

Southwest 2018 Potato Collecting Trip Report

Arizona and New Mexico sites. September 15-25, 2018

Participants: John (JB) and Ingrid (IB) Bamberg, Alfonso del Rio (AdR), Charles "Chico" Fernandez (CF).
Affiliations: US Potato Genebank (USPG), 4312 Hwy 42, Sturgeon Bay, WI, 54235. International Potato Center (CIP) participant René Gomez (RG). Collection prefix = GBdRF numbers 360-392.

1. General Goals, Outcomes, and *in situ* Research-related observations:

One objective of this trip was to visit sites with expected robust populations to show CIP colleague René Gomez. That was accomplished for both species. These expeditions for collecting and research on USA potato began as an initiative of APIC, the Association of Potato Intergenebank Collaborators in 1992, with participation that first year by Alberto Salas of CIP (SBV collections in GRIN).



CIP collaborators collecting in Arizona: Alberto Salas (left, 1992), René Gomez (right, 2018).

The trip's locations and timing apparently was nearly ideal for potatoes this year, since we also collected 10 sites from which only very poor previous collections had been made, and 17 completely new sites, both of which often had robust populations and provided much improved samples for the genebank. On the other hand, 4 sites previously observed to have very robust populations presented only a few small plants this year.

We collected fruits and tubers. Instead of collecting live potted transplants, we tried three collections of shoots with roots (but no soil) in plastic "baggies" kept cool until return to USPG. They did not establish well at USPG. All fruit were treated on return to USPG with 6.5 ml/L imidiclorid insecticide to kill fruit fly larva although fruit this year was unusually free of oviposit scars that indicate infestation.

Research. A singular feature of this 2018 trip was the common occurrence of both species at the same location. Out of this sprang the contention of RG that some plants observed were interspecific hybrids—an idea we had

not previously seriously considered in light of past experience of strong crossing barriers between *S. jamesii* and *S. fendleri*. We also encountered several unusually large populations. Our past research concluded that a genebank seed increase using 20 parents is sufficient to capture the genetics of an accession. But as very large populations are observed in more locations in more years it calls into question the common practice of representing such sites as a single germplasm accession in the genebank. We noted very viable-looking mother tubers in *jamesii*, making us wonder if this species known for survival mechanisms of extreme tuber dormancy and tuber freezing tolerance also might have the novelty of viable mother tubers. Before this expedition we had only one collection from the Burro Mountains, the historic SBV17, known to be genetically distinct from other *jamesii*. It will be interesting to test if these new collections are also distinctive. However, relevant to the risks of transgene escape, we note that in 27 years of collecting in the USA, we have never seen any other potato species except *jamesii* and *fendleri*. This year's Caprock Trail collections will also contribute to work in progress identifying a "mega-population" (AJPR 93:564) at Mt. Lemmon. Finally, sighting of abundant potatoes at the Gila Cliff dwellings may contribute to work in progress studying the interaction of potato with local ancient peoples.

2. Preparations:

Permit from USFS for all NFs of the Southwest Region (see Permit section). Garmin GPSs borrowed from PEO, and uploaded tracks, waypoints and notes from DeLorme Topo10 and GoogleEarth. We reviewed all known potato sightings and herbarium records (particularly from SEINET) and also spent much time using maps to scout and list promising new sites to explore before the trip. As in previous years, GoogleEarth aerial photos were very helpful in showing the exact ground cover, aspect (steep and shaded NE preferred), elevation, and soil moisture potential of the micro-locations which are the small niches in which potatoes are most likely to appear within a general area. The most promising sites that are most rapidly accessible (ideally on paved roads) near the general trip loop have to take priority in order to efficiently spend travel time. As in previous expeditions, the conclusion was again reinforced that models based on *general* eco-geo parameters are virtually useless for predicting the micro-habitats where potatoes may be found.

Navigation. One of the biggest challenges is knowing where you are in relation to the desired destination mark on the map. The rental vehicle this year (2018 Chevy Suburban) had GPS and detailed maps screen on the dashboard. Thus, GPS tracking on Topo on the laptop was mostly not needed, since the marks on Topo were almost always near landmarks that were recognizable on the dashboard map (e.g., a distinctive bend in the road).

Personnel. Some division of labor made collecting more efficient: AdR navigating; JB driving; IB taking detailed collecting notes from JB's dictation; CF collecting tubers, carrying and indexing tubers, fruit and plants, extracting seeds and establishing plants at USPG. All took photos. Some of our USA collecting trips have emphasized backpacking and hiking trails of a single mountain range. But for trips that visit many dispersed sites and involve driving many miles and staying at a different motel most nights, a maximum of four participants is most practical. Thus, this year, CF participated in the first half of the trip, and IB participated in the second half, switching at the Tucson airport on Sept 19th. This also allowed CF to carry home live plants to be immediately established at USPG, within a few days of their being collected in the wild, even though they had been sampled from sites of origin visited at the start of the expedition.

3. Logistics:

Travel was by air to Tucson, then we rented a 2018 Chevy Suburban driving a total of 1507 miles. No backpacking, camping or major hiking was done on this trip.

4. Germplasm:

Wild potato *S. jamesii* and *S. fendleri* (*stoloniferum* in GRIN) were collected as 33 samples. Samples were given temporary codes (#1 - #33) during the expedition, and assigned GBdRF collector codes and PI numbers later (see Tables for details).

5. Deposit of records, germplasm and files:

US Potato Genebank, 4312 Hwy 42, Sturgeon Bay, WI, 54235. 920-743-5406. john.bamberg@ars.usda.gov. Query GRIN text "GBdRF". Detailed trip log, GPS track and Waypoints files, and additional photos and miscellaneous notes are available from JB at USPG.

6. Trip expenses:

JB=\$1884, AdR=\$2180, CF=\$1070 for total=\$5134 direct. Project staff salary and other associated trip costs, plus private and CIP support for IB (\$740) and RG, respectively, not included. We thank K. Williams of PEO for \$7.5K funding.

7. Daily Itinerary and Collections abstract:

Sat 15th: JB & CF fly from GRB to MSP, meet AdR and RG at TUS. Rent 2018 Chevy Suburban from *National*. Drive to Benson for Starbucks coffee then to Sierra Vista to lodge.

Sun 16th: 7AM Mama's Kitchen. Fry's grocery for picnic food, cooler and ice. Arrive Montezuma Pass. W to Ida Canyon. **Collection #1J** (as tubers and also collected plants). W and NW toward Parker Lake, at Scotia Canyon. Site of previous F. Found J. **Collection #2J**. To Parker Lake site of lost J. Find only two small J. **Collections #3J**. Leave 1:30. Look unsuccessfully at Parker Lake for F as herbspec Reina 2002-486. N on 83 and look previous J sites along W side of 83 at 667011, 667017, 667018 finding none. Unsuccessfully attempt to get to McLaughlin 8039 and 8119 sites below Elgin. Arrive Sonoita at 3PM then to Nogals, supper, lodge at Quality Inn.

Mon 17th: 6AM breakfast. NE on 82 and W on gravel Dusquene Road and S on Harshaw Road to Majalca Drive site of lost F collections 620874, 667016. **Collection #4F**. Retrace N on Harshaw to Dusquene road intersection site of lost 667019F. **Collection #5F**. N on Harshaw road to creek crossing site of 667021F. **Collection #6F**. Return S on Harshaw road to Shaffer Ranch site of lost 667020F. **Collection #7F**. Retrace to Nogales for Safeway grocery lunch. N on 19 to Green Valley and W to Madera Canyon (paved) in Santa Rita Mts to collection sites from 2010 expedition for observation. Not as abundant or large plants along road along Madera Canyon that goes to trailheads, e.g., at Chuparosa Lodge. Did not hike to high elevations, e.g., to Mt. Wrightson. Posada Java coffee shop at Green Valley then to Tucson and Quality Inn on Valencia, and El Indio supper.

Tue 18th: 7AM breakfast. Safeway grocery for more ice and picnic food. To Hitchcock Highway toward Summerhaven and Mt. Lemmon. Look at very low elevation (4400 ft) Molino Basin camp reported F site of Wendy Hodgson H958. To Ski Run road and Mt. Lemmon Meadow. **Collection #8F**. Observed scattered F on S-facing slopes below parking lot as less abundant than in 2016. To Summerhaven for lunch. Return to Caprock Trail parking lot at top of ski hill and gravel road E, hiking along and below Caprock Trail, collecting one berry from abundant, widely dispersed plants over about ¼ mile. **Collection #9F**. Return down Hitchcock to Loma Linda or "Control Road" intersection, site of lost 667025F. **Collection #10F**. Continue down Hitchcock highway to Middle Bear Campground to observe previous abundant collection site, finding only a few small F. Return to Tucson and Quality Inn.

Wed 19th: Breakfast at 7AM. Take CF to TUS airport and pick up IB. El Charro Cafe lunch. Original plan was to then drive E to Chiricahuas (steep gravel mountain roads), but heavy rain forecast for Wed PM and Thu in southern AZ made us decide instead to reverse schedule and spend the rest of Wed driving 200m to farthest N sites. To Show Low, Cattlemen's Steakhouse supper, and lodge 8:30 PM Kiva motel—rained all the way.

Thu 20th: 7AM Sweethearts Cafe breakfast. W on 60, NW on 260. NE on 43rd Ave = Old 160 to Bagnol Wash site near 673367J, but on NE side of 260. Much debris from high water **Collection #11J**. Continue E on 60 to Windmill and water tank site in draw. **Collection #12J**. Continue E on 60 to pulloff at mile marker 360. **Collection #13J**. Arrive Springerville noon and Safeway grocery for picnic lunch. S on 180 toward Alpine and E on FR56 (gravel) to Hulsey Lake. **Collection #14F**. Return to 180 and S to Alpine and continue 191 S and W on FR26 (gravel) at Beaver Creek. To “Beaver Curve” site of previous 679931F, also finding J. **Collections #15F and #16J**. Continue W on FR26 to “Beaver Bridge” site at bridge over Beaver Creek lost J sites, also finding F. **Collections #17J and #18F**. On drive back to 191, stop at intersection with 37C and observe J. Retrace toward Alpine stopping at previous F site “County Line”. **Collection #19F**. Supper 7PM Bear Wallow Cafe in Alpine. N 27 miles to Springerville to Reed's Motor Lodge.

