentheses.

Mosyakin species groups (1995)	Sukhorukov species groups (2007)
<i>C. pacificum</i> is described as related to Asian <i>C. crassifolium</i> and <i>C. maynense</i> .	Macrocarpum group: <i>C. pacificum</i> <i>C. pallidum</i>
<i>C. hookeri</i> , <i>C. pallasii</i> , <i>C. americanum</i> , and <i>C. villosum</i> are described as part of the <i>C. pallasii</i> aggregate.	Hyssopifolium group: <i>C. pallasii</i> (<i>C. hyssopifolium</i>)
<i>C. pallidum</i> is described as possibly related to <i>C. macrocarpum</i> .	Nitidum group: <i>C. americanum</i> (<i>C. nitidum</i>)
	Hookeri group: <i>C. hookeri</i>

Descriptions of *Corispermum* Species

The following descriptions include *Corispermum* species native to Washington (*C. americanum*, *C. pacificum*, *C. pallidum*, and *C. villosum*), and species reported from nearby British Columbia (*C. hookeri* and *C. pallasii*). These descriptions are adapted from Mosyakin (1995, 2003), with additional notes from examinations of herbarium specimens at the University of Washington, including those on loan from herbaria at Harvard University, Oregon State University, and Washington State University. Table 2 presents a summary of the key features of these taxa, as I have interpreted them. For

comparison, Table 2 also includes nonnative *C. hyssopifolium* and *C. nitidum*. In the discussion that follows, plant collections are indicated by the collector's name followed by the collection number, as in Suksdorf #3675. The notation "sn" indicates that the collection was not identified by a collection number.

C. americanum* var. *americanum typically has elongate, narrow, interrupted inflorescences. This trait is quite extreme in a collection by Suksdorf (#3675), and the inflorescences extended nearly to the base of the plants, with few leaves that were not narrow floral bracts. This specimen is the only Washington plant with this type of inflorescence, and regarding it as typical may initially have given me an inaccurate concept of the species. This trait is less distinct in the FNA illustration and in scans of six additional specimens from the Missouri Botanical Garden (Bush #9153, Chandonnet sn, Churchhill #4693, Englemann sn, Harper sn, and Leiberg #1602) that I was able to view on-line. Fruits are relatively flat, pale or reddish-brown, with thin, transparent wings. Their surface is often marked with reddish-brown spots and whitish warts. These fruit characteristics are described on the basis of the single Washington collection (Suksdorf #3675) and three specimens from Utah, in addition to the written descriptions. The Washington collection has flat reddish brown fruits with thin wings, similar to two Utah collections (Eastwood and Howell #6694 and Atwood #21568) and similar in most respects to a third Utah collection (Mitchell and Grover, s.n.). These four appear distinct among the western *Corispermums* I examined and key easily to *C. americanum*. A small number of other specimens from Washington had at least faint warts on the fruits, suggestive of *C. americanum*, but the shape of the inflorescences differed markedly from the Suksdorf #3675 collection. No specimen of *C. americanum* that I could examine had been annotated by Mosyakin, so my understanding of this species is based solely on his description, without the elucidation of verified voucher specimens.

A collection by Maxwell (#1311) from White's Island in the lower Columbia River keys to *C. americanum* with Mosyakin's key because of the presence of pronounced warts, but her collection differs from Suksdorf #3675 in the shape and color of the fruit, the thickness of the wing, and the shape of the inflorescence; essentially every feature except the presence of warts. Overall Maxwell's specimen looks intermediate between *C. americanum* and *C. pallasii* (fruits that are dark green, strongly convex abaxially, with thick wings and warts).

Specimens examined: Atwood #21568, Bush 3284 and 9153, Bartley 2812, Baxter 5499, Boivin 13971 and 13982, Eastwood and Howell #6694, English #1173, Mastrogiussepe #2732, Maxwell #1311, Mitchell and Grover s.n., Mukle #668, Suksdorf #3675. Online scans of Bush #9153, Chandonnet sn, Churchhill #4693, Englemann sn, Harper sn, and Leiberg #1602.

C. hookeri* var. *pseudodeclinatum has dense inflorescences and strongly convex fruits and overall appears to be a slightly larger and markedly narrower version of *C. pacificum*. The shape of the fruit (a width/length ratio of 0.68) is considerably narrower than *C. pacificum* (a width/length ratio of 0.94). While not reported from Washington,

Table 2. Summary of key features of selected taxa of *Corispermum*, based on descriptions by Mosyakin (2003).

Species	Inflorescence	Fruit				
		Shape	Size (mm)	Color	Wing (measurements are width in mm)	Surface
<i>C. americanum</i> var. <i>americanum</i>	interrupted, narrow and elongate	flattened	(2.3-) 2.5-3.5 x 2-3.5. width/length ratio 0.79	light brown	translucent, thin, (occ. translucent only at margin, thick), 0.2-0.3, apex broadly triangular	with spots and/or warts
<i>C. hookeri</i> var. <i>pseudo-</i> <i>declinatum</i>	condensed at tip, elongate and interrupted	elongate, strongly convex abaxially	(3.2-) 3.5-4.5 (-5) x 2.2-3.3 (-3.5) width/length ratio 0.68	deep olive green or brown	gen. narrow, thick, entire-edged, to 0.2, apex rounded or indistinctly triangular	usu. without spots or warts
<i>C. hyssopifolium</i> (nonnative)	compact, usu. not strongly condensed at apex, occ. interrupted at the base	broadly elliptic, prominently convex abaxially	2.2-3.2(-3.5) x 1.7-2.8 width/length ratio 0.82	brown to deep olive	may be absent or translucent 0.1(0.15), margins entire, apex rounded	usu. without spots or warts
<i>C. nitidum</i> (nonnative)	narrow, usu. interrupted from base to apex	rotund or broadly elliptical, convex abaxially	2.3-3.3(-3.5) x (1.8-)2-2.8 width/length ratio 0.86	straw colored, light brown, to deep olive, occ. tinged red	translucent and thin, usu. 0.1-0.3, margins entire, apex rounded	usu. without spots or warts
<i>C. pacificum</i>	usu. compact and dense	broadly ovate to almost orbicular, slightly convex abaxially	3-4 x 2.7-3.8 width/length ratio 0.94	usu. black, rarely dark green	translucent, thin, (0.2-) 0.3-0.6, margins undulate or indistinctly erose denticulate, apex rounded or occ. indistinctly notched	usu. without spots or warts
<i>C. pallasii</i>	usu. compact and dense, rarely lax and interrupted in proximal ½	relatively narrow, convex abaxially	(3.2-)3.5- 4.5(-4.7)x(2-) 2.4-3 width/length ratio 0.68	light to dark brown or green	thick, entire, 0.2-0.4, apex broadly triangular	often with spots and warts
<i>C. pallidum</i>	lax or slightly condensed, linear, interrupted only near the base	flattened or slightly convex abaxially	2.8-3.5(-3.8) x 2.4-2.8 (-3.3) width/length ratio 0.83	pale	thin, wide, transparent, 0.7-1, margins erose, apex notched or rounded	occ. with reddish- brown spots
<i>C. villosum</i>	compact, dense, congested, occ . interrupted in proximal ½	strongly convex abaxially, elliptic or obovate- elliptic	1.8-3 (-3.2) x 1.5-2 width/length ratio 0.75	light to dark brown	none (generally) or to 0.1 (0.15), apex triangular	usu. spotted, may be with warts

this taxon is reported from the lower Fraser River area, and it seems likely that it will be found in Washington.

I was only able to examine a single specimen that had been identified as *C. hookeri* (Lomer #4671), and our reference specimen did not fit the description well. It differed from the published description in having pronounced warts and wide wings.

Specimens examined: Lomer #4671

C. pacificum has congested, often clavate inflorescences; Mosyakin describes this species as having broadly ovate black (rarely dark green) fruit that is slightly convex abaxially with thin wings and no warts or spots. Many Washington collections fit this description well. Other specimens, especially more recently collected ones, key best to this taxon, but differ slightly from Mosyakin's descriptions. Fruits are often dark or medium olive green rather than black, with thick wings and a more convex shape.

