

Expedition to collect plant genetic resources wild American hops In Colorado and New Mexico

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Coordinator:

Kim E. Hummer, Research Leader, USDA ARS NCGR-Corvallis

Participants:

Jim Oliphant, Biological Science Research Technician, USDA ARS NCGR-Corvallis
Doug Cook, Information Manager, USDA ARS NCGR-Corvallis
Jodi Jackson, Biological Sciences Research Technician, USDA ARS NCGR-Corvallis
33447 Peoria Road, Corvallis, Oregon, 97333-2521

Scott Dorsch, Biologist, Busch Agricultural Resources, Inc.,
3515 East County Road 52, Ft. Collins, Colorado, 80524



CHUM 1352 *Humulus lupulus* var. *neomexicanus* from the White River watershed near Buford, Colorado. Cones and seeds were collected on September 13, 2002.



Habitat of CHUM 1349, *Humulus lupulus* var. *neomexicanus* from Beaver Creek in the Yampa/Green River Watershed, Colorado.

Summary Report

A plant collection trip was taken on 9-20 September 2002 to obtain genetic resources of wild American hop germplasm (*Humulus lupulus* var. *neomexicanus*) in Colorado and New Mexico. Thirty-five populations of *Humulus lupulus* var. *neomexicanus* from 12 major drainage basins in Colorado and New Mexico were sampled resulting in 54 seed and 16 plant accessions for a total of 625,000 seeds and 16 clones. Herbarium specimens were collected from 9 significant new localities to be distributed to major regional herbaria. Much variation in morphology and aroma was observed in most populations. *Humulus* distribution in the Rocky Mountains is scattered and uncommon. While herbarium locality data was invaluable to locate populations, no clear predictors of potential habitat based on associated species, topography, or even proximity to water were evident after our extensive survey. *Humulus* appears to have an opportunistic, fragmented distribution pattern and may be undergoing range expansion or local extinction. *Humulus* was much more fragmented on east slope than the west slope. The drier climate and loss of habitat through human development of the east slope may be factors contributing to this observation. The seed and plant accessions were deposited at the USDAARS NCGR-Corvallis, Oregon, and are available to researchers upon request.

Objectives

Obtain seed collections of *Humulus lupulus* var. *neomexicanus* from localities in Colorado and New Mexico along major river drainages of the southern Rocky Mountains.

Introduction and Methods

Wild American hops varieties have potential for unique traits, such as resistance to Hop Powdery Mildew, to be utilized in breeding programs. At the present time, *Humulus* germplasm collections are lacking representation of much of the native North American varieties. A collection trip was made in September 2002 to collect *Humulus* germplasm from the southern Rocky Mountain region of Colorado and New Mexico. The currently recognized variety in this region is *Humulus lupulus* var. *neomexicanus*. A collection trip the previous year (2001) to Canada and North Dakota collected the variety *Humulus lupulus* var. *lupuloides*.

The southern areas of the current distribution of *Humulus lupulus* are in regions that were unglaciated during the Pleistocene. The geographic distribution of *Humulus lupulus* suggests that populations of var. *neomexicanus* in CO, NM, UT, AZ, NV, and WY (and to a lesser extent the populations of var. *pubescens* in the eastern US) should have significant genetic diversity that would have accumulated during repeated interglacial isolation events. This potential historical impact on genetic variation suggested a sampling strategy that should maximize isolation between sampled populations.

We obtained herbarium label data from the major regional herbaria as well as the National Herbarium (US). The regional herbaria are the Rocky Mountain Herbarium (RM), University of Wyoming, Laramie, WY; University of Colorado Museum Herbarium (COLO), Boulder, CO; Colorado State University Herbarium (CS), Ft. Collins, CO; Herbarium (ASC), Adams State College Alamosa, CO; University of New Mexico Herbarium (UNM), Albuquerque, NM; and the Biology Herbarium (NMC), New Mexico State University, Las Cruces, NM. The assistance of these institutions is gratefully acknowledged.

We divided the southern Rocky Mountains into major watersheds on both sides of the Continental Divide (see Tables 1 & 2). Within each of the watersheds we attempted to sample 3-6 populations. At each population we tried to sample 5 subsites of 1-10 individuals separated by at least 100m. The vining growth habit of *Humulus* and its tendency to layer and root at a distance from the original crown made determination of unique clones in the field dubious. Collecting at different subsites we should increase our confidence that we are sampling unique clones. We collected seed from clones when possible. Cuttings or rootstocks were collected if seed set was sparse or lacking. When plants were collected we tried to sample both male and female clones.