Fri 21st: 7AM breakfast at Booga Red's. Ace Hardware for folding camp shovel and other supplies. Planning session at Java Junk includes RG sharing observations thus far. S on 191 to “Eagar Triangle” previous collection site 673370J and many previous visits. **Collection #20**. S on 191/180 to Alpine and E on 180 to Luna Lake campground. At site of 679924F collection, found new J. **Collection #21J**. Also observed both J and F at spillway as collected in 2016. E to NM and S to jct of 12 (goes E to Reserve). Observed a few J as previously at NE corner of intersection. S on 180 to Adobe Cafe and Bakery for lunch. S to Glenwood. Tried to go E on Catwalk Road and along Whitewater Creek, but was posted private and was rough gravel. Continue S and then W on 78 to Mule Creek, site of lost J. **Collection #22J**. Retrace to 180 and S to stop at Tammy's Cafe at Cliff for pie and continue to Silver City. Continue E to Santa Clara and N on Ft. Bayard Road to cemetery. **Collection #23J**. To Silver City and lodge at 7:30PM at Quality Inn.

Sat 22nd: 7AM breakfast. Albertsons for ice and lunch food. N on 15 for 46 miles (paved) to Gila Cliff Dwelling National Monument. Trail from cliff dwellings parking lot for ½ mile NW out of monument land in to Gila National Forest. Three river crossings to lush bottoms with both species present with berries. **Collections #24J and #25F**. Return to parking lot, tour ruins, picnic lunch. Return on 15 S to McMillan Campground. **Collection #26F**. Continue S on 15 to Cherry Creek Campground, arrive 5PM. **Collection #27J**. Return to Silver City, Vicki's Eatery supper, Quality Inn lodge at 8:30PM.

Sun 23rd: 7AM breakfast and S on 90 toward Lordsburg. W on Tyrone Road (good gravel) to Burro Mountain Homestead. **Collections #28J, #29F**. Return E on Tyrone Road about 2 miles to wash. **Collection #30J**. Continue E on Tyrone Road to intersection with Deadman Canyon Road. **Collections 31F and 32J**. Return E to 90 and S. Stop to observe J site near Continental Divide first collected by Hawkes [1958], then SBV17 [1992], and later by us. To Lordsburg for gas and lunch, and to Portal, AZ. About 10.5 miles W past Portal town on FR42 to Sunny Flat Campground near intersection of S. Fork Road (all paved). **Collection #33J**. Supper at Portal Peak Lodge. Return to 10 and W to Wilcox lodging Quality Inn at 8PM.

Mon 24th: 7 AM breakfast. Safeway for ice. Drive to Tucson. PM off duty to visit Desert Museum in W Tucson, go over notes. Four Points Sheraton supper and lodge LaQuinta Inn.

Tue 25th: 7 AM breakfast. Drive to Wal-Mart for high-capacity jump drive, then Angel Coffee X-Change to transfer RG photos to it. Discuss trip and next steps in collaborative research. Gas up; return rental vehicle to airport. Return to Wisconsin and Peru.

Tables. List of materials collected and narratives

Full narratives with location coordinates, habitat and plant descriptions, collection details and disposition are available in GRIN by query on individual PI number or the "GBdRF" collector prefix. Also access GRIN for updates and eventual evaluation data on these stocks.

Place	Temp coll #CODE	sp. Suffix	Sept 2018 date	GBdRF	PI	Coll Type	plants	tubers	fruits	seeds
Ida Canyon	1	J	16	360	689399	Restore	12	25		
Scotia Canyon	2	J	16	361	689400	new		2		
Parker Lake	3	J	16	362	689401	Restore		2		
Majalca Road	4	F	17	363	689402	Restore			6	360
49&61	5	F	17	364	689403	Restore	4		10	305
Harshaw & Creek	6	F	17	365	689404	re-coll			51	3833
Shaffer Ranch	7	F	17	366	689405	Restore			3	177
Lemmon Meadow	8	F	18	367	689406	re-coll	8		63	2361
Caprock Trail	9	F	18	368	689407	new			55	2968
Control Road	10	F	18	369	689408	Restore			25	1166
Show Low	11	J	20	370	689409	new			4	6
Windmill 60	12	J	20	371	689410	new		16		
60 at 360	13	J	20	372	689411	new		11		
Hulsey Lake	14	F	20	373	689412	re-coll			130	9861
Beaver Curve F	15	F	20	374	689413	re-coll			79	4538
Beaver Curve J	16	J	20	375	689414	new		43		
Beaver Bridge J	17	J	20	376	689415	Restore		59		
Beaver Bridge F	18	F	20	377	689416	Restore			3	177
County Line	19	F	20	378	689417	re-coll			62	2055
Eagar Triangle	20	J	21	379	689418	re-coll			45	250
Luna Camp	21	J	21	380	689419	new		16		
Mule Creek	22	J	21	381	689420	Restore		10		
Bayard Cemetery	23	J	21	382	689421	Restore		14		
Gila Cliff J	24	J	22	383	689422	new			78	1170
Gila Cliff F	25	F	22	384	689423	new			37	1166
McMillan Camp	26	F	22	385	689424	new			142	8833
Cherry Creek Camp	27	J	22	386	689425	new		25	7	76
Burro Mt. Homestead J	28	J	23	387	689426	new		36		
Burro Mt. Homestead F	29	F	23	388	689427	new		2		
Tyrone Road	30	J	23	389	689428	new		36		
Tyrone and Deadman F	31	F	23	390	689429	new			12	300
Tyrone and Deadman J	32	J	23	391	689430	new		22		
Sunny Flat Camp	33	J	23	392	689431	new	8	50		

Collection Type: Restore = previous collection lost or poor (10). New = no previous germplasm collections (17). Re-coll = previous collection in genebank (6).

8. Additional and more intensive future exploration possibilities related to this trip

Portal area – E foothills. Burro mountains on Tyrone road. Silver City between SC and Cliff Dwellings. More below Mt. Lemmon on Pusch Ridge?

9. Permit

Wed 7/11/2018 9:32 AM
Zayatz, Jason - FS
2018 Potato Genetic Collection in the USFS Southwest Region (R3)

To: Bamberg, John
Cc: Kennedy, Kathryn L -FS; Cummings, Dave -FS
You replied to this message on 7/11/2018 9:46 AM.

Message Forest Products_fs_2400_8 v04-2012.docx Things needed for Permit (highlighted).pdf

Here you are sir!

John Bamberg and others **employed from only the USDA/ARS - U. S. Potato Genebank** are allowed to collect wild potatoes on National Forest lands within the Southwest Region (USFS R3) as "within-USDA" cooperating agents.

Other non-credentialed personnel will require a "Free Use Botanical Collection Permit".

If you have any additional questions you may contact Kathryn Kennedy, Regional Botanist p: 505-842-3263; c: 314-302-3760: kathrynkennedy@fs.fed.us for help with the Permit application or myself.

PS- I have attached the permit for any non-credentialed person to use and apply for collections within Region 3 of the USFS.


Jason Zayatz, Forester
Contracting Officer, NM-Zone Timber Sales
R3, Forest Officer
U.S. Forest Service
Southwest Regional Office, R3
Forest Management
Phone: 505-842-3888
Cell: 505-280-6596
jzayatz@fs.fed.us
333 Broadway
Albuquerque, NM 87102
www.fs.fed.us

10. Photos and maps of locations, habitats, and plants

General area and driving loops both starting at Tucson and going clockwise.

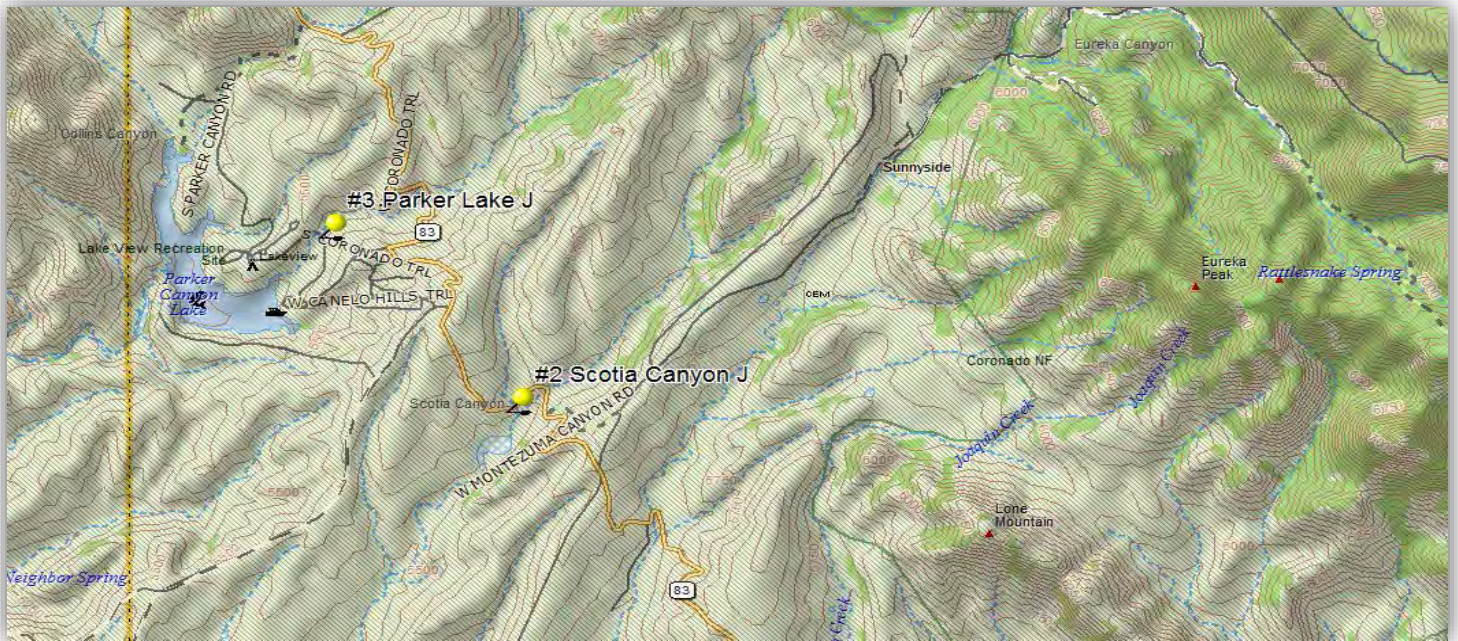


11. Collection site visuals (GPS tracks are for JB)

Ida Canyon #1. Restored lost and minimal past samples. See photos in section 1. with pictures of Alberto Salas and René Gomez at this location.