C. pacificum is known from Oregon and a broad swath across southern Washington into Idaho. The habitat includes sandy shores and dunes; fruits mature in late summer and fall.

A Zika collection (#18022) from Hayden Island in 2002 appears to differ from collections by Thompson (#3843 and #3915) from the same island in 1927. Zika's collection has shorter, narrower leaves, shorter bracts, and dull dark green (rather than shiny black) fruit. Thompson's collections look more like Piper's (#1770 in 1893) and Ownbey's collection (s.n. in 1939) from Wawawai on the Snake River.

Specimens examined: Cotton s.n., #754, #885; Evans s.n.; Gleason #572; Gorman s.n., Hallock #1; Halse #4701; Legler #3087; Nelson #4185; Ogilvie s.n.; Ownbeys s.n.; Piper #1770 (isotype); St. John #9233; Suksdorf s.n. (2), #1385; Thompson #3915; and Zika #16656, #16658, #18022, #17866, #19074, and #19075.

C. pallasii has large, relatively narrow fruits, with well-developed, thick wings. The abaxial surface of the fruit is often sculpted with warts and spots. Similar in many respects to *C. hookeri*, it is distinguished in Mosyakin's descriptions (2003) primarily by the prominence of warts and spots and by wings that are usually broader (0.2-0.4 mm), whereas those of *C. hookeri* are narrower, up to 0.2 mm. *C. pallasii* is a species generally known from northeastern North America, and not reported in Mosyakin (2003) from the northwest part of the continent. I have had access to a single specimen of *C. pallasii* from British Columbia (Lomer #4670).

In size, Maxwell #1311 tended toward *C. pallasii*; it was quite similar to Lomer #4670, identified by Lomer as *C. pallasii*.

Specimens examined: Bailey s.n., Baldwin #4320, Chaney# 211, Chase #1264 and #1735, Ek #1942 (may be the year of collection), Lapham s.n., Lomer #4670, Turner #1574, Umbach #1388, and Wadmond #16239.

C. pallidum has pale, somewhat flattened fruits, with wide thin wings 0.7-1.0 mm wide, together wider than the body of the achene. Inflorescences are lax or slightly condensed, interrupted only near the base, and linear. This combination of characteristics sets this taxon apart. In addition, it has historically been found to have mature fruit in late June, while the other *Corispermum* species tend to mature late in the summer and well into the fall.

C. pallidum is a narrow endemic species, possibly extinct, known only from Grant County, Washington. The habitat includes sandy shores of lakes and rivers and inland open sands. Fruit matures in late spring and early summer, earlier than other *Corispermum* species.

Specimens examined: St. John #4948, Sandberg and Leiberg #309 (holotype), Sandberg and Leiberg #9010?(paratype), Thompson #6764.

C. villosum is characterized by lacking wings and having relatively narrow fruit. Generally it is quite distinctive. If thin wings are present, they may be up to 0.1 (0.15) mm wide, with entire margins. In this case it may look something like a narrow-winged *C. pacificum* or, if warts are present, a small-fruited *C. pallasii*. *C. villosum* is a relatively common species in the northwest and north-central U. S. and adjacent Canada. Inflorescences are rather compact, dense, condensed in the distal half, occasionally interrupted in the proximal half, usually clavate or clavate-linear. Fruits are yellowish brown, light brown, or dark brown, usually with reddish brown spots and occasionally whitish warts, strongly convex abaxially, elliptic or obovate-elliptic, dull, with a triangular stylar beak that extends beyond the wings. The habitat includes sand dunes and sandy and gravelly shores. Fruit matures in late summer-fall.

A pair of specimens from disturbed ground (“foreign gravel” according to the collector) along a railroad bed (Suksdorf #6411) illustrate the difficulty in confidently assigning a plant, in some cases, to one species or another. One specimen has fruit with distinct wings (best fit *C. pacificum*) and one specimen has fruit without wings (best fit *C. villosum*). However, the plants, growing next to each other, are otherwise identical. It is difficult to regard them as different species, yet difficult to override the key characters of wings on the fruit and identify them as the same taxon.

Specimens examined: Arnot #560; Caplow #200504; Leiberg #912; St. John #6738; Suksdorf #6411; Thompson #12172, #13274; Zika #18064.

Classification and Status of *Corispermum* in Washington

Table 3 presents a summary of *Corispermum* taxa from Washington State, including proposed Washington status. Three of the Washington taxa are generally distinct: *C. pacificum*, *C. pallidum*, and *C. villosum*. The emphasis here should be on the word “generally”. Occasional plants look very much like *C. pacificum*, but faint warts or spots suggest *C. americanum*. The distinction between *C. villosum* and the group that includes *C. americanum*, *C. pallasii*, and *C. hookerii* remains problematic, as does the clear

distinction between *C. americanum* and *C. pallasii*. Mosyakin describes numerous specimens as being intermediate between these two species, and notes what appear to be hybrids between *C. villosum* and *C. americanum*. Some specimens of *C. americanum* appear unmistakable compared to some specimens of the others, but there are intermediate collections, and occasional plants with winged fruits that otherwise appear to be *C. villosum*.

Table 3. Status of *Corispermum* species in Washington State

species	Washington collection summary	Proposed status
<i>C. americanum</i> var. <i>americanum</i>	Only a single collection from WA is unambiguously <i>C. americanum</i> . Several others key best to this taxon, but our understanding of the delineation of this species remains unresolved.	Review Group 2 (unresolved taxonomic status)
<i>C. pacificum</i>	Numerous unambiguous specimens, historical and current.	No special status
<i>C. pallidum</i>	A total of four historical specimens; likely extirpated.	Potentially extirpated
<i>C. villosum</i>	Three fairly recent Washington collections, and three historical.	Sensitive

Keys to *Corispermum* species

After careful examination of *Corispermum* specimens from Washington, I have come to regard Sukhorukov's preface at the beginning of the introduction to this report as quite accurate. While many plants encountered conform well with the descriptions in Mosyakin (2003), occasionally specimens are encountered that just do not fit well into the published taxa, and our familiarity with them is not great enough for us to confidently decide whether they should be regarded as hybrids, as individuals with characteristics that are slightly outside of the published range, or as undescribed taxa.

The keys below are based on Mosyakin's publications (1995, and 2003), communication between him and Peter Zika (Mosyakin 2001), and examinations of approximately seventy specimens at the University of Washington, including those on loan from herbaria at Harvard University, Oregon State University, and Washington State University.

The first key follows Mosyakin (2003) fairly closely, abridged to include only those species that appear likely to occur in Washington, and modified slightly to reflect examination of the specimens.

The second key is based on the most distinct characteristics of the specimens I examined. After trying with varying success using Mosyakin's (2003) key to fit the plants I was examining into the taxa that he described or recognized, I found it useful to take a different approach: to combine the plants that I observed into groupings that made sense based on the features that I observed, and then compare the groupings I developed with the taxa he described or recognized.

Both keys include the four native species that Mosyakin (1995, 2003) reports in Washington (*C. americanum*, *C. pacificum*, *C. pallidum*, and *C. villosum*), two Canadian species reported from nearby British Columbia (*C. hookeri* and *C. pallasii*), and the two

non-native species that Hitchcock and Cronquist (1973) included in *Flora of the Pacific Northwest* (*C. hyssopifolium* and *C. nitidum*).

As in Arnett (2008), this key should be considered provisional, revised as more material is examined in the field and herbaria, and our understanding of this variable genus increases.

