

2018 SCOUTING AND COLLECTING EFFORTS OF *QUERCUS SADLERIANA* IN CALIFORNIA



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Introduction

Denver Botanic Gardens (the Gardens) partnered with Chicago Botanic Garden (CBG) to target *Quercus sadleriana* (Sadler's oak) for the Tree Gene Conservation Partnership project through a grant awarded by the American Public Gardens Association and the U.S. Forest Service. This near-threatened oak species (Beckman 2016) is native to the mountainous regions of southwest Oregon and northwest California. This species was specifically targeted, as all oak species are known to have recalcitrant seed and cannot be traditionally seed banked, limited research has been conducted on this species, and currently the species is maintained in only six *ex situ* living collections within the United States, representing less than 30% of the species' geographic and ecological range (Figure 1; Beckman et al., in prep.). For these reasons, we believed that *Q. sadleriana* would be an ideal candidate for this project.

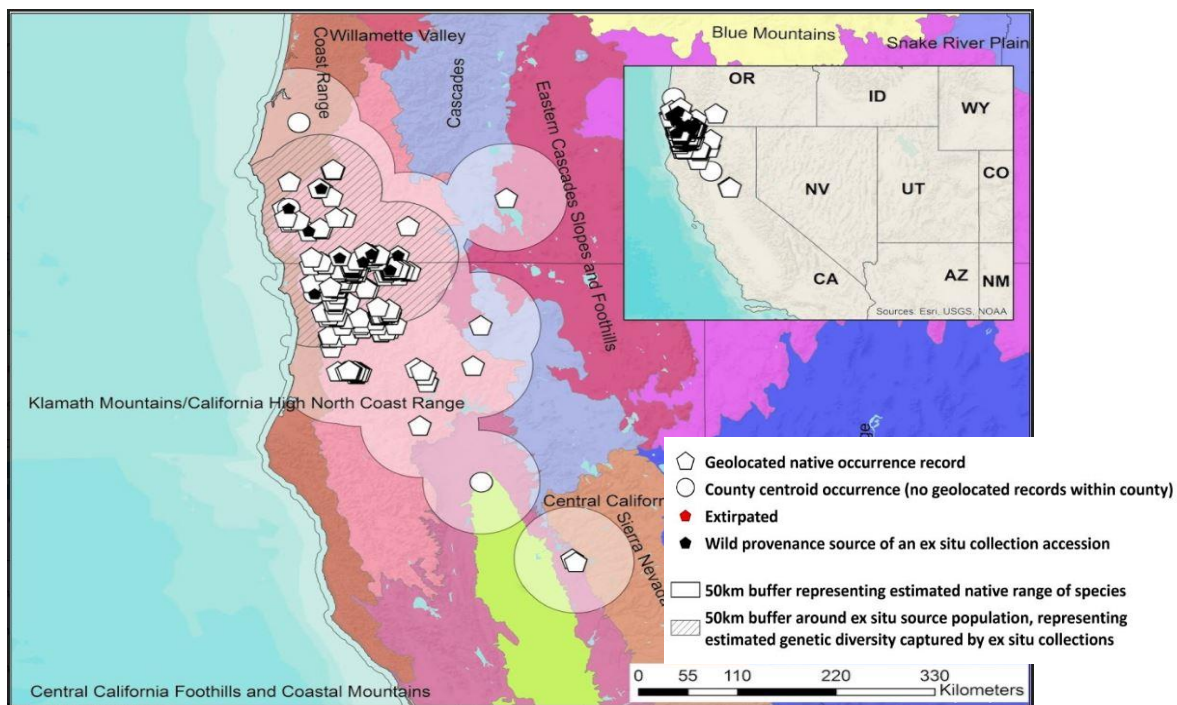


Figure 1. Map of known populations of *Quercus sadleriana*. Wild provenance source of *ex situ* collection accessions are in black. From Beckman et al., in prep.