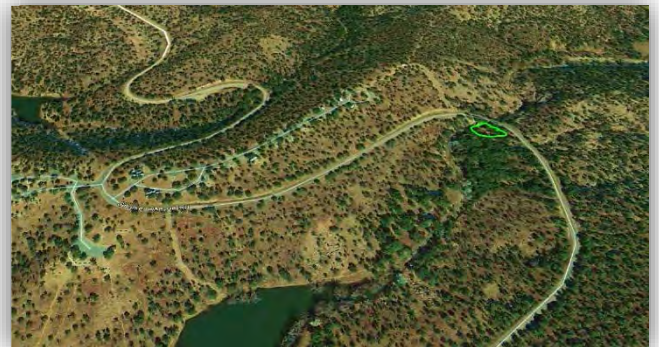


Scotia Canyon #2J and Parker Lake #3J sites



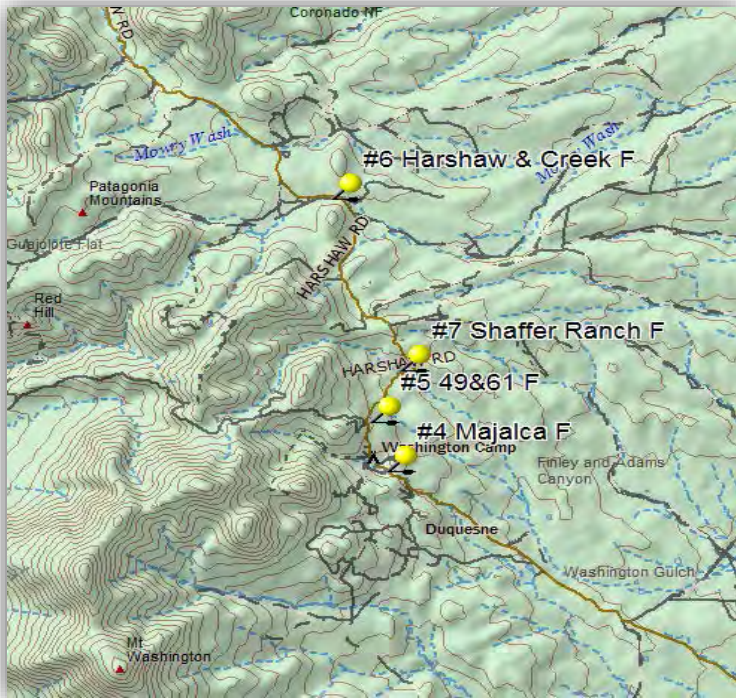
Below left: New J found at Scotia #2, previous site of F collection (view facing NE).

Below right: J found at Parker Lake #3, site of previous F collection (observed from SW).



←Typical presentation of J likely to have at least one mature tuber for collecting.

Patagonia Mts. #4 - #7 (F) along gravel Harshaw Road E of 82 (Nogales to Sonoita)



Typical habitat and plant (F). Majalca #4 site shown ↓

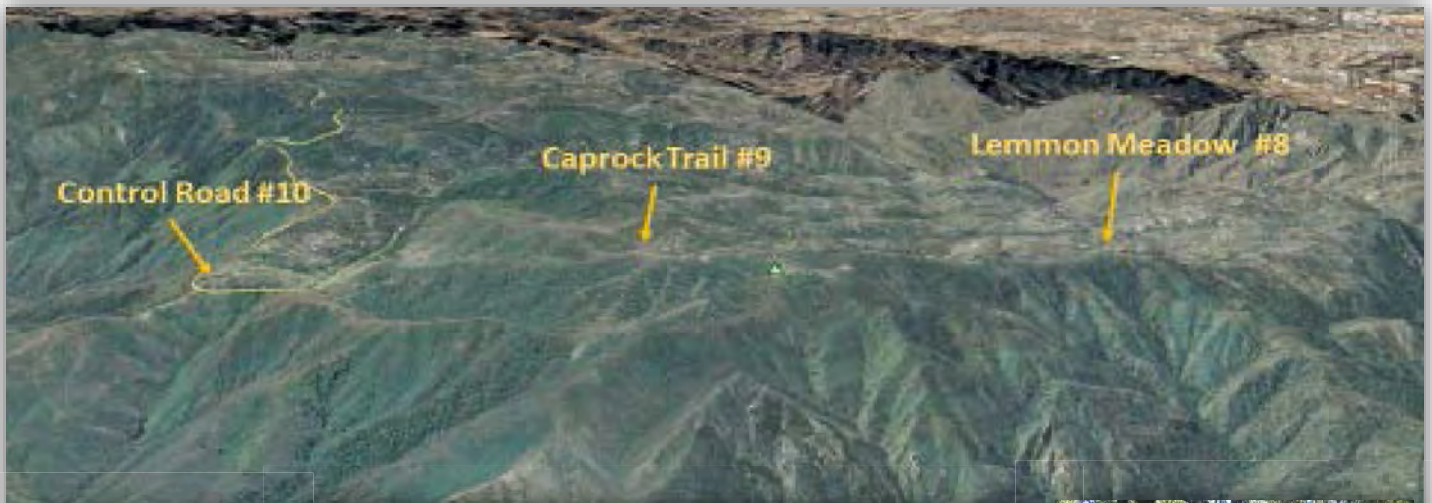




Sites and habitats
 Harshaw & Creek #6 (↑)
 49&61 #5 (↓)
 CF at Shaffer Ranch #7F→



Mt. Lemmon high elevation F Collections #8 - #10 (facing S).



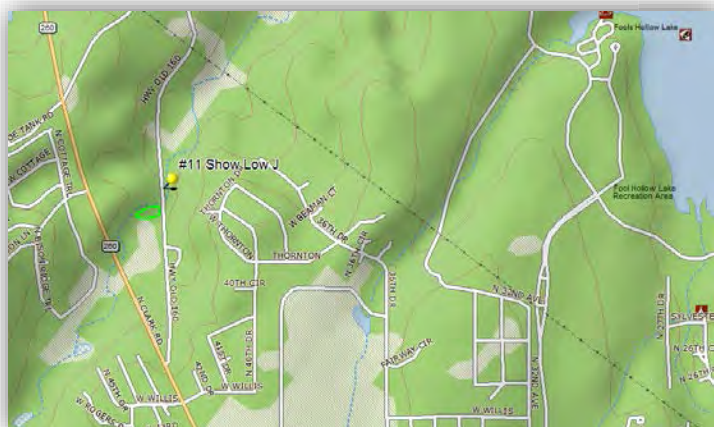
Control Road #10F collection location ↓



Lemmon Meadow #8F ↓



Show Low #11J collection site ↓



Collections #12J and #13J on 60 between Show Low and Springville ↓



Windmill 60 - #12J

Hulsey Lake #14F. Extremely abundant plants. Note clusters of green fruit on plants and many dark purple on ground in lower panel.