Key to *Corispermum* species based on Mosyakin (2003)

1a. Fruits more or less distinctly broadest above the middle, narrowly to broadly obovate-elliptic, shiny or dull, often with dark spots and/or warts when mature; margins of the wings of the fruit entire or erose

Corispermum species native to North America

2a. Fruits 2.5 - 4.5 (-5) mm long, wingless, or with a narrow, entire-margined wing up to 0.2 mm wide

3a. Fruits 2.5 – 3.1 x 1.9 – 2 mm, sometimes spotted and/or warty, often with a triangular, beak-like stylar base, usually wingless but occasionally with a narrow wing less than 0.1 (-0.4) mm wide; known from Washington, Oregon, and Idaho

C. villosum



Figure 1. Fruit of *C. villosum* (from Mosyakin 2003)

3b. Fruits elongate, (3.2-) 3.5 - 4.5 (-5) x 2.2 – 3.3 (-3.5) mm, occasionally spotted but generally with neither spots nor warts, apex rounded or indistinctly triangular, wingless or with wing up to 0.2 mm, semi-transparent, reported from BC., associated with the Fraser River

C. hookeri var. *pseudodeclinatum* (illustration not available)

2b. Fruits 3-4 mm long, with pronounced wings 0.2-1 mm wide

4a. Wing margins mostly entire, firm, generally translucent only at the outer edge or half, though in older specimens the wings may appear more transparent; fruits dark, black to olive green; inflorescences usually compact, rather dense, clavate, condensed at least near the apex

5a. Fruits shiny, without spots or warts, black or dark green, broadly orbiculate-obovate to almost orbiculate; reported in Washington near the Columbia and Snake Rivers.

C. pacificum

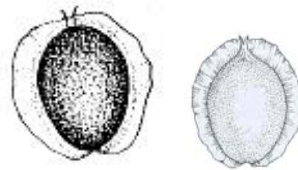


Figure 2. Fruits of *C. pacificum* (from Mosyakin 1998, 2003)

5b. Fruits often with warts and spots, light to dark brown or deep olive green, narrowly obovate; inflorescence is congested distally, with single fruits in axils of narrow bracts proximally; mostly known from northeast and north central North America

C. pallasii

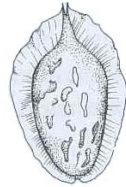


Figure 3. Fruit of *C. pallasii* (from Mosyakin 2003)

4b. Wing margins erose and thin, mostly translucent; fruits generally light brown, yellowish, reddish, or green, or olive green (very rarely almost black, then more elongate, not orbiculate-ovate or orbiculate), shiny or dull, occasionally spotted or/and warty; inflorescences generally lax

6a. Wings of the fruit pronounced, 0.7-1.0 mm wide; fruit flattened or only slightly convex abaxially; plants 5-25 cm; bracts similar in size and generally narrower than fruits; historically known only from Grant County, Washington.

C. pallidum

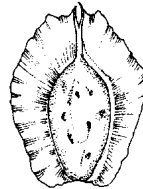


Figure 4. Fruit of *C. pallidum*

6b. Wings of fruit absent or 0.2-0.6 (0.7) mm wide; fruits somewhat to strongly convex abaxially; plants 10-55 (-70) cm; distal bracts often much shorter than proximal bracts, and at least as wide as mature fruits (proximal leaflike bracts may be narrower than fruits); widespread in North America.

C. americanum

Washington plants are *C. americanum* var. *americanum*



Figure 5. Fruit of *C. americanum* var. *americanum*

1b. Fruits broadest near the middle or slightly above the middle (almost elliptic or broadly elliptic), shiny, normally without warts, very seldom with dark spots; margins of the wings of the fruit entire.

***Corispermum* species native to Eurasia**

7a. Leaves linear-lanceolate, usually plane; fruits brown or dark brown to deep olive green; wing of the fruit 0.1 (– 0.15) mm; inflorescence compact; bracts ovate to ovate-lanceolate, to 0.7 cm wide, wider than the fruit.

C. hyssopifolium



Figure 6. Fruit of *C. hyssopifolium* (from Mosyakin 2003)

7b. Leaves narrowly linear or filiform, usually convolute or folded; fruits yellowish or light brown to deep olive green; wing of the fruit 0.1 - 0.3 mm; inflorescence lax; bracts narrowly ovate to linear, up to 0.3 (-0.4) cm wide, usually narrower than the mature fruits.

Some specimens resembling this species in North America appear more like *C. americanum*, based on fruit, and may be the result of introgression from the introduced *C. nitidum* into the native *C. americanum* (Mosyakin 2003).

C. nitidum



Figure 7. Fruit of *C. nitidum* (from Mosyakin 2003)

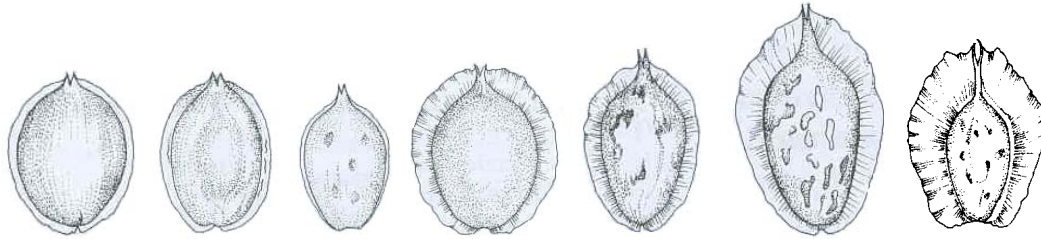


Figure 8. Comparative drawings of *Corispermum* fruits (left to right): *C. hyssopifolium*, *C. nitidum*, *C. villosum*, *C. pacificum*, *C. americanum* var. *americanum*, *C. pallasii*, and *C. pallidum*.

Simplified key to *Corispermum* species

This key is based on the usual range of features; atypical specimens will require more thorough study of the descriptions, which should in any case be reviewed once an identification has been made, to compare the specimen with the overall description. I have also placed the shape of the inflorescence at the beginning of the key, because of the prominence of this feature in the single specimen in Washington that closely fits Mosyakin's description of *C. americanum*. However, subsequent review of other specimens of this taxon may necessitate less reliance on this feature.

1a. Inflorescences narrow and elongate, interrupted for all or most of their length

2a. Abaxial surface of the fruit with warts or reddish spots; fruit flattened abaxially, widest above the middle

C. americanum var. *americanum*

2b. Abaxial surface of the fruit without warts or reddish spots; fruit convex abaxially, widest near the middle

C. nitidum (Eurasian)

1b. Inflorescences condensed, clavate, with broad floral bracts distally; proximal bracts may be narrower, interrupted, with fruits in their axils

3a. Fruit without wings, or with narrow wings < 0.2 mm

4a. Fruits with warts and spots, 1.8-3 x 1.5-2 mm; width/length ratio 0.75

C. villosum

4b. Fruits without warts or spots

5a. Fruits widest above the middle, 3.5-4.5 x 2.2-3.3 mm; narrow, width/length ratio 0.68; inflorescence condensed at the tip
C. hookeri var. *pseudodeclinatum*

5b. Fruits widest near the middle, 2.2-3.2 x 1.7-2.8 mm; broad, width/length ratio 0.82
C. hyssopifolium

3b. Fruits with well-developed wings > 0.2 mm wide (*C. hyssopifolium* may occasionally key here).

6a. Wings 0.7-1 mm wide, thin, translucent, with undulate margins
C. pallidum

6b. Wings <0.7mm wide, thick, with entire margins

7a. Warts and spots absent or indistinct
C. pacificum

7b. Warts or spots well developed

8a. Fruits large, narrow, 3.5-4.5x2.4-3, ratio 0.68
C. pallasii

8b. Fruits smaller, with ratio >0.8
Possible hybrids involving *C. pacific*,
C. americanum, or non-native species?

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Appendix A

Table of *Corispermum* specimens examined

Most of the specimens in this table were examined at the University of Washington Herbarium at the Burke Museum. Collections included specimens housed at the University of Washington (WTU), Harvard University (HUH), Washington State University (WS), and Oregon State University (OSC). Specimens were also examined at the New York Botanical Garden (NYBG) herbarium in March 19, 2012 and at Harvard University herbarium on March 21, 2012.

Highlighted rows indicate that the specimen had been annotated by Sergei Mosyakin.