We decided to target populations of *Q. sadleriana* in the southern end of its range, as *ex situ* collections currently represent populations in the middle to upper extent of the species' range (Figure 1). Specifically, we scouted for populations located in the Six Rivers, Klamath, and Shasta-Trinity National Forests in northern California. Sampling populations outside the region currently represented would greatly increase the genetic diversity represented in the *ex situ* collections of this species. Furthermore, sampling from the southern edges of the species' range would capture the unique genetic diversity of these edge populations (Guerrant et al. 2014). Since these populations are located in high elevation areas, conserving this diversity in *ex situ* collections would be a safeguard against potential effects of climate change, e.g., limited upward migration.

We scheduled a scouting trip in May 2018 to identify populations for collections, as northern California has been subject to numerous wildfires in recent years, and many of the known occurrences of the species in this region are decades old. A collection trip was scheduled for mid-October 2018.

Scouting Trip: May 13-18, 2018

Alex Seglias (the Gardens) and Jessa Finch (CBG)

We decided to do an initial scouting trip to northern California to locate populations for collection, as we were unfamiliar with the species and wildfires in recent years may have destroyed historical occurrences. Occurrence records were obtained from Emily Beckman (The Morton Arboretum) and used to create a scouting route (Figure 3).

May 13, 2018

Alex and Jessa met in San Francisco, CA – Alex flying from Denver and Jessa flying from Chicago. After we both landed in San Francisco, we picked up a rental car and started driving north on Highway 101 towards Eureka. We stopped in Eureka to buy groceries for the week and continued driving to Hoopa, where we stayed the night.

May 14, 2018

From Hoopa, CA, we traveled east on Big Hill Road (Figure 2) until we reached the entrance of Six Rivers National Forest. As soon as we entered the National Forest we began to notice *Q. sadleriana* along the road (Figure 4). The first population looked healthy, with close to 100 individuals. We continued driving along the Forest Service road until we reached the point of the next population.

Accessing this population involved hiking to the peak of a mountain,

where we found only a few individuals. The information for this population is from 1947, so this population may have seen decline over the past few decades. As we continued along Big Hill Road, we saw thousands of *Q. sadleriana* plants. We eventually reached a couple of road closures, at which point we could not access some of the populations that we had mapped out. Most of those records were decades old and perhaps the roads were open for travel then. In total we found 6-10 populations along Big Hill Road. Since this species is a shrub that grows in clumps, it can often be hard to determine separate populations without genetic work.



Figure 2. Jessa on Big Hill Road. Photo by Alex Seglias.