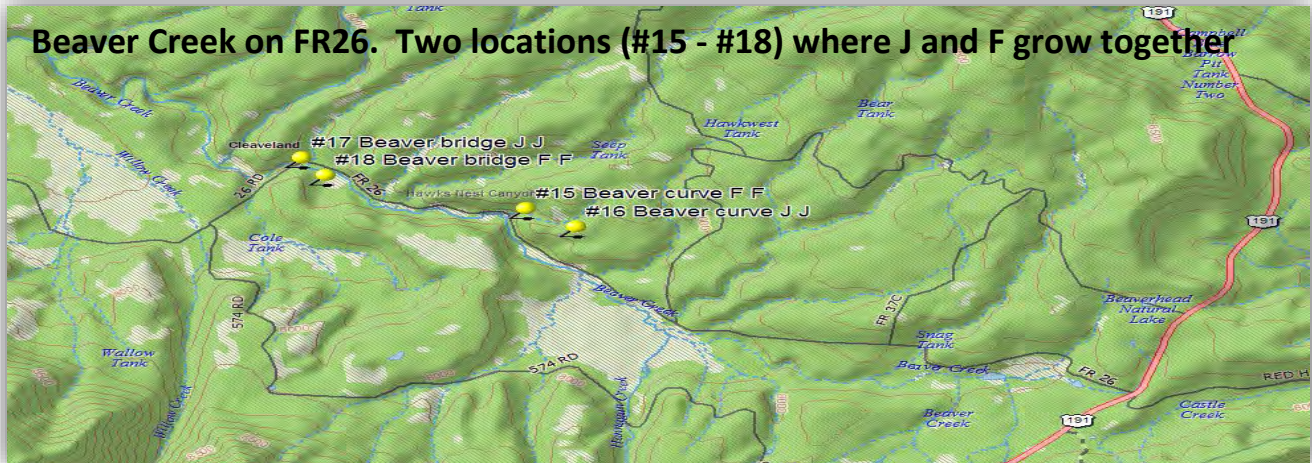


Hulsey Lake large plants with fruit

Hulsey Lake habitat (S shore) →



Beaver Creek on FR26. Two locations (#15 - #18) where J and F grow together



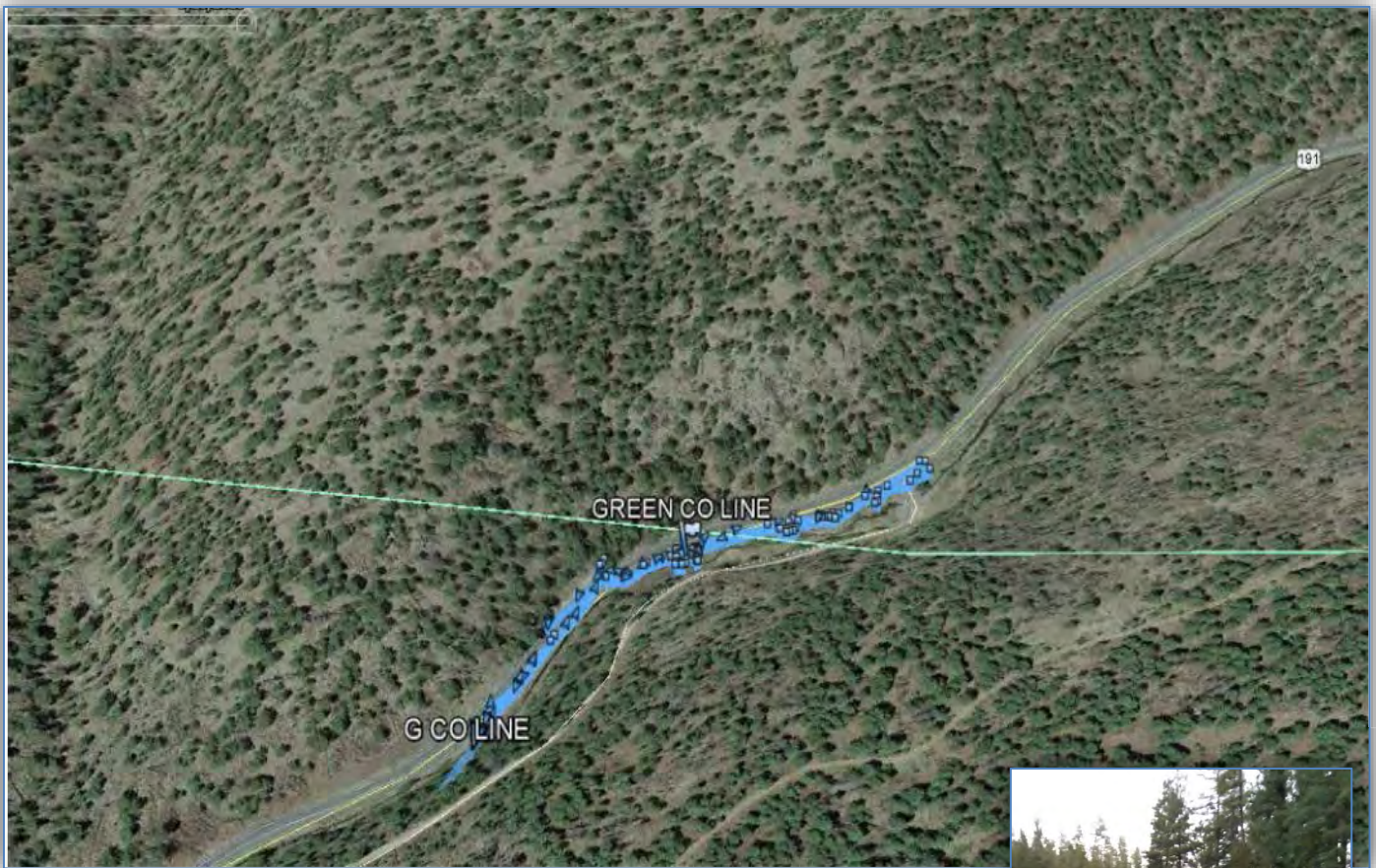
Beaver Curve #15(F) & #16(J) - both species within green circle



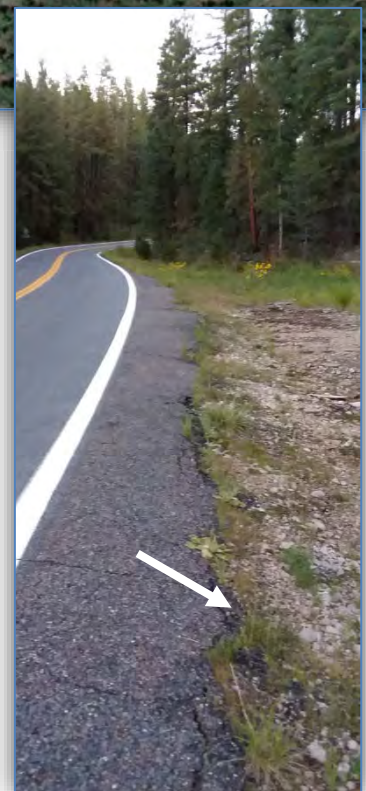
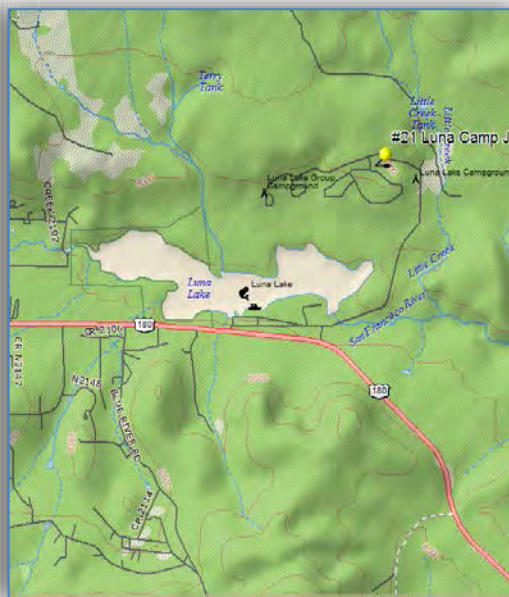
J in open in grass at
←curve (note Colorado
potato beetle), and
among rocks→ of berm
at bridge.



County Line #19F. W bank of Coleman Creek in gravel shoulder beside pavement.