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
Arnett, J		WTU	1March2012	Fishermans Bar Park, Clark Co WA	C. pacificum	C. pacificum	dense and clavate	2 x 25	very broad, short acuminate tip, some bracts nearly as broad as long, quite pub with stellate hairs
Arnot	560	WTU	8Dec2011, 8Feb2012	Okanogan county by river, 23Sept1992	C. villosum	C. hyssopifolium	compact 20x7mm	linear, 1.2x20	ovate, very pub
Atwood, D.	21568	WTU	15Dec2011	Kane Co UT, 26Sept1996	C. americanum var?	C. americanum	diffuse, delicate	2x45	ovate, winged, <fruit in width
Bailey, L.H.	sn	HUH	7Dec2011, 26Jan2012	S. Haven Michigan, 24Aug1882	C. pallasi	C. hyssopifolium	congested	1.5x25	
Baldwin, W.	4320	HUH	7Dec2011	Quebec, 31Aug1952	C. pallasi	C. hyssopifolium			
Ball, J	s.n.	HUH	29Nov2011, 26Jan2012	Hungary, 1890	C. nitidum	C. nitidum	diffuse, delicate		
Bartholemew, E.	sn	NYBG	19March2012	Rocport Rooks Co 1889-94	C. americanum	C. hyssopifolium	diffuse along the stem		
Bartley, F.	2812	NYBG	19March2012	Ohio, 30Aug1964	C. americanum	C. hyssopifolium	diffuse along the stem		
Baxter, M.S.	5499	NYBG	19March2012	E Rochester NY, 11Sept1921	C. americanum	C. hyssopifolium	diffuse along the stem		

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Arnett, J		3.5 x 3.8	very broad, rounded	0.5, very thin	no	black	
Arnot	560	2x2.5	very convex abax	most none, occ to 0.2	occ red/very few warts	green dull	Ann by Zika 2001; someone (prob Zika) noted trend toward <i>C. hookeri</i>
Atwood, D.	21568	2x3	flat,	0.3	none, or faint warts	reddish	overall more delicate and sparse than <i>Suksdorf</i> 3675, but similar fruit and diffuse infl
Bailey, L.H.	sn	2.5x3.5, 3x4	rotund	0.4	red spots	green	Det by Mosyakin
Baldwin, W.	4320						Det by Mosyakin
Ball, J	s.n.			0.1-0.2		copper	delicate plant, dendritic hairs on floral bract
Bartholomew, E.	sn		broad, flat, maybe immature	0.4, thin		reddish tan	Annotated by Mosyakin
Bartley, F.	2812	1.7 x 3	very broad	0.3	red spots	reddish tan	Annotated by Mosyakin
Baxter, M.S.	5499	2 x 3	broad, broadly rounded at tip	0.5, thin			Annotated by Mosyakin

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
Boivin, Bernard	13982	NYBG	19March2012	Manitoba CA 2Sept1960	<i>C. americanum</i>	<i>C. hyssopifolium</i> var. <i>rubricaula</i>	not condensed, scattered along the length of the stem	ca 1 x 15	
Boivin, Bernard	13971	NYBG	19March2012	Manitoba CA 1Sept1960	<i>C. americanum</i>	<i>C. hyssopifolium</i> var. <i>rubricaula</i>	condensed, small dense inflorescences widely scattered down the stem	ca 1 x 15	
Brainerd, R.E.	1642	WTU	26Jan2012	Sauvie Island, 15Oct2009	<i>C. pacificum</i>	<i>C. pacificum</i>	dense clavate, but with a few separated fr in axils of lower leaves		
Burgess	sn	NYBG	19March2012	28Aug1894, New York	<i>C. americanum</i>	<i>C. hyssopifolium</i>	somewhat condensed, but space between most fruits		
Burgess	sn	NYBG	19March2012	28Aug1894, New York	<i>C. americanum</i>	<i>C. hyssopifolium</i>	on some stems quite condensed, in others solitary axillary fruits		
Burgess, E.S.	sn	NYBG	19March2012	New York, 28Aug1894	<i>C. americanum</i>	<i>C. hyssopifolium</i>	diffuse along the stem in places, but at least imm infl		
Bush, B.F.	3284	NYBG	19March2012	Missouri	probably <i>C. americanum</i>		diffuse		
Bush, B.F.	9153	NYBG	19March2012	Missouri	probably <i>C. americanum</i>		diffuse		

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Boivin, Bernard	13982		fairly broad and rounded at the tip, only moderately convex	0.3-0.4	red spotted, esp adaxially, rough surface but no warts	golden, embreyo is darker	inflorescence clearly like what I expect <i>C. americanum</i> to look like. Annotated by Mosyakin.
Boivin, Bernard	13971		fairly broad, and broadly triangular at the tip, only moderately convex	0.3-0.4	red spotted, esp adaxially, rough surface but no warts	golden, embreyo is darker	Differs from Boivin 13982 in that fruits are more triangular at the tip, and the infl is dense. Also annotated by Mosyakin
Brainerd, R.E.	1642	3x4	very broadly elliptic	0.5	none	green	
Burgess	sn						Annotated by Mosyakin
Burgess	sn		because there are no wings, fruit is narrower, more tapering at the tip	nearly wingless			Annotated by Mosyakin. Had been annotated as <i>C. orientale</i> in 1977 by Maihle and Blackwell (MU)
Burgess, E.S.	sn	2 x 3	not broad	nearly wingless	drough adaxially, no warts or spots	tan	Annotated by Mosyakin
Bush, B.F.	3284						Noted by Mosyakin (1995) as immature, probably <i>C. americanum</i> . Yatskievych (2000) noted that "application of Mosyakin's nemes remains unclear".
Bush, B.F.	9153						

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
Caplow	200504	WTU	8Dec2011, 8Feb2012	Grant Co dune, 14July2005	<i>C. villosum</i>	<i>C. villosum</i>	5x20	to 3x35 flat, most smaller	5x40 imbricate, ovate, very pub
Chaney, R.W.	211	HUH	29Nov2011, 26Jan2012	Michigan, 9/14/1910	<i>C. pallasii</i>	<i>C. hyssopifolium</i>	dense, +/-clavate, but with separated fr in axils of lower leaves		broad ovate, with long tip, ac = fr
Chase, Agnes	1735	HUH	29Nov2011, 7Dec2011, 26Jan2012	Lake Michigan, 27Sept1901	<i>C. pallasii</i>	<i>C. hyssopifolium</i>	dense, +/-clavate, but with separated fr in axils of lower leaves (interrupted in proximal 1/2)	1.5x22	broad ovate, with long tip, ac = fr
Chase, Agnes	1264	HUH	29Nov2011, 7Dec2011, 26Jan2012	Lake Michigan, 9Oct1899	<i>C. pallasii</i>	<i>C. hyssopifolium</i>	dense, +/-clavate, separated fr in axils of narrow lower leaves		narrow, much narrower than fruit
Ckbopoulos	sn	HUH	7Dec2011, 16Feb2012	Russia	<i>C. nitidum</i>	<i>C. nitidum</i>	very diffuse		
Clinton, G.N.	1062	NYBG	19March2012	Buffalo	<i>C. americanum</i>	<i>C. hyssopifolium</i>	diffuse along the stem		
Cotton, J.S.	754	WS	13Feb2008Dec2011. 2Feb2012	near Sunnyside, 20July1902	<i>C. pacificum</i>	<i>C. hyssopifolium</i>	moderately compact, not well developed or preserved	3x30	

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Caplow	200504	2x2.5	very convex abax	none	no/white warts	green, some stellate pub	
Chaney, R.W.	211	2.0x3.5; 2.5x3.8,	broadly elliptic, wider above middle	0.5	no real warts or spots, but wrinkled surface	dark green	Had been annot. To <i>C. nitidum</i> and then to <i>C. pallasii</i> by Mosyakin
Chase, Agnes	1735	2.8x3.5		0.5	some frs warty	med brown	Identified by Mosyakin. Distal bracts wider than fr, separated proximal bracts narrow
Chase, Agnes	1264	3x4		0.4-0.5		med brown	had been id'd as <i>C. hyssopifolium</i> . Identified by Mosyakin
Ckbopuos	sn	2.8 x 3.4	broad oval, flat	0.3, 0.4		med green, shiny	
Clinton, G.N.	1062						Annotated by Mosyakin
Cotton, J.S.	754	2.8x3.8, 2.9x3.3	very broadly elliptic	0.3, thick	faint suggestion of warts	med green, dull	relatively broad leaves