Daily Itinerary

Monday 9 September 2002 Leave Portland, Oregon arrive Denver, Colorado

Tuesday 10 September 2002 Collect at El Dorado Springs, drive to Boulder, Estes Park, to Fort Collins

Wednesday 11 September 2002 Collect at Redstone Canyon, drive along Poudre River to Walden, spend night in Steamboat Springs

Thursday 12 September 2002 Collect along Yampa River then to Browns Park, spend night in Vernal, Utah

Friday 13 September 2002 Collect along White River, spend night in Glenwood Springs

Saturday 14 September 2002 Collect along Colorado River, Rifle Gap, Sweetwater Lk., spend night in Frisco

Sunday 15 September 2002 Collect in Silver Plume, Aspen, search near Paonia, spend night in Gunnison

Monday 16 September 2002 Meet Scott and Nazareno, collect along Gunnison River, Arkansas River, spend night in Alamosa

Tuesday 17 September 2002 Collect in San Luis Valley, Wagon Wheel Gap, to Chimney Rock, Durango, spend night in Ouray

Wednesday 18 September 2002 Collect along San Miguel and Delores Rivers, to Durango, then south into New Mexico, search near Los Alamos and Placitas, spend night in Santa Fe

Thursday 19 September 2002 Collect along Pecos River, Canadian River, Purgatorie River, spend night in Pueblo, Colorado

Friday 20 September Collect near Canon City and Sedalia, drive to Denver airport, fly to Portland, Oregon

Collection Summary

Thirty-five populations of *Humulus lupulus* var. *neomexicanus* from 12 major drainage basins in CO and NM were sampled resulting in 54 seed and 16 plant accessions (Table 1 & 2, Figure 1, Appendix 1). The seed lots total about 625,000 seeds. It is recommended that some of the seed subsites should be bulked and treated as 1 accession for purposes of germplasm maintenance. Herbarium specimens were collected from 9 populations representing significant new localities. These specimens will be distributed to the following herbaria: CS, CO, NM, RM, US. Additionally, 5 collections were made of *Fragaria*, *Ribes*, and *Rubus* (Appendix 2).

Much variation in morphology and aroma was observed in most populations. *Humulus* distribution in the Rocky Mountains is scattered and uncommon. While herbarium locality data was invaluable to locate populations, no clear predictors of potential habitat based on associated species, topography, or even proximity to water were evident after our extensive survey. *Humulus* appears to have an opportunistic, fragmented distribution pattern and may be undergoing range expansion or local extinction. *Humulus* was much more fragmented on east slope than the west slope. The drier climate and loss of habitat through human development of the east slope may be factors contributing to this observation.

Generally, when we located a *Humulus* site we collected from all possible individuals. Due to the fragmented distribution pattern, it was not possible to always sample subsites as had been originally planned.