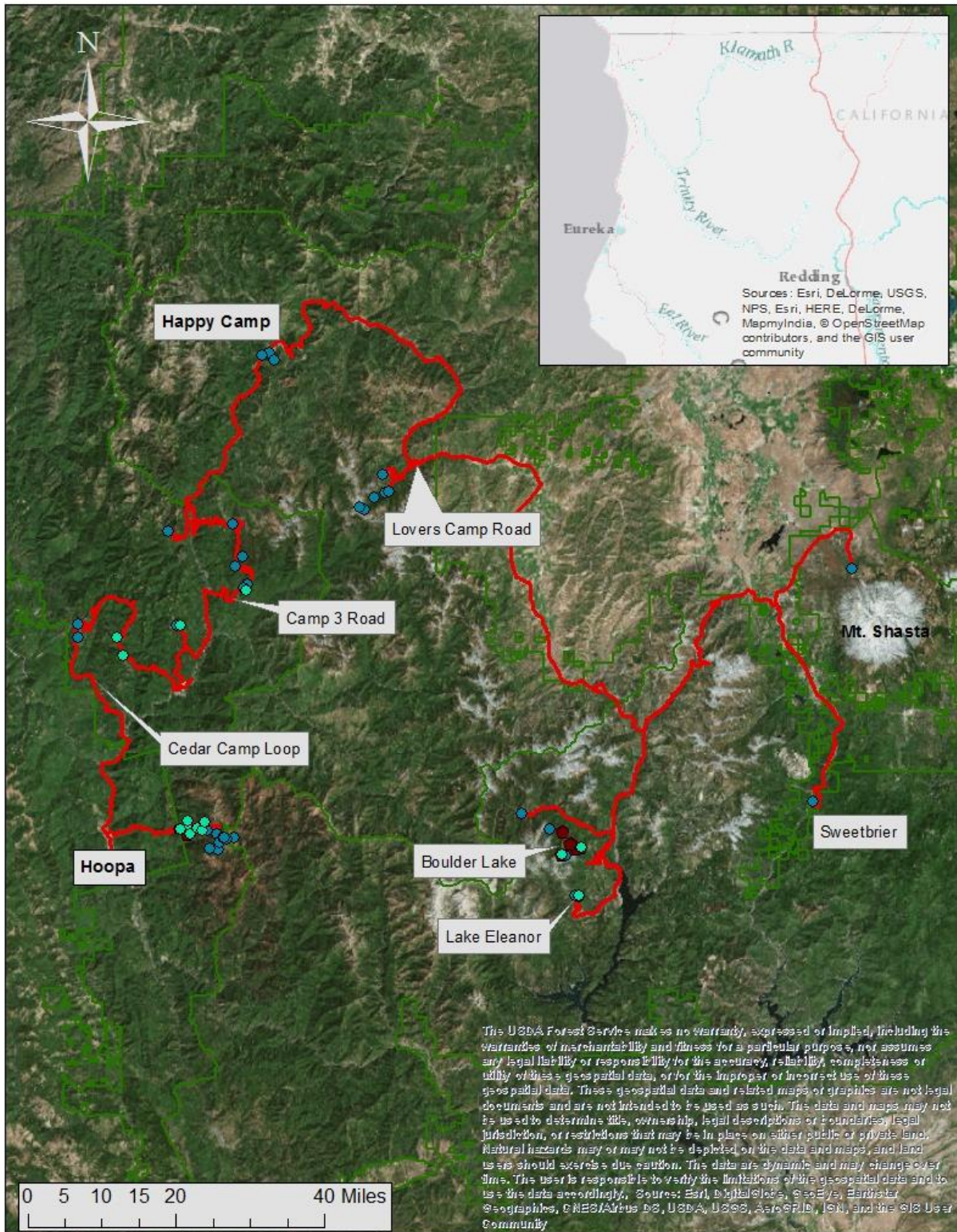


Figure 3. Map of scouting route in red with targeted populations in dark blue, collected herbarium vouchers in teal, and visited populations (no voucher collected) in dark red. Dark blue populations were either not found, could not be accessed because of road closures, or not visited during the scouting trip, but visited during the collection trip (no voucher). National Forest boundaries are outlined in green.



Figure 4. *Quercus sadleriana* individual on Big Hill Road.
Photo by Alex Seglias.

found only 10-15 individuals. We did not drive the entire loop of Cedar Camp Road due to time restrictions, and instead drove up to Cedar Camp and out, and then took the other entrance and drove northwest to the other mapped population (Figure 2), where we found a population at Bald Mountain.

From Orleans we drove north to Forest Rd. 12N52 (Camp 3 Road), where we found individuals along the road until we reached Camp 3. As we continued driving, we encountered road closures due to slides and could not access mapped populations. We also encountered a road closure on FR88 as we traveled west from Klamath River Highway, and could not access one population (Figure 5).



Figure 5. Road closure on FR88 preventing access to populations.
Photo by Alex Seglias.

We drove north towards Happy Camp, where there were three historical occurrences. We could not find any of the three populations (two of which were known from the 40s and 50s). We spent the night at Klamath River Resort Inn.

May 16, 2018

We woke up on this dreary, rainy morning and drove southwest into the heart of the Klamath National Forest, south of Scott Bar. The road was closed to Lovers Camp at the Route 96 turnoff due to slides. We were only able to access one of the populations that we had planned for this



Figure 6. Miss Pretty (six-toed cat). Photo by Jessa Finch.

day, but we were not able to find any individuals of Sadler's oak. It seems that the weather matched our fortune.