Luna Camp #21J ↓ at previous F collection site

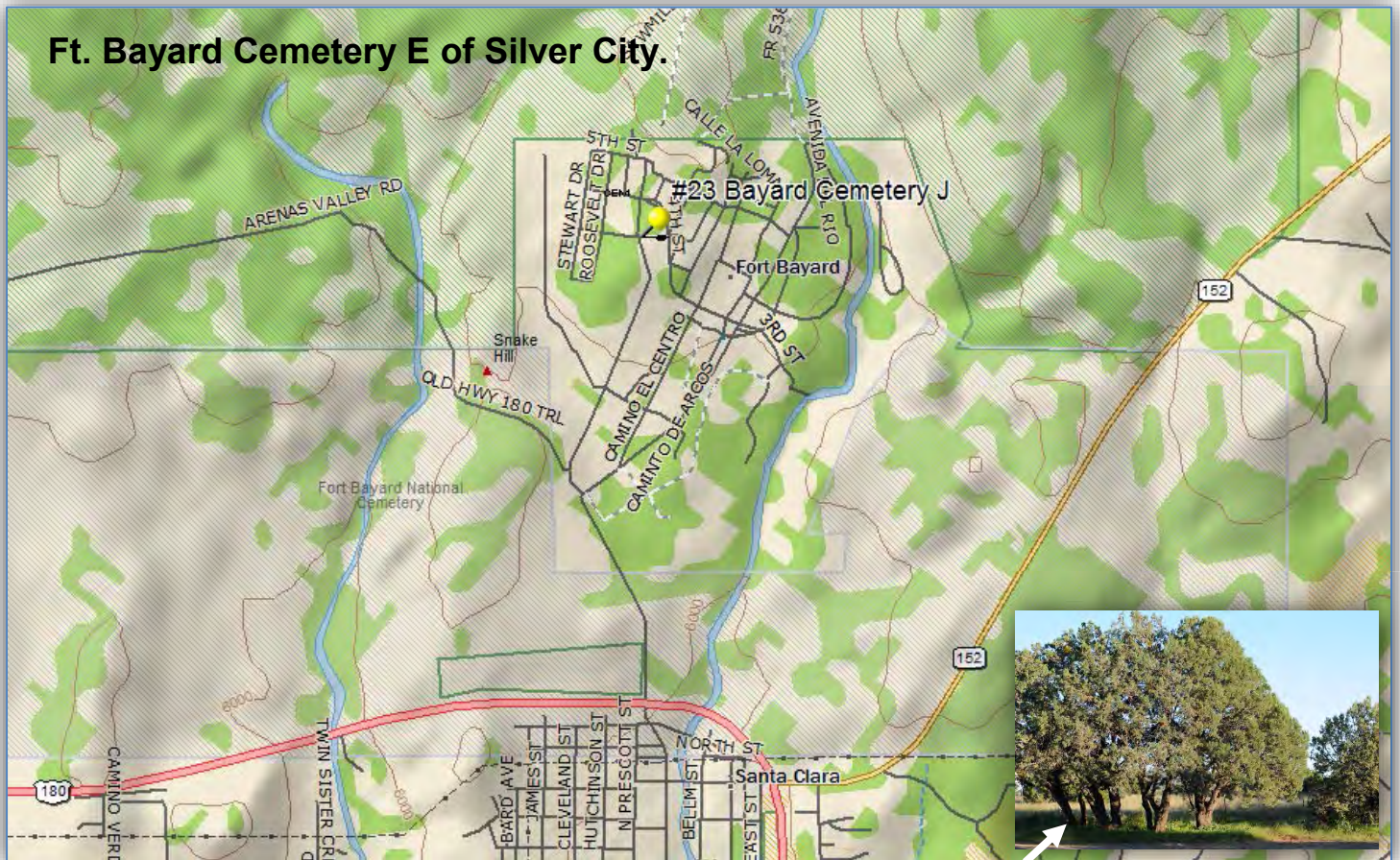


←

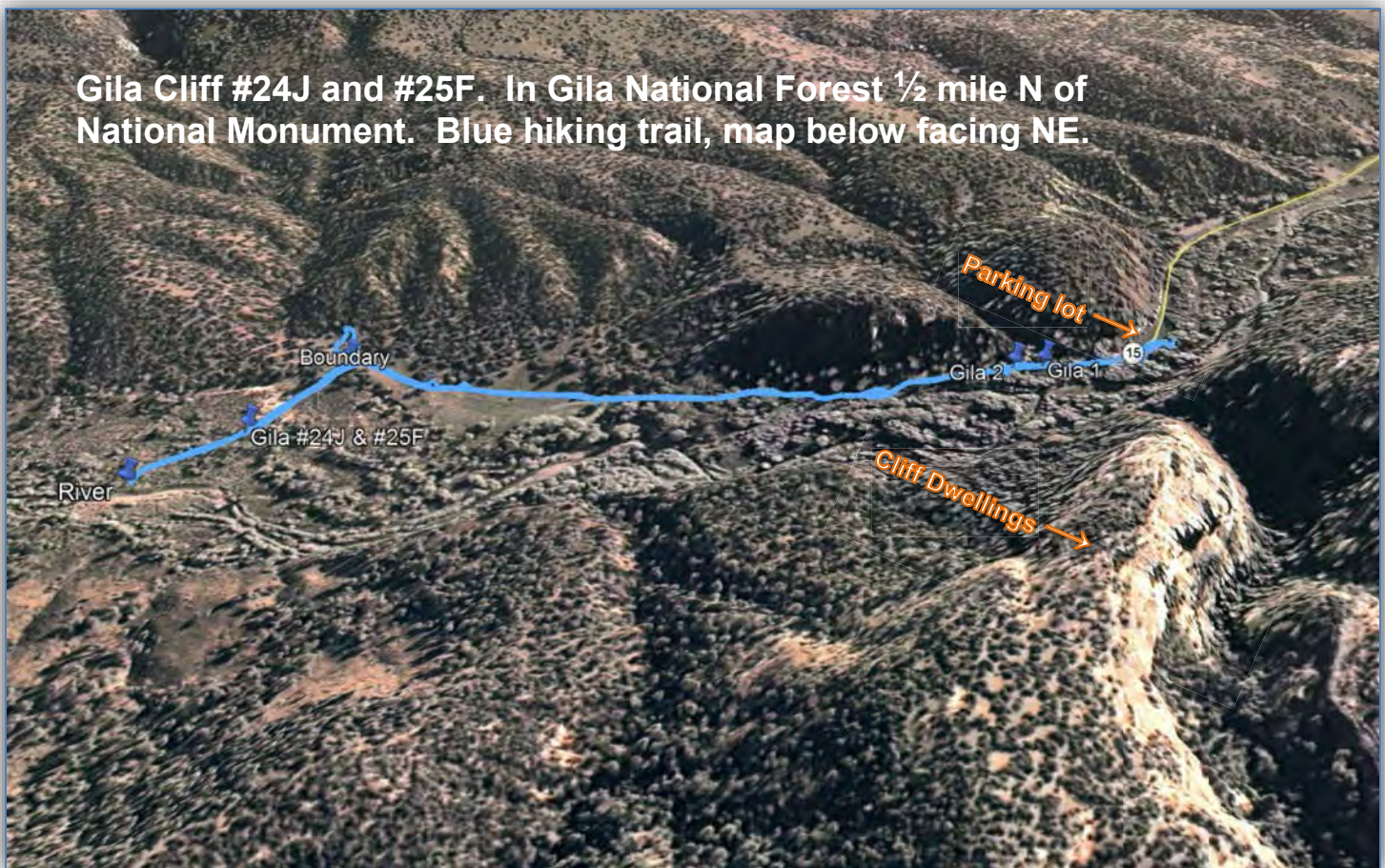
Mule Creek #22J. On 78 W of 180 (view facing W). Below left, typical small J only at pin on purple walking track. Below right, post office building landmark.



Ft. Bayard Cemetery E of Silver City.



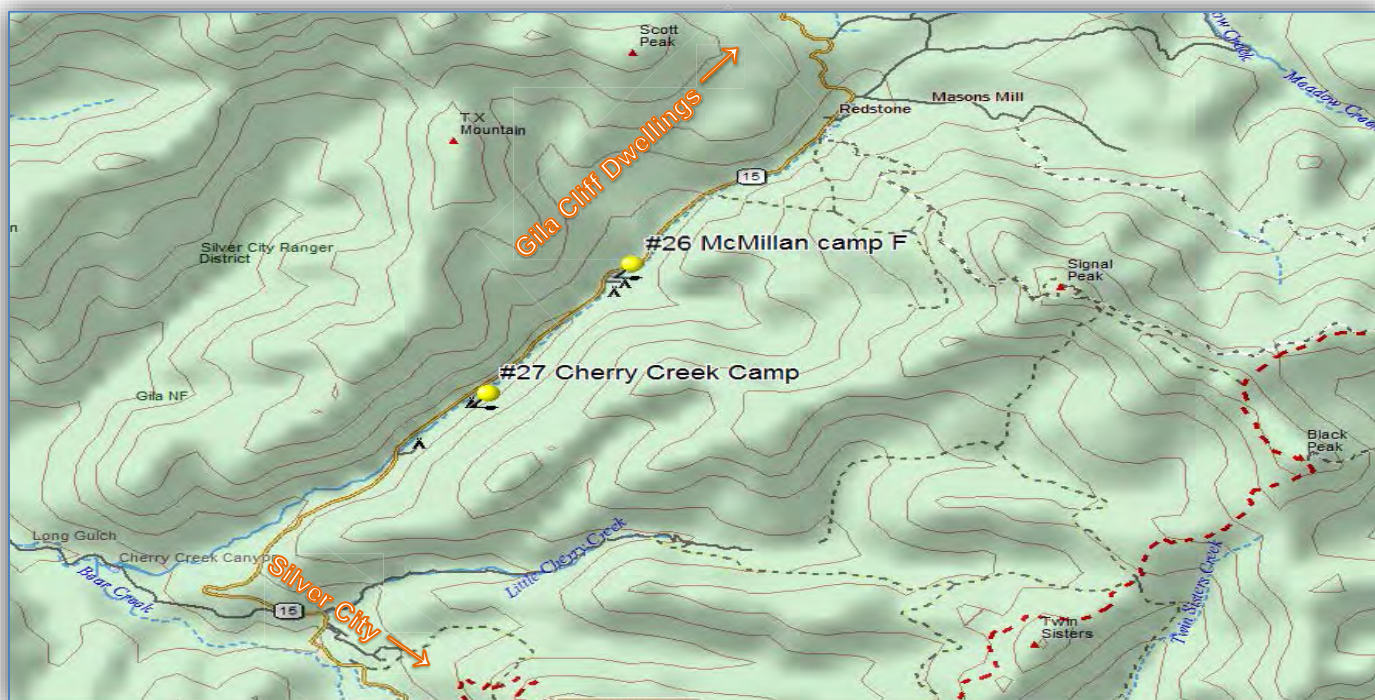
Occasional J under junipers along SE edge of cemetery, for example under juniper shown at cemetery gate at top of purple walking track.



Three crossings of W fork of Gila River to get to collection site→ J with fruit and potato beetle. ←



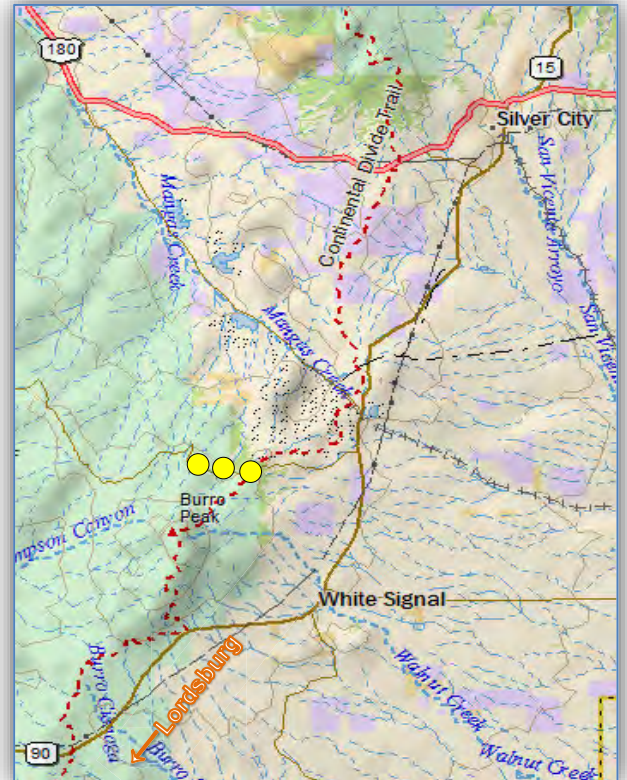
McMillan Camp #26F and Cherry Creek Camp #27J