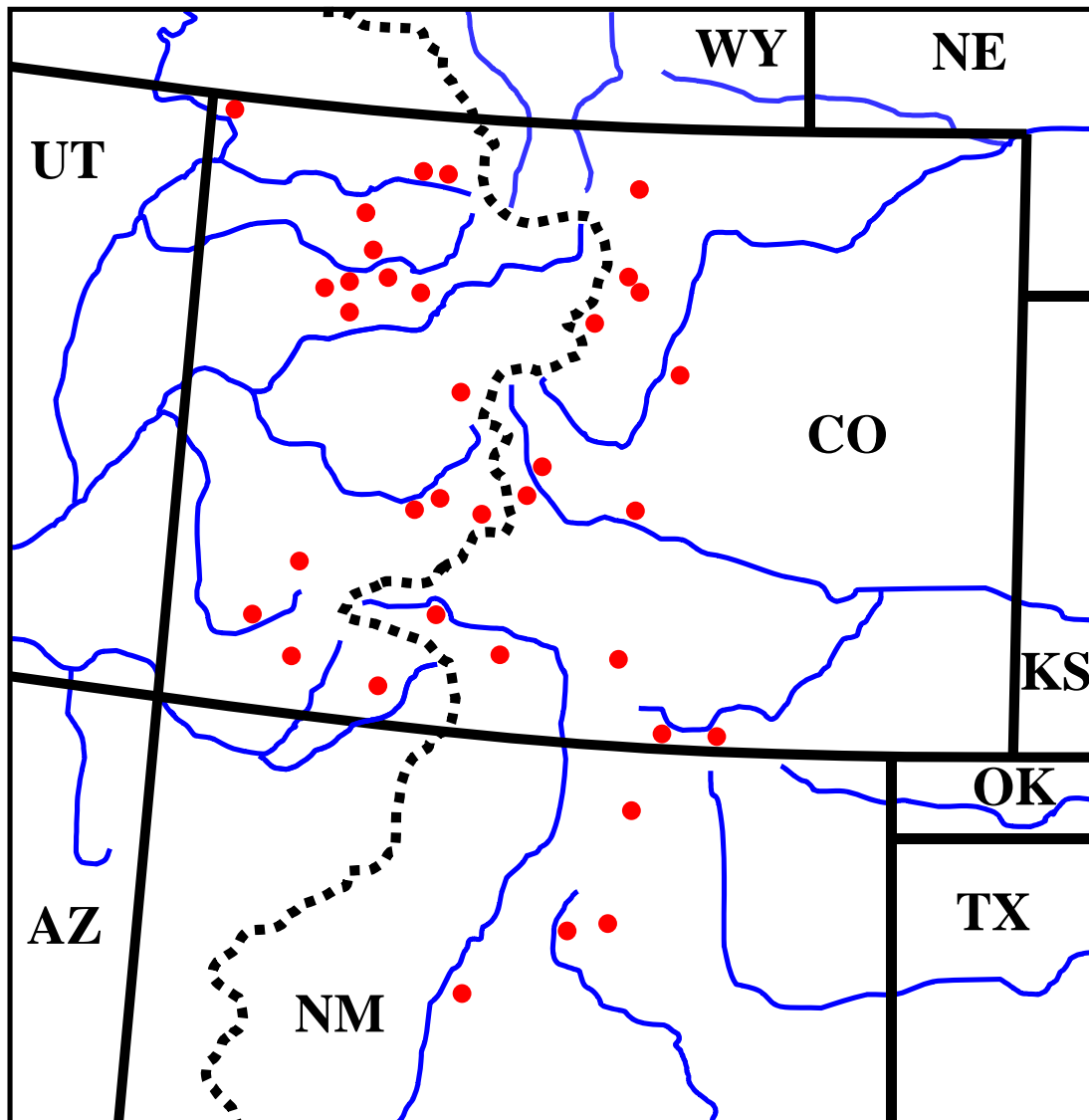
Table 1. Summary Collection Data of *Humulus* in East Slope Watersheds

Watershed	# of Subsites	Form	Elevation (m)	Date
East Slope Continental Divide				
South Platte R.				
Coal Cr., CO	1	Seed	1829	9/10/02
El Dorado Springs, CO	4	Seed	1834	9/10/02
Redstone Cr., CO	2	Seed	1768	9/11/02
Sedalia, CO	1	Seed	1779	9/20/02
Silver Plume, CO	1	Seed	2791	9/15/02
Arkansas R.				
Nathrop, CO	1	Seed	2348	9/16/02
Poncha Cr., CO	1	Seed	2532	9/16/02
Phantom Canyon, CO	2	Seed/Plants	1980	9/20/02
Purgatoire R.				
Cordova Plaza, CO	1	Seed	2070	9/19/02
Wooton, CO	1	Seed	2201	9/19/02
Canadian R.				
Cimarron R., NM	2	Seed	2480	9/19/02
Manuelitas, NM	1	Seed	2176	9/19/02
Pecos R.				
Pecos, NM	2	Seed/Plants	2341	9/19/02
Rio Grande				
Las Huertas, NM	1	Seed	2149	9/18/02
Rock Cr., CO	2	Seed	2507	9/17/02
Sangre de Cristo, CO	2	Seed	2475	9/17/02
Wagon Wheel Gap, CO	1	Seed	2537	9/17/02