We made our way back to Route 3 and headed south to Coffee Creek, where we spent the night at Ripple Creek Cabins and made friends with an adorable six-toed cat that lives on the property (Figure 6).

May 17, 2018

We drove south towards Trinity Center and found Boulder Creek Trail. We started hiking on this trail for a few miles, when we realized that we wanted Boulder Lake Trail. To our surprise, however, we found some individuals of *Q. sadleriana* along Boulder Creek Trail and collected a voucher. There was another shrubby plant along this trail that looked very similar to *Q.*

sadleriana and continued to fool us. We have not yet identified whether it was an oak or a species of another genus.

We then drove towards the Boulder Lake trailhead, where we found numerous *Q. sadleriana* individuals as we ascended the mountain along the road. We hiked the trail towards Boulder Lake and found thousands of individuals along the trail and around the beautiful alpine lake (Figure 7). Because we spent extra time on a trail that was not supposed to be part of the scouting route, we were not able to get to the other populations that we had planned for that day and decided to scout for them the following day. We traveled back to our cabin at Ripple Creek and spent the night there.



Figure 7. Alex looking at *Q. sadleriana* along Boulder Lake Trail. Photo by Jessa Finch.

May 18, 2018

On this final day of the scouting trip, we traveled northeast towards Mt. Shasta (Figure 8), where there were two occurrence records along a road going towards Bolan Lake (from 1981), and one population in Sweetbrier along the Sacramento River (from 1957). We were not able to find any of these populations, perhaps because they were destroyed due to development or natural causes.



Figure 8. Mt. Shasta. Photo by Jessa Finch.

Following the unsuccessful trip to Mt. Shasta, we traveled back towards Trinity Center to Lake Eleanor, where we looked for the populations that we did not have time for on the 17th. We ended the day and the trip with success! There were hundreds of individuals along the trail and around Lake Eleanor. An added pleasure was that we came across a gorgeous sea of flowering pitcher plants (*Darlingtonia californica*) as we hiked the Lake Eleanor Trail. We could not have asked for a better end to our scouting trip. We spent our final night at Ripple Creek Cabins after

indulging in pizza, beer, and live music at Trailhead Pizza, a local favorite in Coffee Creek.

Collecting Trip: October 13-18, 2018

Alex Seglias, Jessa Finch, and Adrienne Basey (Metro, City of Portland)

After the success of the scouting trip, we had high hopes for acorn collection when we returned to northern California in October. We invited Adrienne Basey to join us, as many of the individuals from the partnering institutions were attending the APGA Conference or the IOS Conference during this time.

October 13, 2018

Alex flew to Portland from Denver, where Adrienne Basey picked her up at the airport. The two of us went grocery shopping while we waited for Jessa to arrive from Chicago. Once Jessa landed in Portland, we started the drive south on Route 5. We eventually made it to Orleans, CA, where we spent the night at Sandy Bar Ranch, our favorite cozy cabin getaway.



Figure 9. Adrienne looking for acorns underneath *Q. sadleriana* along Cedar Camp Road. Photo by Jessa Finch

October 14, 2018

On this first day of the collection trip, we went west from Orleans and drove the Cedar Camp Road loop. There were numerous populations of *Q. sadleriana* (~15-20, depending on what one

might consider a population) and thousands of individuals (Figure 9). However, there were hardly any acorns to be found, and the acorns that we did find were either aborted or had insect damage and were thus not viable. Our hope for collecting any acorns that day grew dimmer and dimmer as we made our way north to Camp 3 Road (Forest Rd. 12N52). The roads (Camp 3 Rd. and Forest Rd. 13N03) to the populations were still blocked due to slides, but we decided to hike in to the population along FR 13N03. We found that this area had been hit by a wildfire in recent years, with new plant growth looking about 1-2 years old. We did not find any mature *Q. sadleriana* individuals, but did find what we believed to be Sadler's oak seedlings (Figure 10).



Figure 10. *Quercus sadleriana* seedling. Photo by Jessa Finch.