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
Cotton, J.S.	753	WS	30Nov2011	Sunnyside, Yakima Co., 19July1902	<i>C. pacificum</i> ?	<i>Corispermum hyssopifolium</i>	fairly dense, clavate		
Cotton, J.S.	885	WS	30Nov2011, 2Feb2012, 16Feb2012	Yakima Co north of Rattlesnake Mt Sept 17, 1902	<i>C. villosum</i>	<i>C. hyssopifolium</i> , ann as <i>C. h.</i> and as <i>C. villosum</i>	elongate, apically compact in some cases, but separated fruits extending down the stem	2.5 x 25	ovate, broad winged
Cusick, W.C	2718	WS	13Feb2008	Lake, OR 2Aug1901					
Dream, Chas. C.	1746	NYBG	19March2012	Indiana, 23Sept1906	<i>C. americanum</i> , transitional to <i>C. pallasii</i>				
Eastwood, A. and J.T. Howell	6694	WTU	15Dec2011, 8Feb2012	Mexican Hat, UT	<i>C. americanum</i> var.?	<i>C. hyssopifolium</i>	diffuse, delicate	1x10	ovate
Ek, Charles	1942 (year?)	HUH, WS	29Nov2011, 26Jan2012, 2Feb2012, 16Feb2012	Kokomo Indiana, prob, from NW Indiana, 1942	<i>C. pallasii</i>	<i>C. hyssopifolium</i>	dense, +/-clavate, a few proximal separated fr		ovate with hyaline margin, occ stellate pub
English, Carl Jr.	1173	WS	13Feb2008, 30Nov2011, 2Feb2012, 16Feb2011	RR right of way, Pullman WA, 18Sept1928	<i>C. americanum</i> var. <i>americanum</i> best fit? <i>C. pacificum</i> ?	<i>C. villosum</i> on label, annotated to <i>C. hyssopifolium</i>	dense, clavate, but with a few axillary down the stem	to 1x20	broadly ovate, acuminate, with hyaline wings, sparsely villous with stellate hairs

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Cotton, J.S.	753	3 x 3.5, ratio 0.86		0.3, thick		pale green, dull	shape of fruit and think wing suggests <i>C. pacificum</i> , but dull surface and pale color not typical
Cotton, J.S.	885	1.9 x 2.5, 1.9 x 2.7 ratio 0.76	narrowly obovate	0	faint or none	dark green, dull	
Cusick, W.C	2718						
Dream, Chas. C.	1746						Annotated by Mosyakin (1995), and by G. Yatsklevych (1999) who notes that "application of this epithet remains unclear".
Eastwood, A. and J.T. Howell	6694	2 x 3	flat	0.4, broad, hyaline, erose	warty	reddish	Had been annotated to <i>C. nitidum</i>
Ek, Charles	1942 (year?)	3 x 4, 2.8 x 4.2	broadly ovate	0.4-0.5	faintly warty, with red spots	pale green, dull	"transitional to <i>americanum</i> " (Mosyakin, on specimen from HUH)
English, Carl Jr.	1173	2 x 2.6, 2.2 x 3, 2.1 x 2.7 ratio 0.75	broadly obovate, fairly flat	0.4, 0.5	imm but occ. faint warts	slightly immature, pale, light brown, quite dull, roughened, esp abax	Fruits, especially because of flatness and color, could be considered to be <i>C. americanum</i> ; inflorescence looks like <i>C. pacificum</i> , with separated proximal fruits (like <i>C. pallasi</i>), faint warts

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
Evans	sn	OSC	7Dec2011	opposite the Dalles, 1915	<i>C. pacificum</i> x <i>C. villosum</i>	<i>C. villosum</i>	compact	3.5x45	broad, ovate, covering fr
Flinn, Dr.	sn	WS	13Feb2008	sandy riverbank, Hood River OR 10Oct1909					
Gleason, J	572	WS	13Feb200830Nov2011, 2Feb2012	Wawawai, 8Oct1942	<i>C. pacificum</i> ?	<i>C. hyssopifolium</i>	short, dense, incl axillary	5x40	ovate, > fruit
Gorman	sn	OSC	7Dec2011, 2Feb2012	Spedio, Klickitat Co, 19Sept1925	<i>C. pacificum</i>	<i>C. hyssopifolium</i>	compact	5x40	broad, ovate, covering fr
Gorman, M.W.	3655	WS	13Feb2008	Hayden Island, 23Sept1915					
Hall, E.		NYBG	19March2012	Athens, Ill., 1861	<i>C. americanum</i> , transitional to <i>C. pallasii</i>				

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Evans	sn	2.3x3.2		gen wingless	none	dark green, dull	Det by Mosyakin 1994, "note abortive fruits!" Short pl, 10 cm to ground, large compact infis. Also what appear to be typical <i>C. villosum</i> fr, as well as smaller, not-filled, winged
Flinn, Dr.	sn						
Gleason, J	572	3.5x3.5	very broadly elliptic, fairly flat	0.6	none, surface rough	very dark	shape and darkness of fruit suggest <i>C. pacificum</i> , wing margin very thin, transparent
Gorman	sn						Determined by Mosyakin, noted as immature plant
Gorman, M.W.	3655						
Hall, E.		fruit large!					Annotated by Mosyakin as transitional to <i>C. pallasii</i>

Hallock, L.	1	WTU	8Dec2011, 8Feb2012	sand hollow, Grant Co., 21Oct2005	<i>C. pacificum</i>	<i>C. villosum</i>	very broad and compact	3x25	very broad, ovate, winged
Halse	4701	OSC	7Dec2011, 2Feb2012	Klickitat Co near Dalles, 26August1993	<i>C. pacificum</i>	<i>C. hyssopifolium</i>	compact	3x40	broad, ovate, covering fr
Junge	3525b	HUH	26Jan2012	E. Europe? 6Sept1907	<i>C. nitidum</i>	<i>C. nitidum</i>	narrow, elongate		
Lapham, I.A.	sn	HUH	7Dec2011, 26Jan2011, 16Feb2012	Milwaukee, nd	<i>C. pallasii</i>	<i>C. hyssopifolium</i>	congested, a few remote prox fr, most glab, but some stellate pub	2x40	ovate, mostly glab, occ scabrous or stellate pub.
Legler	3087	WTU	8Dec2011, 8Feb2012	Frenchmans Bar, near Vancouver WA, 21Sept2005	<i>C. pacificum</i>	<i>C. pacificum</i>	compact, 10x10mm	1.2x25mm	ovate 3.5x2.5 mm
Leiberg	912	OSC	7Dec2011, 2Feb2012	Wallula, 17Sept1894	<i>C. villosum</i>	<i>C. hyssopifolium</i>	somewhat elongate	2.8 x 15	broad, ovate, covering fr
Lomer, F.	4671	WTU	8Dec2011, 8Feb2012	Vancouver BC, 5Nov2002	<i>C. hookeri</i>	<i>C. hookeri</i>	dense, broadest at tip, but axillary fr way down the stem; linear clavate	2 x 30	upper bracts ovate, winged, with long acuminate tip. Lower bracts are stem leaves
Lomer, F.	4670	WTU	8Dec2011, 8Feb2012	Vancouver BC, 5Nov2002	<i>C. pallasii?</i>	<i>C. pallasii</i>	dense, robust, elongate, with some axillary fruits separated down the stem	4.5 x 30	ovate, winged, cover fr completely, essentially glabrous

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Hallock, L.	1	2x3	broadly ovate, rounded at the tip, strongly convex abaxially	0.3	a few with indistinct white warts	dark brown, or green, some with reddish "varnish"	Short, very thick inflorescences. Label note wide variety of forms.
Halse	4701	immature		prominent		pale	Immature fruti, dendroid pubescence
Junge	3525b	2x2.8	broadly elliptical	0.2, thick, narrow, entire edge		reddish	
Lapham, I.A.	sn	2.7x4, 2.6 x 3.9	broadly elliptical	to 0.3	red spots	green, shiny	Det by Mosyakin
Legler	3087	2.9x2.5	very broadly obovate, somewhat convex	0.3 firm light green, entire	no/faint hint	dark green	
Leiberg	912	2x3		0	none	dull abax shiny adax, black	Annotated by Mosyakin as C.v. with note of "probably with hybrid influence of <i>C. pacificum</i> "
Lomer, F.	4671	2.5x4, 2.8 x 4, 2.3 x 3.4	strongly convex abaxially, concave adaxially, ratio 0.63	0.4, entire, moderately thick, rounded at apex	spots and warts	shiny, vary from reddish brown to pale green	Older fr have prominent red or dark spots, younger fr not marked. Fruit down the stem as in <i>C. pallasii</i> , but plants far too large and out of range. Intermediate between <i>C. americanum</i> and <i>C. pallasii</i>
Lomer, F.	4670	2.4x3	strongly convex, elliptical, ratio 0.8	0.4, rounded at apex	occ faint warts, most fr without spots, but some with pronounced spots	dark green	