Table 2. Summary Collection Data of *Humulus* in West Slope Watersheds

Watershed	# of Subsites	Form	Elevation (m)	Date
West Slope Continental Divide				
Green & Yampa R.				
Beaver Cr., CO	1	Seed	1733	9/13/02
Buford, CO	1	Seed	2157	9/13/02
Deer Gulch, CO	2	Seed/Plants	2129	9/14/02
Miller Cr., CO	1	Seed	2192	9/13/02
South Fork Canyon, CO	1	Seed	2338	9/13/02
White R.				
Axial, CO	4	Seed	2005	9/12/02
Hayden, CO	4	Seed	1978	9/12/02
Milner, CO	1	Seed	2063	9/12/02
Colorado R.				
Aspen, CO	1	Seed	2437	9/15/02
E. Rifle Cr., CO	2	Seed	1948	9/14/02
Sweetwater Lk., CO	3	Seed	2363	9/14/02
Gunnison R.				
Cochetopa Canyon, CO	1	Seed	2439	9/16/02
Tomichi Cr., CO	1	Seed	2518	9/16/02
Willow Cr., CO	1	Seed/Plants	2350	9/16/02
Dolores/San Miguel R.				
Delores R., CO	1	Seed	2265	9/18/02
Leopard Cr., CO	2	Seed	2264	9/18/02
San Juan/ Animas R.				
Cherry Gulch, CO	1	Seed	2164	9/18/02
Chimney Rock, CO	1	Seed	2025	9/17/02

Figure 1. 2002 Hop Collection Sites



The Dotted line represents the continental divide. The dots represent collection locations. The blue lines represent the river drainage systems for the region.

Travel Log and Journal

I= Interstate Highway US= United States Highway S= State Highway C= County Road OCJ= Collector number

Monday 9 September 2002

Traveled from Corvallis, OR to Aurora (Denver), CO

Tuesday 10 September 2002

From Aurora we went west on I-70 to S-58 and west to Golden, north on S-93 to Coal Creek (OCJ-1). North on S-93 to El Dorado Springs Drive, southwest on drive to Mesa Trailhead parking lot. We found some *Humulus* amongst willows on the south side of Boulder creek. There were a number of male plants to the south of parking lot (OCJ-2). Continue up South Boulder Creek to Rattlesnake Gulch Trailhead (OCJ-3) and further up to El Dorado Canyon State Park (OCJ-4). Going back downstream to the rock climbing area just upstream from El Dorado Springs (OCJ-5) we made are last collection. We returned northeast back to S-93 and north to Boulder. We took US-36 north to Lyons. West of town some young plants were found with no cones. From Lyons we went on S-7 up the South St. Vrain Creek, turned onto C-103 to the small community of Raymond, to a site collected 80 years ago. We found only one plant growing on a mailbox and declined to collect it. Returned to S-7 via S-72 and went north to Estes Park. Followed US-34 down the Big Thompson River and north on US-287. Spent the night in Fort Collins.

Wednesday 11 September 2002

Stopped at Scott Dorsch's office (Bush Agriculture) to pickup shipping boxes and cone collecting buckets. From Fort Collins we went south on US-287, west on West Harmony to South Taft Hill Road, north on S. Taft Hill Rd. to West County Road 38E. Follow C-38E past Horsetooth Reservoir, uphill and down hill toward Redstone Creek. Starting halfway downhill and collecting until nearly the creek (OCJ-6) were plants. Followed Redstone Creek up C-N25E for about 4.5 miles to Happy Hollow Gluch (OCJ-7). Returned to C-38E and head southerly to Masonville. Turned south onto C-N27 to C-W32C. Traveled up C-W32C for about a mile (no plants) and returned to Masonville. Went northwest up Buckhorn Creek on C-N27 to Stove Prairie Road and on to S-14. Followed S-14 down the Cache La Poudre River to US-287. Went south on US-287 right on West County Road 54E, left on North County Road 25E, right on West County Road 52E, right on North County Road 27E and back to US-287 on West C-54E (no plants). Retracted route back up the Cache La Poudre River and continued on S-14 to US-40. In route, at Rustic, we turned north for a side excursion. Going up C-69 then C-68C for about 6 miles. At Elkhorn Creek is a driveway going into a ranch (locked gate). Downhill from there in a ditch were some *Humulus*. The Elkhorn drainage is large enough there maybe a number of populations. While travelling through Jackson County it appeared too cold for *Humulus* to grow. We went west on US-40 to Rabbit Ears Pass (OCJ-8) and onto Steamboat Springs for the night.