Habitats for #26F← and #27J↓



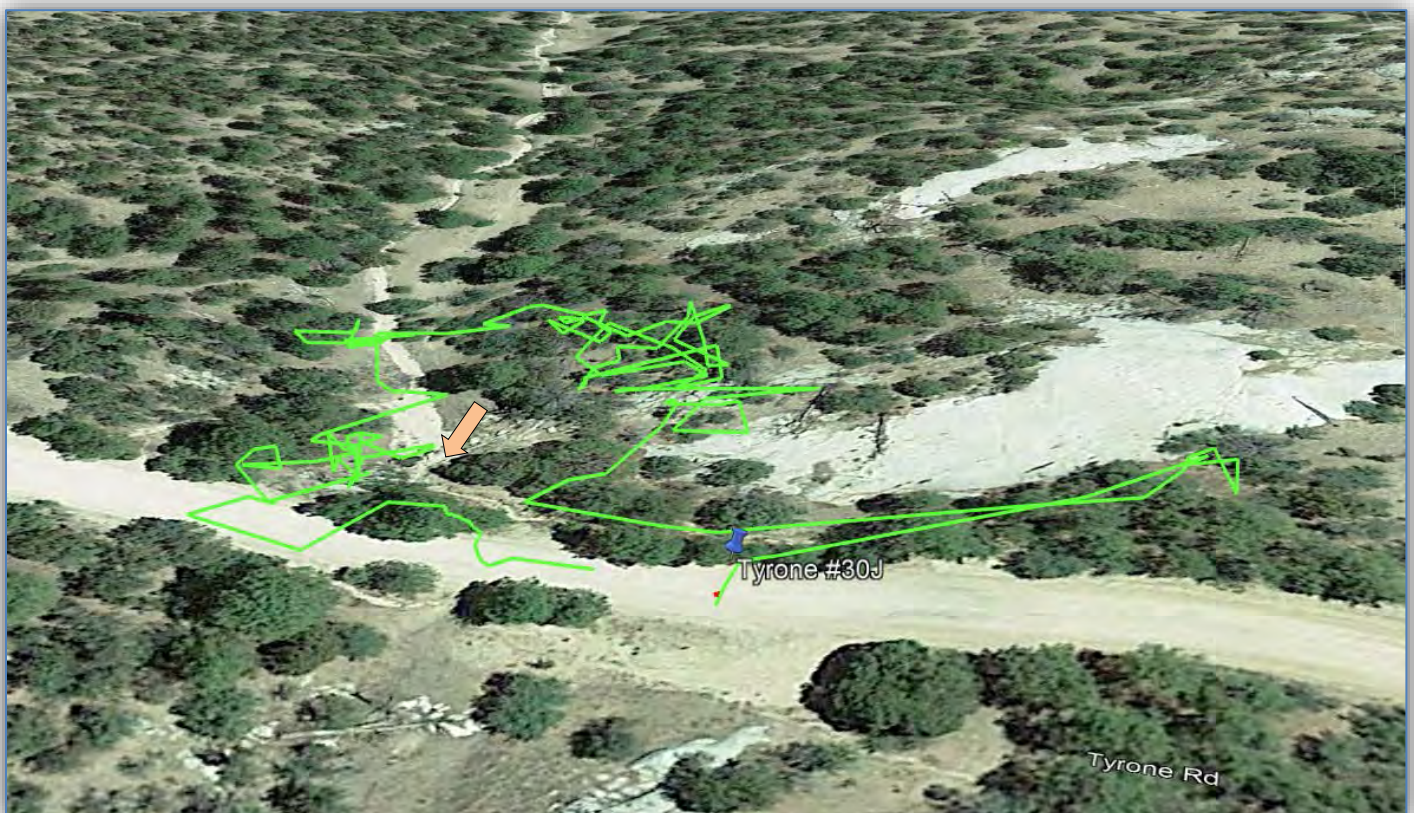
Tyrone Road collections #28 - #32 from three sites. Yellow pins on map, W to E, “Burro Mountain Homestead”, “Tyrone Road”, “Tyrone Road at Deadman Canyon”.



BMH: Two small colonies of F found. ↓
J found at several places on blue track←



Tyrone Road #30J. S-facing view of culvert shown below and located by arrow in green track map on N side of Tyrone road. Occasional plants found. Also searched and found plants on opposite (S) side of road.



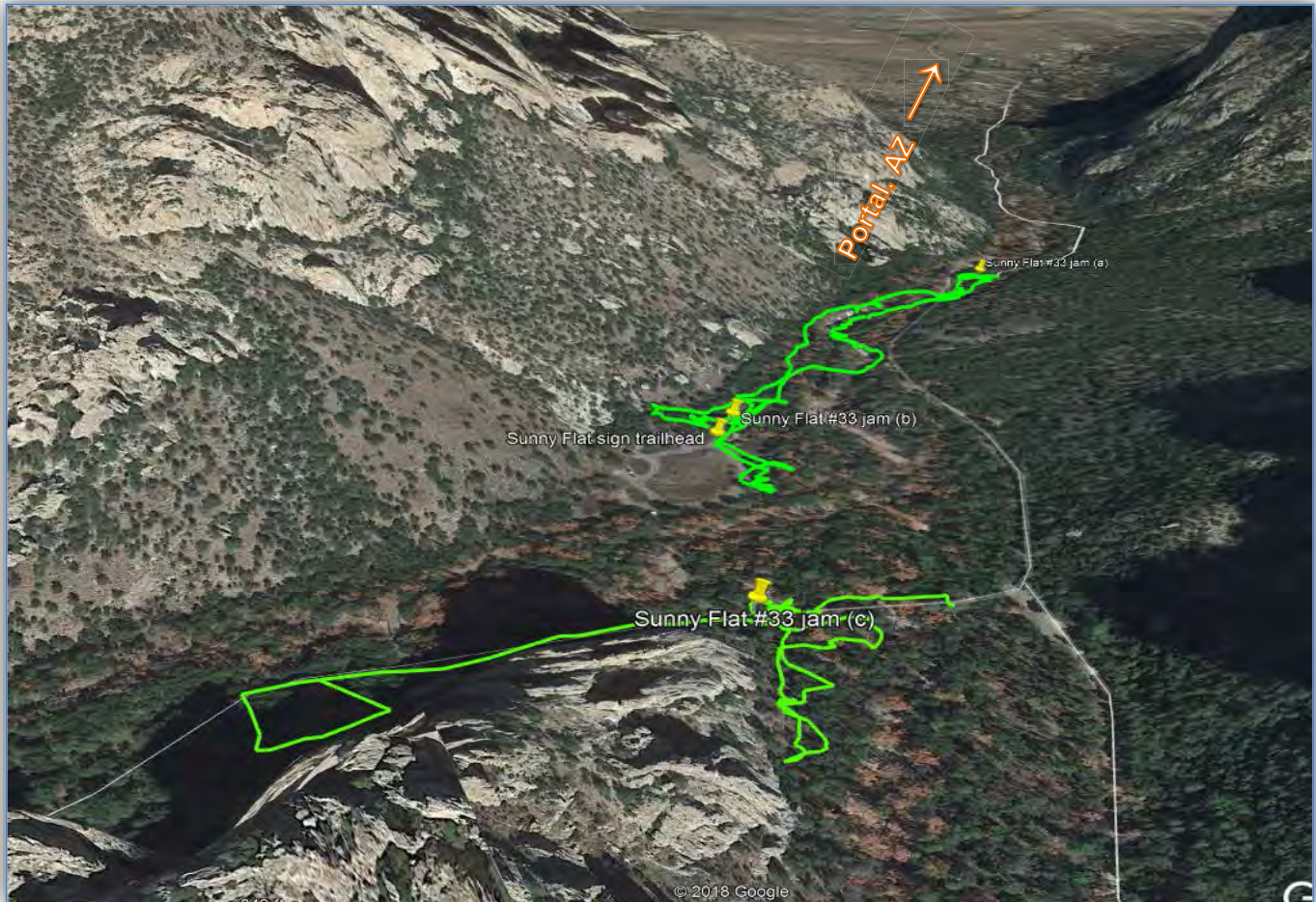
Tyrone Road at Deadman Canyon #31F and #32J sites.



Only two small colonies of F found under Ponderosas in needle mulch at (a→) and (b). Occasional J ↓ throughout track.



Sunny Flat #33J. E foothills of Chiricahua Mts. (facing NE)



↑ Searching track on hiking trails along Cave Creek from Sunny Flat campground (sites a&b) and along FR42 (site c).

← Looking S toward J collecting sites from Portal road.



↑ Abundant J at bridge over FR42 at site (c) from which distinctive landmark of double rock spires is visible facing to the SW.

← Unusual purple-stemmed J at site (c) in sandy banks of Cave Creek.

12. Collection site narratives

PI 689399. GBdRF 360. *S. jamesii*. United States. Arizona. Cochise County. Huachuca Mountains. Coronado National Forest. Near Montezuma Pass. From Sonoita S on 83 past Canelo and Parker Canyon Lake to gravel Montezuma Canyon Road or from Sierra Vista S on 92 S to Coronado National Memorial and W on Montezuma Canyon Road. From Montezuma Canyon Road N to Ida Canyon on FR about 0.6 mile to valley at confluence of creeks and near water tank. At WSG N31.380556° x W110.329444° and 5800 ft. **Coll #1**. September 16, 2018. Thousands of plants over a widespread area. Small to about 10 inches, some yellow, flowers rare. In rich valley soil in leaf mulch under shade of sycamore and oaks. Collected 25 tubers.

PI 689400. GBdRF 361. *S. jamesii*. United States. Arizona. Cochise County. Coronado National Forest. Near Parker Lake. Along SR83 about one mile SE of Parker Lake. S side of road 83 at pulloff at Scotia Creek. At WSG N31.41716° x W110.43218° and 5533 ft. **Coll #2**. September 16, 2018. Only two small colonies of about 10 plants, but large tubers. Canyon flats under thick leaf mulch under shade of oaks and juniper, in medium brown soil. Collected 2 tubers.