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
Magocsy et Pollak	3842	HUH	29Nov2011, 7Dec2011, 26Jan2012	Austro-Hungary	<i>C. nitidum</i>	<i>C. nitidum</i>	sparse, well separated fr	narrow, 1 x 10 mm	narrower than achene but longer, narrowly ovate
Mastrogioiuseppe	2732	WS	13Feb2008, 7Dec2011, 26Jan2012, 2Feb2012, 16Feb2012, 1March2012	Priest Rapids, 12Sept1980	<i>C. americanum</i> best fit	<i>C. hyssopifolium</i>	compact	few, 1 x 15	broadly ovate, hyaline margins sparse stellate pub
Maxwell	1311	WTU	29Nov2011, 7Dec2011, 15Dec2011, 8Feb2012, 1March2012	Whites Island, 18Sept1994	<i>C. pacificum</i> or <i>C. pallasii</i>	<i>C. americanum</i> var. <i>americanum</i>	clavate, dense, to 30 x 10 mm, but separated axillary frs down the stem	1 x 15	imbricate > fr
Mitchell, L. and F. Grover	sn	WTU	8Dec2011	Emery County UT, 16Sept1957	<i>C. americanum</i> var. <i>americanum</i>	<i>C. hyssopifolium</i>	some partly dense, mostly elongate, frs separated		ovate, cover fr
Mukle?, Wm	668	WS	13Feb2008, 30Nov2011, 2Feb2012, 16Feb2012, 1March2011	Kenniwick, Sept. 1916	<i>C. americanum</i> var. <i>americanum</i> (except dark fr)	<i>C. hyssopifolium</i> on label	dense, clavate, occ lower axillary fr	1.5 x 15	ovate, winged, much broader than fruit, sparse stellate fr
name not legible		NYBG	19March2012	Buffalo	<i>C. americanum</i> transitional to <i>C. pallasii</i>	<i>C. hyssopifolium</i>	condensed		

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Magocsy et Pollak	3842	2.3x2.5	round	0.3-0.4	no	light brown, pale green	fruit quite broad.
Mastrogioseppe	2732	2.5x3.5/2.1 x 3.2	rounded, broadly obovate	0.5 - 0.4, thin, irregular edge, rounded to broadly triangular	blotchy, not really warty or red spotted, faint warts	pale brown, reddish	Inflorescence most like <i>C. pacificum</i> , but pale color, blotchy surface, more flat shape, and more thin wing more like <i>C. americanum</i> . Specimen quite dry and bleached looking, may account for pale color of fruit. Very similar to Suksdorf 6411, the part with winged fruit
Maxwell	1311	3 x 3.9, 3.2 x 3.9	broad, wide near middle, round apex, very strongly convex, ratio 0.78	0.4, entire, firm, golden brown, mostly entire, but thin at the edge	both, strongly warted	dark green	two specimens on the sheet, appear identical in gross appearance, but one has fruit with broad, thin wings, crenate edges, only moderately convex abaxially, like <i>C. pacificum</i> except for faint warts on some.
Mitchell, L. and F. Grover	sn	2x3	fairly flat	to 0.4, broadly triangular at apex	no	pale reddish brown	
Mukle?, Wm	668	2.6x3.6, 2.7 x 3.5	broadly obovate, rounded	0.2-0.3, 0.4, rounded at apex	very warty, a few red spots	dark green	Specimen just a small sprig of the plant. Keys best to <i>C. americanum</i> , but infl shape like <i>C. pallasii</i> , dark fruit like <i>C. pacificum</i>
name not legible							annotated by Mosyakin

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
Nelson, J.C.	4185	WS	30Nov2011, 7Dec2011, 2Feb2012	Hayden Is, 8Oct1921	<i>C. pacificum</i>	<i>C. hyssopifolium</i>		3x40	
Nikitina	3525a	HUH	16Feb2012	Ukraine, 18Sept1901	<i>C. nitidum</i>	<i>C. nitidum</i>			
Ogilvie	sn	OSC	7Dec2011	Along Snake bet Wawawai and Lewiston, 15Sept1956	<i>C. pacificum</i>	<i>C. hyssopifolium</i>	compact	4x30	broad, ovate, covering fr
Ownbey	sn	WTU, OSC	13Feb2008, 7Dec2011, 2Feb2012, 8Feb2012	Wawawai 15Oct1939	<i>C. pacificum</i>	<i>C. hyssopifolium</i>	compact	4x40	broad, ovate, covering fr
Ownbeys s.n.				Wawawai	<i>C. pacificum</i>	<i>C. pacificum</i>	condensed clavate dist	to 5x40 flat	
Pawlowski & Walas	112	HUH	7Dec2011, 26Jan2012, 16Feb2012	Poland	<i>C. hyssopifolium</i>	<i>C. hyssopifolium</i>	short condensed, small infis axillary to leaves down the stem		
Pickett	668	WS	7Dec2011, 2Feb2012	Kenniwick, Sept1916	<i>C. pacificum</i> and <i>P. pallasii</i>	<i>C. hyssopifolium</i>	looks compact, but not well developed, and lower flowers distant	1.5x20	
Piper, CV	1770	WS	13Feb20087Dec2 011, 26Jan2012, 2Feb2012, 12Feb2012	Wawawai, Oct 1893	<i>C. pacificum</i> isotype		compact	to 3 x 40 mm	broad, ovate, covering fr
Pobedimova	3525d	HUH	16Feb2012	Russia? 11Sept1947	<i>C. nitidum</i>	<i>C. nitidum</i>	elongate and diffuse		

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Nelson, J.C.	4185		thin			reddish	immature fruit color suggests <i>C. americanum</i> , but shape and wing, inflorescence suggest <i>C. pacificum</i> . Not much material, only saw one immature fruit
Nikitina	3525a	2.5 x 3.4	broad oval and relatively flat	0.3-0.5	none	pale green shiny	
Ogilvie	sn	2.5x3.2		0.5	none	pale	fr may be immature, not full
Ownbey	sn	3x4	moderately broad, rounded	0.3	none	dull abax shiny adax, black	
Ownbeys s.n.					no/no	black, shiny	
Pawlowski & Wasas	112	1.9 x 3, 2.1 x 3.2	broadly elliptical, gen broadest around the middle, a few above the middle	0.2, thick, narrow, entire edge	roughened	shiny, but roughened abaxially, green	
Pickett	668	2.6x3.6, ratio 0.72	broadly obovate, fairly flat	0.3, fairly thick, apex rounded	warts and red spots	medium green, to almost black	Looks like <i>C. pacificum</i> , except it has warts and spots; fits <i>C. pallasii</i> fairly well
Piper, CV	1770	2.6 x 3.6	+/- flat, shiny adax, dull-shiny abax, wrinkled	hyaline of 0.4 mm undulate, entire, firm achene 1.9-2.7	none	dark brown to black	
Pobedimova	3525d	2.5 x 3.4	broad oval	0.3m 0.4	none	med green, shiny	