Thursday 12 September 2002

Traveled west from Steamboat on US-40 to Milner (OCJ-9) and the area around Hayden (OCJ-10). Explored north and east on C-80 for 2 or 3 miles and returned back to Hayden. We went back eastward on US-40, north on C-52 going along Wolf Creek. Turned around at Meadow

Gulch(OCJ-11) and returned to US-40. Going westward turn right onto C-70 for only 100m (OCJ-12) and back to US-40. Went west on US-40 for a mile and turned south on C-27 for just a mile (no cones on plants) before taking US-40 to the west of Hayden (OCJ-13). Turned south on S-13 passing through Hamilton and going by Axial along Good Spring Creek up to about milepost 60 (OCJ-14 to OCJ-17) before returning to the westward trek on US-40. At Maybell we turned northwest onto S-318 going to its end at the Utah boarder (OCJ-18). After returning to US-40 we continued west to Vernal, Utah for the night.

Friday 13 September 2002

From Vernal go eastward on US-40 back to State highway 64 at Dinosaur. Follow S-64 to Rangley, continue east of town to C-122 and follow it south to Calamity Ridge (we had a flat tire in route). No plants were found. Go downhill eastward on C-122 then C-20 to C-5 and finally back to S-64. We traveled on S-64 and S-13 to Meeker. To the east of town turn right onto C-8 up the White River. Turn south on C-57 up Miller Creek 4.5 miles (OCJ-19 and OCJ-20). Returned to C-8 and went east to Buford, turn south on New Castle Buford Road. Turned up C-10 following the South Fork White River to the South Fork Campground (OCJ-21). Returned to Buford and went just east on C-8 past the buildings (OCJ-22). Returned to S-13 and traveled south to I-70 and Glenwood Springs for the night.

Saturday 14 September 2002

From Glenwood Springs we traveled back up S-13 to Rio Blanco and west on C-5 for 6 miles to Deer Gulch up a small overgrown dirt road (OCJ-23 to OCJ-25). Back on C-5 go one-half mile toward S-13 to where a plant with cones were found along Piceance Creek (OCJ-26). Follow S-13 toward I-70 and turn north on S-325 to Rifle Gap (no cones on plants). From Rifle Gap Reservoir we explored up S-325 for seven miles (OCJ-27, CJ-28) and C-252 for the same (no plants). From S-325 via I-70 go north on the Colorado River Road to Sweetwater Road and follow it to Sweetwater Lake (OCJ-29 to OCJ-31). Return to I-70 and go east to Vail Pass and go up Shrine Pass Road to summit (OCJ-32). Spent the night further east down I-70 at Frisco.

Sunday 15 September 2002

From Frisco we went east on I-70 to Silver Plume (OCJ-33). From here we went back westward on I-70 and south on S-91 and US-24 then west on S-82 to Aspen (OCJ-34). We continued westward on S-82 and south on S-133 to Paonia. From Paonia we took back roads and tracks toward Lamborn Mountain and Landsend Peak, but daylight ran out on us (no plants found). After returning toward Paonia we followed C-39.00 to S-92 which lead us to US-50 and east to Gunnison for the night.

Monday 16 September 2002

On this day Scott Dorsch (Busch Agricultural Resources Inc.) and Nazareno Perez (Agrar del Sur) joined us to observed and help collect plants. From Gunnison we went west on US-50, south on S-149 and south on C-31 up Willow Creek to where Pole Creek enters (OCJ-35 to OCJ-39). Back on US-50 go east of Gunnison, turn south on S-114 and up Cochetopa Creek for 5 miles to just before C-43A (OCJ-40). Continuing on US-50 eastward to where Owens Creek enters Tomichi Creek or roughly 6.5 miles west of Sargents (OCJ-41). Follow US-50 east, go north past Nathrop on US-285 to C-301. On C-301A between US-285 and the Arkansas River (OCJ-42). Go south on US-285 past US-50 up Poncha Creek for about 5 miles (OCJ-43). Continued south

on US-285, took S-17 south to Lane 6 N going east to S-150 into the Great Sand Dunes National Monument. Explored up Mosca Creek (no plants). Scott Dorsch agreed to ship samples collected to date back to NCGR-Corvallis for us. Spent the night in Alamosa.