In general we found that individuals growing in the shade showed less evidence of reproduction than individuals growing in full sun. However, the individuals growing in the sun had no evidence of viable acorn production. Other oaks in the area were producing viable acorns at the time, mid-October is usually the time when acorns are mature, and personal communication led us to believe that this was a reasonable time for *Q. sadleriana* to have mature acorns. As such we do not believe that we were too late for collection, but it may be that we missed peak fruiting by a couple of weeks and that acorns were predated on during that time.

We drove back to Sandy Bar Ranch to reflect on what might be going on with this species, prepare dinner, and feast on homemade, fresh goat cheese from the goats on the property, made by the owner of the cabins, Blythe.



Figure 11. Alex amidst large population of *Q. sadleriana* along Big Hill Rd., which was not visited during the scouting trip in May. Photo by Jessa Finch.

October 15, 2018

We woke up, packed up our belongings, as we would not be returning to Sandy Bar Ranch, and headed south towards Hoopa. We went east on Big Hill Road into the Six Rivers Forest. Again, we found empty acorn caps, aborted acorns, and damaged acorns. We did drive to one population that we had not visited in May (Figure 11) and found one viable acorn. Unfortunately, we cut it open

to determine its viability, thereby rendering it non-viable. In total, we found thousands of individuals on this second day, but only one viable acorn. Our optimism was quickly dwindling as we finished our fieldwork for the day and made our way towards Coffee Creek, where we spent the night at Ripple Creek Cabins and hung out with our favorite six-toed cat.

October 16, 2018

Our first destination for the day was Lake Eleanor (Figure 12). We had high hopes that perhaps the populations in this region were producing viable acorns. We hiked to Lake Eleanor and discovered lots of individuals, but alas, no viable acorns. We saw some evidence of flowering in this population, but not as much as we had seen in the other populations that we had visited during this trip. We did find a few acorn caps, suggesting some reproduction, but likely nothing viable.



Figure 12. Lake Eleanor with *Q. sadleriana* in the foreground. Photo by Jessa Finch.



Figure 13. *Darlingtonia californica* along Lake Eleanor Trail. Photo by Alex Seglias.

Although we didn't find any acorns at Lake Eleanor, we checked on our old friends, *Darlingtonia californica*, and found a beautiful sea of now fruiting pitcher plants (Figure 13). We spent some time with these elusive, hooded carnivores before heading to our final *Q. sadleriana* population of the trip.

Our final destination for the day and the trip was Boulder Lake. Sadly we came up empty here as well, despite the abundance of mature *Q. sadleriana* individuals. Although it was a beautiful hike and we enjoyed some time at the lovely alpine lake (Figure 14), we couldn't help but feel disappointment that our trip ended without any viable acorns to bring home. We headed back to our cabin, hung out with our favorite cat, and enjoyed a final dinner in northern California, as we thought about future plans for Sadler's oak collection.

October 17-18, 2018

We left Ripple Creek Cabins and drove north to Portland on the 17th. On the 18th, Jessa and Alex said goodbye to Adrienne, departed Portland, and flew to their respective destinations.

Conclusions, Hypotheses, and Future Directions

Although we were not able to collect any viable acorns from this species, the trip was not entirely unsuccessful. We were able to ground truth whether occurrence records in the region from decades ago were still accurate. This gives us a better idea of current population status and trend for this species. We collected voucher specimens from all populations during the scouting trip and some populations during the collecting trip, giving us phenological records for future or current research.

Additionally, we were able to gather some information as to the reproductive biology of the species and develop some hypotheses about acorn production.

Because we found large clumps of this species, we believe that one explanation for low acorn production could be more resource allocation to asexual (clonal) reproduction. Perhaps in non-masting years, this species reproduces clonally, rather than sexually through acorn production. Another explanation could be that this species only reproduces in masting years, and this was not a masting year, or that the species produces a small amount of fruits and we missed peak fruiting. Our third possible explanation is that the conditions this year were not adequate for viable acorn production, perhaps due to abiotic and/or biotic factors.