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
Rideout, L.	sn			sandy gravelly riverbank, Nez Perce ID 12Oct1924					
Sandberg and Leiberg	309		13Feb2008	Junction of Crab and Wilson Creek, 25June1893	<i>C. pallidum</i> type	<i>C. hyssopifolium</i>			
Sandberg and Leiberg 9010?	sn	WTU	8Feb2012	Egburt spgs July ? 1893	<i>C. pallidum</i> paratype	<i>C. hyssopifolium</i>	to 35x7 mm	to 1.1x34 mm	to 20x70 mm lanceolate
Schiraeovsky	3521	HUH	16Feb2012	Russia ?		<i>C. hyssopifolium</i>	elongate, fruits gen well separated		
Sprague	sn	OSC	7Dec2011, 2Feb201	Chambers Bar, NW of White Bluffs, 19Aug1938	<i>Corispermum</i> sp	<i>C. hyssopifolium</i>			
St John	6738	WS	13Feb2008, 30Nov2011, 7Dec2011, 26Jan2012, 2Feb2012, 16Feb2012	Wawawai, 24Oct1924	<i>C. pacificum/villosum</i>	<i>C. hyssopifolium</i> , ann to <i>C. nitidum</i> (by St. John)	battered, orig prob dense	3.5x30	< fruit
St John, Courtney, and Parker	4948	WS	30Nov2011, 26Jan2012, 2Feb2012, 8Feb2012, 16Feb2012	Dry sand SW of Moses Lake, 25June1921	<i>C. pallidum</i> paratype	<i>C. pallidum</i>	two plants with relatively elongated inflorescence, to 35 x 7 mm, one plant infl compact	to 1.2 x 20 mm	covering fruit, 5-7x2.5 mm, broad ovate with broad hyaline margin, nearly or quite glab, though leaves have stellate pubescence

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Rideout, L.	sn						
Sandberg and Leiberg	309						Label date is given as 25 July, but field notes place it as 25 June 1893
Sandberg and Leiberg 9010?	sn	3.6x3.2 3.5x2.9, achene 2.2x1.5, 2.3x1.6		0.9 or 1.0	small red spots, a few faint warts	achene golden brown wing pale tan	sheet also has immature pl that has the shape of <i>C. pacificum</i>
Schiravsky	3521	2.3 x 2.7, 2.3 x 2.9	nearly orbicular, most broadest near the middle, a few above the middle	none or narrow, thick to 0.2	occ red spots adax	pale green	
Sprague	sn						Det by Mosyakin 1994
St John	6738	2x2.4	broadly ovate, rounded distally, fairly flat	0.2		various, dark copper to black, dull	Like <i>C. villosum</i> (nearly wingless), or <i>americanum</i> (flattened, some pale), or <i>pacificum</i> (broad rounded fruit, thin wing, with somewhat diffuse inflorescence, congested distally, very similar to Suksdorf 6411, with narrow wing; small width of fr may be because of lack of wing
St John, Courtney, and Parker	4948	3.4x2.7, 3.3x2.8, achene 2x1.2, 2x1.4		to 0.7 mm	no/no	achene golden brown wing pale tan	

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
St John, English, Jones, and Palmer	9233	WS	13Feb2008, 7Dec2011, 26Jan2012	Ilia, Garfield Co., 23Oct1927	<i>C. pacificum</i>	<i>C. hyssopifolium</i>	compact	2.3x20	broad, ovate, covering fr
St. John	6792	WS	13Feb2008	Clearwater R. near Lewiston, 12Oct1924					
Steinitz	3840	HUH	29Nov2011, 7Dec2011, 26Jan2012	Austro-Hungary,	<i>C. nitidum</i>	<i>C. canescens</i>	slightly more dense than previous specimen	narrow, 1x7mm	narrower than achene but longer, narrowly ovate
Steinitz, W.	598	HUH	29Nov2011, 26Jan2012	Hungary, 12Oct1879	<i>C. nitidum</i>	<i>C. hyssopifolium</i>	diffuse, delicate		
Stevens, O.A.	669	NYBG	19March2012	Fargo ND 12Sept1942	<i>C. americanum</i> , transitional to <i>C. villosum</i>	<i>C. villosum</i>	dense and compacted		
Suksdorf	3675	WS, WTU	13Feb2008, 30Nov2011, 7Dec2011, 26Jan2012, 2Feb2012, 8Feb2012, 16Feb2012	Bingen, 16July1895	<i>C. americanum</i> var. <i>americanum</i>	<i>C. nitidum</i>	elongate diffuse to 7 cm	1.5x20	ovate, about = fruit, nearly or quite glab, or with sparse scabrosity
Suksdorf	sn	WS	13Feb2008, 30Nov2011, 26Jan2012, 2Feb2012, 16Feb2012	riverbank, Bingen, 2Nov1898	<i>C. pacificum</i>	<i>Corispermum</i> , ann. <i>C. hyssopifolium</i>	compact	4x45	broadly ovate, hyaline margins sparse stellate pub
Suksdorf	sn		7Dec2011	Columbia Riverbank Klickitat 11Sept, 29Oct1893	<i>C. pacificum</i>	<i>C. hyssopifolium</i>	compact	2.5x40	broad, ovate, covering fr

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
St John, English, Jones, and Palmer	9233	2.8x3.5		0.4, somewhat uneven edged, translucent	maybe faint warts	dull, dark	
St. John	6792						
Steinitz	3840	2x2.2		0.1	no	central portion slightly darker, brown	Identified by Mosyakin
Steinitz, W.	598	2.5x3.5	broadly elliptic to rotund, moderately convex abaxially	0.4, broad, thin, hyaline at outer edge, irregular edge	no	pale coppery	fr. Shiny, no warts, gold, a bit darker, greenish in center, pronounced wing. Det. by Mosyakin
Stevens, O.A.	669	ar 2 x 3	broadly obovate	0.1, 0.2	red spots, faint warts	pale tan	Annotated by Mosyakin. Dense inflorescences pronounced feature
Suksdorf	3675	2x3	obovate, the achene is rounded, but not broadly so	fairly thin, hyaline, jagged-edged, 0.4, broadly triangular at the tip	red spots/no	reddish gold light and dark bands around achene edge	wing membranous, erose
Suksdorf	sn	2.5 x 3.2; 3 x 4, 3 x 3.8	close to orbicular	0.3, 0.5	possibly a few indistinct warts	dull, very dark green	leaves and bracts quite robust
Suksdorf	sn	3.2x4.5		0.6	none	dull abax shiny adax, black	annotated by Halse to <i>C. pacificum</i>

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
Suksdorf	sn	WS	13Feb2008, 30Nov2011, 26Jan2012, 2Feb2012, 16Feb2012	Bingen, 9Oct1890	<i>C. pacificum</i>	<i>Corispermum</i> , ann. <i>C. hyssopifolium</i>	compact	2x30	ovate, sparse stellate pubescence
Suksdorf	1385	OSC, WS	13Feb2008, 30Nov2011, 2Feb2012	Bingen, 11Sept1893, 29October1893	<i>C. pacificum</i>	<i>C. hyssopifolium</i>	fairly dense, axillary		
Suksdorf	6411 right	WS	13Feb2008, 30Nov2011, 26Jan2012, 2Feb2012, 16Feb2012, 1March2012	E of White Salmon R RR, foreign gravel, Bingen, 17Oct1908	<i>C. pacificum</i>	<i>C. villosum</i>	very short and dense, especially in lower leaf axils. The leaves forming these axils are linear, to 35 mm	2 x 35	broadly ovate, acuminate, with hyaline wings, sparsely villous with stellate hairs
Suksdorf	6411 left	WS	13Feb2008, 30Nov2011, 26Jan2012, 2Feb2012, 16Feb2012, 1 March2012	E of White Salmon R RR, foreign gravel, Bingen, 17Oct1908	<i>C. villosum</i>	<i>C. villosum</i>	very short and dense, especially in lower leaf axils. The leaves forming these axils are linear, to 20 mm	2 x 20	broadly ovate, acuminate, with hyaline wings, sparsely villous with stellate hairs
Suksdorf	sn	WS	13Feb2008	Bottomlands, 30June1895		<i>C. nitidum</i>			
Suksdorf	2074	WS	13Feb2008	Bingen, Col. River, 13Oct1891					
Terre, J.	854	WTU	Feb-12	Vaucluse, FR 10Sept1949		<i>C. hyssopifolium</i>			
Thompson, J.W.	3915	WTU	8Dec2011, 8Feb2012	Hayden Is, 8Oct1927	<i>C. pacificum</i>	<i>C. hyssopifolium</i>	short and condensed clavate	to 4 x 40 flat	
Thompson, J.W.	6764	WTU	8Dec2011, 8Feb2012	15June1931 sandy sagebrush near Quincy	<i>C. pallidum</i> paratype	<i>C. pallidum</i>	Moderately congested, with some separated fr down the stem		distal bracts more ovate