Tuesday 17 September 2002

In the morning we went east on US-160 up Sangre de Cristo Creek past Fort Garland to Cottonwood Gulch (OCJ-44) and to where Malo Vega Creek enters (OCJ-45) before turning back westward. West of Alamosa on US-160 to Monte Vista, south on S-15, west on C-E2S, south and west on C-28 up Rock Creek. On C-28 1.5 miles west of junction with C-W9S (OCJ-46) and at Burnt Gulch (OCJ-47) plants with cones were found. Returned to US-160 going west to S-149 and up the Rio Grande River to Wagon Wheel Gap (OCJ-48). Back on US-160 we continued west to Devil Creek (OCJ-49) near Chimney Rock and the Piedra River. West on US-160 and then north on US-550 to Ouray for the night.

Wednesday 18 September 2002

Traveled north from Ouray on US-550, westward on S-62 to Leopard Creek. At about 2.5 miles (OCJ-50) and one-fourth mile (OCJ-51) from Placerville and the junction with S-145 collections were made. Continue southerly on S-145 to where the West Delores River joins the Delores River (OCJ-52) and onward to US-160. From here we went eastward on US-160 to Durango. At Cherry Gulch (OCJ-53) some 5 miles west of Durango cones were collected. South from Durango on US-550, S-544 and S-44 we traveled into New Mexico crossing I-25 onto S-165 which turns into S-44 going up Los Huertas Creek (OCJ-54). Traveled north on I-25 and spent the night at Santa Fe.

Thursday 19 September 2002

From Santa Fe take I-25 eastward to S-50 and then north on S-63 along the Pecos River. Collections were made between the Windy Bridge and the Bert Clancy recreation sites (OCJ-55 to OCJ-60). Returning to I-25 the next excursion was north of Las Vegas on S-518 and northwest on S-94 to Manuelitas Creek (OCJ-61). We continued northwest up S-518 to S-68 which connected to US-64. Traveled eastward on US-64 past Eagle Nest to the Cimarron River (OCJ-62, OCJ-63). The upper reaches of the Cimarron River has many *Humulus* visible from the road. We returned to Colorado taking US-64 and I-25. Just over the boarder at Raton Creek a collection was made (OCJ-64). Further north on I-25 go 19 miles, westward of Trinidad, on S-12 to the last site of the day, collected by flashlight (OCJ-65). The last night was spent at Pueblo.

Friday 20 September 2002

This day we took US-50 west from Pueblo. Before reaching Canon City we turned north on Phantom Canyon Road (C-67), east on C-123 and north on Upper Beaver Creek Road (C-132) to its end on Beaver Creek (OCJ-66). Returned to the Phantom Canyon Road and follow it up Eight Mile Creek pass the second tunnel (OCJ-67 to OCJ-74). Returned to US-50 and went east then north on S-115 to I-25. Traveled north on I-25 to Castle Rock, turn west on US-85 to Sedalia. Turned southwest on S-67 and went less than a mile to West Plum Creek (OCJ-75). From here we drove directly to the Denver International Airport for the flight to Oregon and Corvallis.



Jim Oliphant with several *Humulus* clones (CHUM 1350) at Miller Creek. Note *Humulus* plant in background



Doug cook and Jodi Jackson processing cones at Beaver Creek



Processing Cones along Willow Creek. L to R: Jim Oliphant, Jodi Jackson, Scott Dorsch, Nazareno Perez.



Jim Oliphant and Doug Cook change a flat tire.