PI 689401. GBdRF 362. *S. jamesii*. United States. Arizona. Cochise County. Canelo Mountains. Coronado National Forest. Near Parker Canyon Lake. From Sonoita S on 83 past Canelo to Parker Canyon Lake. At jct of 83 and gravel Montezuma road, continue W on paved Parker Canyon Lake road toward campsites for about 0.9 miles where a great culvert goes under road for drainage S to the lake. About 100 ft E of culvert. At WSG N31.42966° x W110.44601° and 5413 ft. **Coll #3**. September 16, 2018. Rare plants only under a few trees. Small to about 10 inches, somewhat spindly, yellow. In rich valley soil in leaf mulch and grass under shade of trees. Collected 2 tubers.

PI 689402. GBdRF 363. *S. stoloniferum* form *fendleri*. United States. Arizona. Santa Cruz County. Patagonia Mountains. Coronado National Forest. Near Patagonia. From Nogales NE on 82/Patagonia highway to gravel Dusquene road then E into Patagonia mountains. About 14 miles E from 82 to Harshaw Road and S to driveway where creek crosses road, just past Majalca drive. NW corner of intersection. Site of previous coll from PAT and carrier of pigmentless mutant (BF 087, PI 620874, coll 2001). At WSG N31.38015° x W110.68932° and 5259 ft. **Coll #4**. September 17, 2018. To 8 inches, mature, yellowed with fruit. Up to a dozen plants per each of 3-4 colonies. Flat valley floor by wash, in thick mulch over black soil. Collected 6 fruit with 360 seeds.

PI 689403. GBdRF 364. *S. stoloniferum* form *fendleri*. United States. Arizona. Santa Cruz County. Patagonia Mountains. Coronado National Forest. Near Patagonia. From Nogales NE on 82/Patagonia highway to gravel Dusquene road then E into Patagonia mountains. About 14 miles E from 82 to T jct with Harshaw Road. N of parking area E of Harshaw road. At WSG N31.38683° x W110.69166° and 5541 ft. **Coll #5**. September 17, 2018. Up to 20 plants at each of 4-5 spots. Green, up to 10 inches tall, with fruit and no fruit fly scars. Grassy N-facing slope under junipers and among fallen branches in sandy soil. Collected 10 fruit with 305 seeds.

PI 689404. GBdRF 365. *S. stoloniferum* form *fendleri*. United States. Arizona. Santa Cruz County. Patagonia Mountains. Coronado National Forest. Near Patagonia. From Nogales NE on 82/Patagonia highway to gravel Dusquene road then E into Patagonia mountains. About 14 miles E from 82 to T jct with Harshaw Road. N on Harshaw 3 miles at bridge over creek, flats on S side of road. Site of previous 667021. At WSG N31.41722° x W110.69676° and 5257 ft. **Coll #6**. September 17, 2018. Many large plants to 14 inches with many fruit. Most under shade of trees among grass and herbs and among fallen branches in moist sand of creek. Cottonwoods. Grazing pressure from cattle evident. Collected 51 fruit with 3833 seeds.

PI 689405. GBdRF 366. *S. stoloniferum* form *fendleri*. United States. Arizona. Santa Cruz County. Patagonia Mountains. Coronado National Forest. Near Patagonia. From Nogales NE on 82/Patagonia highway to gravel Dusquene road then E into Patagonia mountains. About 14 miles E from 82 to T jct with Harshaw Road. N on Harshaw about 1.0 mile. In hairpin at creek and Shaffer Ranch driveway road. At WSG N31.39397° x W110.68759° and 5257 ft. **Coll #7**. September 17, 2018. About 10 plants, fairly green, 2-4 inches tall. A few other colonies with a few larger, more yellow plants with a few fruit. Within 100 ft N of driveway. N-facing berm under 30-ft tall oaks and cottonwoods, in much leaf mulch and moist, dark soil with rocks. Collected 3 fruit with 177 seeds.

PI 689406. GBdRF 367. *S. stoloniferum* form *fendleri*. United States. Arizona. Pima County. Santa Catalina Mountains. Near Tucson. From Tucson to Summerhaven on General Hitchcock highway and Ski Run road to trailhead to Lemmon Meadow. At Lemmon Meadow site of Harlan 111 [2000], previous Bamberg collection 679938, Hungry "Seeds of Time" film site. At WSG N32.43844° x W110.79344° and 9107 ft. **Coll #8**. September 18, 2018. Very many widely scattered plants of various sizes, often quite large, green, and with many large mature fruit. High flat alpine meadow. Among fallen logs in grass and under large firs. Moist black soil. Collected 63 fruit with 2361 seeds.

PI 689407. GBdRF 368. *S. stoloniferum* form *fendleri*. United States. Arizona. Pima County. Santa Catalina Mountains. Near Tucson. From Tucson to Summerhaven on General Hitchcock highway and Ski Run road to 1/10 mile E of Lemmon trailhead parking lot at Caprock trail parking lot. Along 1/4 mile of Caprock Trail ridge around ski lift equipment and towers and below on S-facing slopes. At WSG N32.44177° x W110.78041° and 9030 ft. **Coll #9**. September 18, 2018. Very many widely scattered plants of various sizes, green, often with many mature fruit. Along open grassy crest path/gravel road, in bare soil or rocks around buildings and tower footings, and in open, rocky, grassy, steep S-facing slope between rocks and among fallen branches. Collected 55 fruit with 2968 seeds.

PI 689408. GBdRF 369. *S. stoloniferum* form *fendleri*. United States. Arizona. Pima County. Santa Catalina Mountains. Near Tucson. From Tucson on General Hitchcock highway. Less than one mile before Summerhaven. At intersection with "Control" road that runs N. S side of intersection. At WSG N32.447778° x W110.755278° and 7925 ft. **Coll #10**. September 18, 2018. Occasional small scattered plants, sometimes with mature berries. On steep grades among rocks and ferns in open N-facing wash. Collected 25 fruit with 1166 seeds.

PI 689409. GBdRF 370. *S. jamesii*. United States. Arizona. Navajo County. Near Show Low. N on Old Highway 160 to Bagnal Wash, W side of road. Within 100 ft. of road at culvert. At WSG N34.26620° x W110.08941° and 6139 ft. **Coll #11**. September 20, 2018. A few old, yellowed plants to 20 inches. Grassy, muddy flood wash of limbs, needles and cones and sandy red soil under Ponderosas. Collected 4 fruit with 6 seeds.

PI 689410. GBdRF 371. *S. jamesii*. United States. Arizona. Navajo County. Sitgreaves National Forest. Near Show Low. From Show Low E on 60 about 6 miles. At windmill, water tank and cattle chute in draw. Both sides of road. At WSG N34.27217° x W109.91727° and 6226 ft. **Coll #12**. September 20, 2018. About 20 small plants to 8 inches without flowers or fruit. Open roadside among grass and branches of wash drift, or in thick needled mulch under small junipers. Collected 16 tubers.

PI 689411. GBdRF 372. *S. jamesii*. United States. Arizona. Apache County. Near Show Low. From Show Low E on 60 about 18 miles to mile marker 360 pulloff. Rare, scattered plants on both sides of road. At WSG N34.27101° x W109.71518° and 6883 ft. **Coll #13**. September 20, 2018. About a dozen plants to 6 inches, very mature or dead without flowers or fruit. Flat roadside under trees in mulch in dry red soil. Colorado potato beetle and tomato hornworm present. Collected 11 tubers.

PI 689412. GBdRF 373. <i>S. stoloniferum</i> form <i>fendleri</i>. United States. Arizona. Apache County. Apache National Forest. Near Nutrioso. From Nutrioso S on 191 and NE on FR56, continuing on FR8056. Hulsey Lake. From parking lot down N toward rock jetty. At WSG N33.93220° x W109.16021° and 8626 ft. Coll #14. September 20, 2018. Many thousands of plants to 24 inches, with very large leaves and many very large mature fruit, including many on the ground. N facing slope of S shore. Under fallen branches and duff in moist dark soil. Among ferns. Collected 130 fruit with 9861 seeds.
PI 689413. GBdRF 374. <i>S. stoloniferum</i> form <i>fendleri</i>. United States. Arizona. Greenlee County. Apache National Forest. Near Alpine. From Alpine S on 191 to FR26 Beaverhead road. About 2 miles W on FR26 at culvert at sharp W turn, W roadside and S along Beaver Creek bottoms. Site of 679931. At WSG N33.71447° x W109.25883° and 7722 ft. Coll #15. September 20, 2018. Many plants. When in open among road shoulder between rocks, very dark and thick leaves. Colorado potato beetle. Fruit common. Open gravel W-facing roadside or flat grassy creek bottom. Collected 79 fruit with 4538 seeds.
PI 689414. GBdRF 375. <i>S. jamesii</i>. United States. Arizona. Greenlee County. Apache National Forest. Near Alpine. From Alpine S on 191 to FR26 Beaverhead road. About 2 miles W on FR26 at culvert at sharp W turn, W roadside and S along Beaver Creek bottoms. At WSG N33.71447° x W109.25883° and 7722 ft. Coll #16. September 20, 2018. Many plants. Most spindly and yellow. Large mature tubers. Colorado potato beetle. No fruit. Open, flat grassy creek bottom in rich black soil. Collected 43 tubers.
PI 689415. GBdRF 376. <i>S. jamesii</i>. United States. Arizona. Greenlee County. Apache National Forest. Near Alpine. From Alpine S on 191 to FR26 Beaverhead road. About 4 miles W on FR26 and 200 ft west of bridge over creek. In gravel parking berm as for 2016 collection 679932, but also to W in flat. At WSG N33.71999° x W109.27628° and 7677 ft. Coll #17. September 20, 2018. Thousands of yellow plants to 10 inches. No flowers or fruit. Grassy flats of Beaver Creek among some pines and in needle mulch in moist dark soil. Grazing pressure from cattle evident. Collected 59 tubers.
PI 689416. GBdRF 377. <i>S. stoloniferum</i> form <i>fendleri</i>. United States. Arizona. Greenlee County. Apache National Forest. Near Alpine. From Alpine S on 191 to FR26 Beaverhead road. About 4 miles W on FR26 and W of bridge over creek. At WSG N33.71999° x W109.27628° and 7677 ft. Coll #18. September 20, 2018. Two small plants with fruit. Beaver Creek flats among fallen logs and in needle mulch in moist dark soil. Grazing pressure from cattle evident. Collected 3 fruit with 177 seeds.
PI 689417. GBdRF 378. <i>S. stoloniferum</i> form <i>fendleri</i>. United States. Arizona. Apache County. Apache National Forest. Near Alpine. From Alpine S on 191 to Greenlee County line. In gravel edge of E side of 191, about 500 ft N and 1000 ft S of Greenlee line. At WSG N33.77841° x W109.18343° and 7940 ft. Coll #19. September 20, 2018. Many robust, mature plants to 8 inches with many mature fruit. Open gravel roadside and among thorny brush on E-facing slopes down to Coleman Creek. Collected 62 fruit with 2055 seeds.
PI 689418. GBdRF 379. <i>S. jamesii</i>. United States. Arizona. Apache County. Apache National Forest. Near Eagar (and Springerville). First E exit S of triangle intersection of Rts 191/180/160 two miles E of Eagar. Then one mile SE on Picnic Creek Road at bottom of loop. Within 100 ft of S edge of road. At WSG N34.094650° x W109.236467° and 7295 ft. Coll #20. September 21, 2018. Abundant, green, small plants with occasional fruit. Under trees. Collected 45 fruit with 250 seeds.
PI 689419. GBdRF 380. <i>S. jamesii</i>. United States. Arizona. Apache County. Apache National Forest. Near Alpine. E from Alpine on 180 to Luna Lake. Luna Lake at San Francisco River. Approximate site of Ricketson 4281 [1988]. At WSG N33.83699° x W109.07939° and 7984 ft. Coll #21. September 21, 2018. Few small plants with fruit. In needle mulch at base of trees or in open among fallen logs. Collected 16 tubers.