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Suksdorf	sn	3.3x4	broad rounded apex, somewhat flattened	0.5, broad, fairly thin, well differentiated from the rest of the fruit.	none	dark green to black	Inflorescence, gen appearance of plant just like Suksdorf 6411; fruit is unmistakable as <i>C. pacificum</i>
Suksdorf	1385	3.5x5	broadly obovate, fairly flat	0.5, 0.6 thick	dull	dark greenish brown	
Suksdorf	6411 right	2.5 x 3.3/2.3 x 2.5/2.3 x 3.2/ 2.5 x 3.3 not incl. wings: 1.8 x 2.8/ 1.9 x 2.7	broadly ovate, broad, fairly rounded at tip	0.4-0.3, rounded at the tip	mostly dull abax, shiny adax, a few faint warts	very dark green, or brown, or blackish	two specimens on the sheet, appear identical in gross appearance, but one has fruit with broad, thin wings, crenate edges, only moderately convex abaxially, like <i>C. pacificum</i> except for faint warts on some.
Suksdorf	6411 left	2.4 x 3.1, 2.1 x 3	both are broadly ovate, broad, fairly rounded at tip	none, or indistinct, narrow and thick wing 0.1	mostly dull abax, shiny adax, a few faint warts	some fruits from have reddish varnish, but fruit itself is dark green or brown or blackish	most like <i>C. villosum</i> , except quite broad in overall shape
Suksdorf	sn						
Suksdorf	2074						
Terre, J.	854				red spots		
Thompson, J.W.	3915	flat 2 x 3.5		wide, to 0.8, hyaline	no/no	black, shiny	fits well; some wings very wide
Thompson, J.W.	6764	3.1 x 2.8, 3.2 x 2.3, achene 2 x 1.3, 2.1x1.2		to 0.7 mm	no/no	achene golden brown wing pale tan	

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
Thompson, J.W.	12172	WTU	8Dec2011, 8Feb2012	Lake Co Oregon, 18July1935	<i>C. vilosum</i>	<i>C. hyssopifolium</i>	Mostly short and dense, occ remote axillary fr		some villous, others glab
Thompson, J.W.	13274	WTU	8Dec2011	Lake Co Oregon, 13July1935	<i>C. vilosum</i>	<i>C. hyssopifolium</i>	short compact		very broad, > fruit, sparsely pubescent
Thompson, J.W.	3843	WTU	8Dec2011	16Sept1927					
Turner, G.H.	1574	HUH	7Dec2011, 26Jan2012	Alberta, 4Sept1939	<i>C. pallasii</i>	<i>C. marginale</i>	dense, cylindrical	1.5x20	ovate, broad, imbricate
Umbach, L.M.	1388	HUH	29Nov2012, 16Feb2012	Millers, Indiana, 8Sept1896	<i>C. pallasii</i>	<i>C. pallasii</i>	clavate distally, separated fr axillary to narrow lvs proximally	1x20	broad distally, narrow and remote proximally
Vasey	sn	NYBG	19March2012	Chicago, no date	<i>C. americanum</i> , transitional to <i>C. pallasii</i>				
Verlemer	sn	HUH	7Dec2011, 26Jan2012	Holland, 19June1930	<i>C. hyssopifolium</i>	<i>C. hyssopifolium</i>	leafy, mostly not developed	2x40	
Wadmond	lg. 16239	HUH	29Nov2011, 7Dec2011	Wisconsin, July 1897	<i>C. pallasii</i>	<i>C. hyssopifolium</i>			
Zika	16656	WTU, WS	13Feb2008, 30Nov2011, 7Dec2011, 2Feb2012, 12Feb2012	Snake River, Asotin Co., 1October2001	<i>C. pacificum</i>	<i>C. pacificum</i>	short compact, axillary and terminal, some more elongate, interrupted below	to 2x40	imbricate

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Thompson, J.W.	12172	2 x 3	narrowly obovate	none	no	green	few fruits
Thompson, J.W.	13274	2 x 3	narrow ovate, strongly convex	0.1			
Thompson, J.W.	3843						
Turner, G.H.	1574	2.5x3.2	broadly elliptic	0.3-0.4	red spots	dull, or a little shiny, pale green, wrinkled abaxially	Det by Mosyakin, he notes "fr small-transitional to <i>C. americanum</i> "
Umbach, L.M.	1398	2.6 x 3.8	broadly elliptic	0.4	red spots, faint warts	gold, greenish middle	Had been ID'd <i>C. hyssopifolium</i> , annot. By Mosyakin says transitional to <i>C. americanum</i> .
Vasey	sn	to 4 mm			red spotted		Annotated by Mosyakin as transitional to <i>C. pallasi</i>
Verlemer	sn	3x2.2	strongly convex abaxially, look wider above the middle!	0.2			
Wadmond	i.g. 16239			0.4-0.5			Det by Mosyakin
Zika	16656	3.3 - 2.6, ratio 0.79	fairly narrow	0.3 or less, thick	no/a few indistinct	pale green, shiny adax, dull abax	

Corispermum herbarium specimens examined in this study

Collector	#	herbarium	date examined	location, collection date	Determination, annotation	original label name	inflorescence	largest leaves mm	bracts
Zika	16658	WTU	13Feb2008, 8Dec2011, 8Feb2012	Snake /River, Asotin Co., 10October2001	<i>C. pacificum</i>	<i>C. pacificum</i>	more narrow and elongate than Zika 18022, somewhat condensed distally, but most fruits separated	to 2x40	imbricate
Zika	17866	WTU	8Dec2011	Frenchman's Park, Clark Co	<i>C. pacificum</i>	<i>C. pacificum</i>	dense, compact	2x40	
Zika	18022	WTU	15Dec2011	Hayden Is	<i>C. pacificum</i>	<i>C. pacificum</i>	dense clusters at br ends, 7x15mm, occ to 8 cm, a few separated axillary fr down the stem	to 2x25 mm flat	imbricate, ca. = fr width
Zika	19074	WTU	8Dec2011	Columbia Co OR, 18Sept2003	<i>C. pacificum</i>	<i>C. pacificum</i>	dense, elongate, to 15 cm, resembles Lomer 4670	2x30	
Zika	19075	WTU	8Dec2011	Columbia Co OR, 18Sept2003	<i>C. pacificum</i>	<i>C. pacificum</i>	dense, compact, a few fruits separated, below on the stems		hairy
Zika	18064	WTU	15Dec2011, 8Feb2012	Beverly dunes 7Oct2002	<i>C. villosum</i>	<i>C. villosum</i>	compact, dense terminal 5x2.5 cm and axillary (0.5 cm or less) or occ. only a single fr	1.5x20	

Corispermum herbarium specimens examined in this study

Collector	#	fruit mm	fruit shape	wing mm	spots/warts	fruit color	notes
Zika	16658	3.3 - 2.6, ratio 0.79	moderately broad, rounded	0.3	no/a few indistinct	black or green, shiny adax, dull abax	Noted diffuse inflorescence, as in <i>C. americanum</i> , but fruit as in <i>C. pacificum</i> . Two sheets, two somewhat different looking plants (relative to inflorescence) with the same number
Zika	17866						immature, no fruit
Zika	18022	3.3 x 3.5	flat and broadly rounded	0.5 entire, undulate, pale green, hyaline at edge	faint red spots/no	dull abax shiny adax, dark green	
Zika	19074	2.8x3.5, 3.8 x 2.5 very convex	broadly obovate,	0.4	some faint warts	dark or pale green	very shiny adaxial, more dull abaxial
Zika	19075	2.2 x 3, 2.3 x 3.2, ratio 0.72	moderately narrow, obovate, strongly convex	0.1, 0.2, quite rounded, though narrow	a few indistinct white warts	pale green	Could almost go to <i>C. villosum</i> , though it is slightly large. Lacks the broad apically rounded wing usual for <i>C. pacificum</i> ; also has occasional white warts
Zika	18064	3.1 x 1.9, 3.0 x 2	very convex	none	large red splotted/indistinct	green	