Appendix 1. Collections of *Humulus lupuloides* var. *neomexicanus* by Watershed

Watershed	Location Name	Altitude (m)	Form	Amount	Herbarium	Date	Field Collection #	Local #
Arkansas R.	Nathrop	2348	SD	22,380		9/16/02	OCJ-42	CHUM 1370
Arkansas R.	Poncha Creek	2532	SD	21,500	1 sheet	9/16/02	OCJ-43	CHUM 1371
Arkansas R.	Phantom Canyon 1	1872	SD	3235		9/20/02	OCJ-66	CHUM 1393
Arkansas R.	Phantom Canyon 2	2088	PL	1	2 sheets	9/20/02	OCJ-68	CHUM 1395
Arkansas R.	Phantom Canyon 2	2088	PL	1		9/20/02	OCJ-69	CHUM 1396
Arkansas R.	Phantom Canyon 2	2088	PL	1		9/20/02	OCJ-70	CHUM 1397
Arkansas R.	Phantom Canyon 2	2088	PL	1		9/20/02	OCJ-71	CHUM 1398
Arkansas R.	Phantom Canyon 2	2088	PL	1		9/20/02	OCJ-72	CHUM 1399
Canadian R.	Manuelitas	2176	SD	21,650		9/19/02	OCJ-61	CHUM 1388
Canadian R.	Cimarron R. 1	2533	SD	100		9/19/02	OCJ-62	CHUM 1389
Canadian R.	Cimarron R. 2	2455	SD	13,565		9/19/02	OCJ-63	CHUM 1390
Colorado R.	East Rifle Creek 1	1887	SD	19,000		9/14/02	OCJ-27	CHUM 1357
Colorado R.	East Rifle Creek 2	2009	SD	20,965		9/14/02	OCJ-28	CHUM 1358
Colorado R.	Sweetwater Lake 1	2366	SD	9640		9/14/02	OCJ-29	CHUM 1359
Colorado R.	Sweetwater Lake 2	2363	SD	28,180		9/14/02	OCJ-30	CHUM 1360
Colorado R.	Sweetwater Lake 3	2363	SD	4900		9/14/02	OCJ-31	CHUM 1361
Colorado R.	Aspen	2437	SD	5760		9/15/02	OCJ-34	CHUM 1363
Dolores/San Miguel R.	Leopard Creek 1	2300	SD	6700	2 sheets	9/18/02	OCJ-50	CHUM 1378
Dolores/San Miguel R.	Leopard Creek 2	2228	SD	7900		9/18/02	OCJ-51	CHUM 1379
Dolores/San Miguel R.	Dolores River	2265	SD	80		9/18/02	OCJ-52	CHUM 1380
Gunnison R.	Willow Creek 1	2357	SD	890		9/16/02	OCJ-35	CHUM 1364
Gunnison R.	Willow Creek 2	2342	PL	3	1 sheet	9/16/02	OCJ-36	CHUM 1365
Gunnison R.	Willow Creek 2	2342	PL	1		9/16/02	OCJ-37	CHUM 1366
Gunnison R.	Willow Creek 2	2342	PL	1		9/16/02	OCJ-38	CHUM 1367
Gunnison R.	Cochetopa Canyon	2439	SD	46,000	3 sheets	9/16/02	OCJ-40	CHUM 1368
Gunnison R.	Tomichi Creek	2518	SD	2000		9/16/02	OCJ-41	CHUM 1369
Pecos R.	Pecos 1	2328	SD	16		9/19/02	OCJ-56	CHUM 1383
Pecos R.	Pecos 1	2328	PL	6		9/19/02	OCJ-57	CHUM 1384
Pecos R.	Pecos 1	2328	PL	1		9/19/02	OCJ-58	CHUM 1385
Pecos R.	Pecos 2	2354	SD	365		9/19/02	OCJ-59	CHUM 1386
Pecos R.	Pecos 2	2354	PL	5		9/19/02	OCJ-60	CHUM 1387
Purgatoire R.	Wooton	2201	SD	7000		9/19/02	OCJ-64	CHUM 1391
Purgatoire R.	Cordova Plaza	2070	SD	17,590		9/19/02	OCJ-65	CHUM 1392
Rio Grande R.	Sangre de Cristo 1	2409	SD	2565		9/17/02	OCJ-44	CHUM 1372
Rio Grande R.	Sangre de Cristo 2	2541	SD	6940		9/17/02	OCJ-45	CHUM 1373
Rio Grande R.	Rock Creek 1	2484	SD	3765		9/17/02	OCJ-46	CHUM 1374
Rio Grande R.	Rock Creek 2	2530	SD	3100		9/17/02	OCJ-47	CHUM 1375