We would like to continue trying to collect material to build up the *ex situ* conservation collection of this species. In the future, we could have someone in the area track acorn production, and only undertake a collection trip in a suitable year. We could also try to propagate this species from vegetative cuttings. Martin Nicholson at Hoyt Arboretum in Portland, OR is interested in pursuing this avenue, and I have been in contact with Adam Black at Peckerwood Garden, TX to talk about approaches he has used for propagation through shoot cuttings with oaks.



Figure 14. Adrienne (right) and Alex (left) at Boulder Lake. Photo by Jessa Finch.

References

Beckman, E. 2016. *Quercus sadleriana*. The IUCN Red List of Threatened Species 2016: e.T78972401A78972404. <http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T78972401A78972404.en>.

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Pictures of Select Acorns



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Herbarium Vouchers Collected

All collections were made on USFS land with the permit provided by the APGA/USFS project. Collections will be held in the Kathryn Kalmbach Herbarium of Vascular Plants at Denver Botanic Gardens and the United States National Arboretum Herbarium.

Collection number	Date	Species	# vouchers	Collectors	County	Latitude	Longitude
AS32	5/14/2018	<i>Quercus sadleriana</i>	2	Alex Seglias, Jessa Finch	Humboldt	41.09002	-123.5489
AS33	5/14/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Humboldt	41.08981	-123.5356
AS34	5/14/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Humboldt	41.08152	-123.5313
AS35	5/14/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Humboldt	41.09165	-123.5173
AS36	5/14/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Humboldt	41.08803	-123.5066
AS37	5/14/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Humboldt	41.10059	-123.5029
AS38	5/15/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Humboldt	41.374	-123.6741
AS39	5/15/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Humboldt	41.34602	-123.6628
AS40	5/15/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Del Norte	41.39141	-123.5512
AS41	5/15/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Siskiyou	41.44237	-123.4217
AS42	5/17/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Trinity	41.06188	-122.7676
AS43	5/17/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Trinity	41.05079	-122.8070
AS44	5/18/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch	Trinity	40.98840	-122.7734
AS70	10/15/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch, Adrienne Basey	Humboldt	41.08951	-123.5510
AS71	10/15/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch, Adrienne Basey	Humboldt	41.10192	-123.5368
AS72	10/15/2018	<i>Q. sadleriana</i>	1	Alex Seglias, Jessa Finch, Adrienne Basey	Humboldt	41.10069	-123.5029
AS73	10/16/2018	<i>Q. sadleriana</i>	2	Alex Seglias, Jessa Finch, Adrienne Basey	Trinity	40.98965	-122.7733

Expense Report

Project Expenses	APGA - USFS		Cost Share - DBG	
	Budget	Actual	Budget	Actual
<i>Scouting Trip: May 13-18, 2018</i>				
Roundtrip flight Denver to San Francisco	\$300	\$288.97		
Roundtrip flight Chicago to San Francisco	\$300	\$350.60		
Car Rental (with gas)	\$500	\$673.62		
Lodging (\$150/room*6 nights)	\$900	\$757.08		
Meals (2 people*6 days*\$30/day)	\$360	\$295.45		
California Gazeteer	--	\$10.22		
<i>Collecting Trip: October 13-18, 2018</i>				
Rountrip flight Denver to Portland (*3)	\$900	\$269.97		
Roundtrip flight Chicago to Portland	\$300	\$370		
Car Rental (with gas)	\$500	\$634.20		
Field supplies	\$50	--		
Lodging (\$100/room*2 rooms*5 nights)	\$1,000	\$557.20		
Meals (4 people *5 days*\$30/day)	\$600	\$190.60		
Travel to/from Denver Airport	--	\$80.02		
Material Distribution	\$50	--		
Salaries			\$8,315	\$4,534.56
Totals	\$5,760	\$4,477.93	\$8,315	\$4,534.56

The actual expense was much lower than the budgeted expense for the collection trip, because other staff members from the Gardens could not join the trip. The budget had included travel expenses for Alex along with two additional staffers. Because we had Adrienne join us, we saved significantly on airfare. Additionally, with fewer people on the collection trip, we saved money on lodging and meals.