PI 689420. GBdRF 381. <i>S. jamesii</i>. United States. New Mexico. Grant County. Near Glenwood. From Silver City NW on 180 and W on 78. Site of previous 2011 lost 664008J. Only along E side of fence W of post office on Bushy Mountain Road. At WSG N33.121950° x W108.956517° and 5215 ft. Coll #22. September 21, 2018. Occasional plants to 6 inches, most yellow, mature tubers. In grass and herbs and under small brush and willows. Collected 10 tubers.
PI 689421. GBdRF 382. <i>S. jamesii</i>. United States. New Mexico. Grant County. Near Silver City. From Silver City E on 180 about 7 miles to Ft. Bayard. SE of main gate on the E side of cemetery. Site of previous lost 620872 from 2001. At WSG N32.79750° x W108.15382° and 6153 ft. Coll #23. September 21, 2018. Up to 20 plants up to 15 inches, green or spindly without flowers or fruit. Shaded and protected under junipers among sparse herbs in moist, red, sandy soil. Collected 14 tubers.
PI 689422. GBdRF 383. <i>S. jamesii</i>. United States. New Mexico. Catron County. Gila National Forest. Near Gila Cliff Dwellings. From Silver City N on 15 for 46 miles to Gila Cliff Dwellings National Monument parking lot. From parking lot NW for 1/2 mile on hiking trail to Gila National Forest, and about 2/10 mile W on trail on delta of west fork of Gila River. At WSG N33.23463° x W108.27371° and 5694 ft. Coll #24. September 22, 2018. Abundant green plants to 15 inches with fruit. Colorado potato beetle present. Open grassy flats under shade of brush and willow scrub. In grass with small herbs. Brown sandy soil with gravel. Collected 78 fruit with 1170 seeds.
PI 689423. GBdRF 384. <i>S. stoloniferum</i> form <i>fendleri</i>. United States. New Mexico. Catron County. Gila National Forest. Near Gila Cliff Dwellings. From Silver City N on 15 for 46 miles to Gila Cliff Dwellings National Monument parking lot. From parking lot NW for 1/2 mile on hiking trail to Gila National Forest, and about 2/10 mile W on trail on delta of west fork of Gila River. At WSG N33.23463° x W108.27371° and 5734 ft. Coll #25. September 22, 2018. Abundant green plants to 15 inches with fruit. Colorado potato beetle present. Open grassy flats under shade of brush and willow scrub. In grass with small herbs. Brown sandy soil with gravel. Collected 37 fruit with 1166 seeds.
PI 689424. GBdRF 385. <i>S. stoloniferum</i> form <i>fendleri</i>. United States. New Mexico. Grant County. Gila National Forest. Near Pinos Altos. From Silver City N on 15 to Pinos Altos, then 6.3 miles to McMillan Campground. From close to campground entrance and NE along creek banks. At WSG N32.92525° x W108.21371° and 6950 ft. Coll #26. September 22, 2018. Many green plants with many mature fruits, many already fallen to ground. Shady deep creek valley, in needle mulch in moist black soil under large Ponderosas. Collected 142 fruit with 8833 seeds.
PI 689425. GBdRF 386. <i>S. jamesii</i>. United States. New Mexico. Grant County. Gila National Forest. Near Pinos Altos. N on 15 from Pinos Altos 5.2 miles to Cherry Creek Campground. Near campsite #2. At WSG N32.91406° x W108.22472° and 6781 ft. Coll #27. September 22, 2018. Dozens of large plants, occasionally with fruits, and large mature tubers. Flat grassy creek banks among oaks and in rich black soil. Collected 25 tubers and 7 fruit with 76 seeds.
PI 689426. GBdRF 387. <i>S. jamesii</i>. United States. New Mexico. Gila County. Burro Mountains. Gila National Forest. Near Silver City. From Silver City S on 90 to Tyrone road (smooth gravel) and W 6.5 miles to Burro Mountain Homestead. Mostly along W side of community road. At WSG N32.62033° x W108.43506° and 6546 ft. Coll #28. September 23, 2018. Small plants to 6 inches, yellowing, no flowers or fruits. Small mature tubers on long stolons. Colorado potato beetle present. E-facing slopes in duff under oaks and in cracks and debris of large rock outcroppings. Collected 36 tubers.
PI 689427. GBdRF 388. <i>S. stoloniferum</i> form <i>fendleri</i>. United States. New Mexico. Gila County. Burro Mountains. Gila National Forest. Near Silver City. From Silver City S on 90 to Tyrone road (smooth gravel) and W 6.5 miles to Burro Mountain Homestead. W side of road through community, behind large white metal building with flag pole. At WSG N32.62033° x W108.43506° and 6546 ft. Coll #29. September 23, 2018. Only two colonies of 5 and 12 green plants to 6 inches, with atypical leaf shape, without flowers or fruit, but tubers on long stolons. In open in drift of branches and debris in moist, brown, gravelly soil. Collected 2 tubers.

PI 689428. GBdRF 389. *S. jamesii*. United States. New Mexico. Gila County. Burro Mountains. Gila National Forest. Near Silver City. From Silver City S on 90 and W at Tyrone road (smooth gravel). Within 100 ft of N road edge and both sides of the wash. At WSG N32.62190° x W108.42111° and 6467 ft. **Coll #30**. September 23, 2018. About 50 small plants without flowers or fruit, but rare immature tubers. On E-facing and W-facing slopes in shade of large oaks and Ponderosas in very deep mulch, or under Junipers, or open in gravelly soil. Collected 36 tubers.

PI 689429. GBdRF 390. *S. stoloniferum* form *fendleri*. United States. New Mexico. Gila County. Burro Mountains. Gila National Forest. Near Silver City. From Silver City S on 90 to Tyrone (smooth gravel) road and W about 4 miles to T intersection with Deadman Canyon Road to N at 20 culverts. In flat valley below and berm from wash on N side of Tyrone Road. At WSG N32.61727° x W108.40636° and 6305 ft. **Coll #31**. September 23, 2018. About 25 plants, green, rosette to 4 inches, some with fruit. Under large Ponderosas and Junipers in needle mulch. Collected 12 fruit with 300 seeds.

PI 689430. GBdRF 391. *S. jamesii*. United States. New Mexico. Gila County. Burro Mountains. Gila National Forest. Near Silver City. From Silver City S on 90 to Tyrone Road (smooth gravel) and W about 4 miles to T intersection with Deadman Canyon Road to N at 20 culverts. Both N and S of Tyrone Road. At WSG N32.61727° x W108.40636° and 6305 ft. **Coll #32**. September 23, 2018. Scattered small plants without flowers or fruit, but mature tubers. In needle mulch and open rich black soil of berm. Collected 22 tubers.

PI 689431. GBdRF 392. *S. jamesii*. United States. Arizona. Cochise county. Chiricahua Mountains. Coronado National Forest. Near Portal. From Lordsburg, NM and W to Road Forks and S on 80 to Portal Road and W into AZ about 10.5 miles. Becomes Cave Creek road = FR42. About 3.5 miles SW of Portal to Sunny Flat Campground. Roads from E are all paved, while access by FR42 over Chiricahua Mountains is mountain gravel. Along FR42 especially around bridge over S Fork Cave Creek which is just S of Sunny Flat Campground. Also along Cave Creek for about 1/3 mile on Cave Creek Nature Trail running NE from Sunny Flat Campground. At WSG N31.88356° x W109.17625° and 5072 ft. **Coll #33**. September 23, 2018. Three small tuberlings with unusual purple stems in creek bank. Over 30 small plants without flowers or fruit, but mature tubers near trailhead. Many very large green plants, one flowering, a few fruit, and many mature tubers at FR42 bridge and nearby. Sandy creekbed under large cottonwoods, grassland juniper shade, and among shady rock abutments at ends of bridge, as well as in mulch in flats at FR42 and South Fork Road jct. Collected 50 tubers.