Rio Grande R.	Wagon Wheel Gap	2537	SD	16,075		9/17/02	OCJ-48	CHUM 1376
Rio Grande R.	Las Huertas Creek	2149	SD	7880		9/18/02	OCJ-54	CHUM 1382
San Juan/Animas R.	Chimney Rock	2025	SD	6895		9/17/02	OCJ-49	CHUM 1377
San Juan/Animas R.	Cherry Gulch	2164	SD	9080	2 sheets	9/18/02	OCJ-53	CHUM 1381
South Platte R.	Coal Creek	1829	SD	1830		9/10/02	OCJ-1	CHUM 1333
South Platte R.	El Dorado Springs 1	1723	SD	3500		9/10/02	OCJ-2	CHUM 1334
South Platte R.	El Dorado Springs 2	1890	SD	4700		9/10/02	OCJ-3	CHUM 1335
South Platte R.	El Dorado Springs 3	1890	SD	1600		9/10/02	OCJ-4	CHUM 1336
South Platte R.	El Dorado Springs 4	1832	SD	10,360		9/10/02	OCJ-5	CHUM 1337
South Platte R.	Redstone Creek 1	1722	SD	7785		9/11/02	OCJ-6	CHUM 1338
South Platte R.	Redstone Creek 2	1813	SD	5320		9/11/02	OCJ-7	CHUM 1339
South Platte R.	Silver Plume	2791	SD	17,940		9/15/02	OCJ-33	CHUM 1362
South Platte R.	Sedalia	1779	SD	12,910		9/20/02	OCJ-75	CHUM 1402
White R.	Miller Creek	2192	SD	35,090		9/13/02	OCJ-19	CHUM 1350
White R.	South Fork Canyon	2338	SD	35,000		9/13/02	OCJ-21	CHUM 1351
White R.	Buford	2157	SD	56,145		9/13/02	OCJ-22	CHUM 1352
White R.	Deer Gulch 1	2179	PL	2		9/14/02	OCJ-23	CHUM 1353
White R.	Deer Gulch 1	2179	PL	2		9/14/02	OCJ-24	CHUM 1354
White R.	Deer Gulch 1	2179	PL	2		9/14/02	OCJ-25	CHUM 1355
White R.	Deer Gulch 2	2079	SD	51	2 sheets	9/14/02	OCJ-26	CHUM 1356
Yampa R.	Milner	2063	SD	25,980	3 sheets	9/12/02	OCJ-9	CHUM 1340
Yampa R.	Hayden 1	1975	SD	7740		9/12/02	OCJ-10	CHUM 1341
Yampa R.	Hayden 2	2032	SD	715		9/12/02	OCJ-11	CHUM 1342
Yampa R.	Hayden 3	1964	SD	5850		9/12/02	OCJ-12	CHUM 1343
Yampa R.	Hayden 4	1939	SD	22,640		9/12/02	OCJ-13	CHUM 1344
Yampa R.	Axial 1	1994	SD	14,800		9/12/02	OCJ-14	CHUM 1345
Yampa R.	Axial 2	2014	SD	21,670		9/12/02	OCJ-15	CHUM 1346
Yampa R.	Axial 3	2025	SD	3900		9/12/02	OCJ-16	CHUM 1347
Yampa R.	Axial 4	1987	SD	7200		9/12/02	OCJ-17	CHUM 1348
Yampa/Green R.	Beaver Creek	1733	SD	5220	2 sheets	9/13/02	OCJ-18	CHUM 1349

Appendix 2. Additional Plant Collections

Scientific Name	Form	Amount	Location Name	County, State	Altitude (m)	Date	Field Collection #	Local #
<i>Fragaria vesca</i> subsp. <i>bracteata</i>	PL	8	Windy Bridge	San Miguel, NM	2298	9/19/02	OCJ-55	CFRA 1817
<i>Fragaria virginiana</i> subsp. <i>Platypetala</i>	PL	3	Rabbit Ears Pass	Jackson, CO	2873	9/12/02	OCJ-8	CFRA 1816
<i>Ribes aureum</i>	SD	600	Miller Creek	Rio Blanco, CO	2191	9/13/02	OCJ-20	CRIB 1347
<i>Ribes sp.</i>	PL	1	Shrine Pass	Summit, CO	3412	9/14/02	OCJ-32	CRIB 1348
<i>Rubus sp.</i>	PL	1	Willow Creek 2	Gunnison, CO	2342	9/16/02	OCJ-39	CRUB 2188