Annual Report of Hawaiian T&E Plants, at Palomar Community College

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Volume 4

This report indicates the current status of the seeds and any subsequent seedlings from the collections made of cultivated T&E seeds from the Honolulu Botanic Gardens, National Tropical Botanic Garden, and the Waimea Valley Arboretum in the spring of 2013.

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Introduction

In the summer of 2012, I contacted the Hawaii Department of Forestry and the US Fish and Wildlife Service to request approval to collect seeds of some Threatened and Endangered plant species native to the Hawaiian Islands from botanical gardens in Hawaii and bring them back to the mainland.

The collected species include:

- ***Sesbania tomentosa***
- ***Abutilon mensiesii***
- ***Abutilon sandwicensis***
- ***Hibiscadelphus distans***
- ***Polycias racemosum***
- ***Caesalpinia kaviaensis***

Currently only *Sesbania tomentosa* is in the garden. This species, along with a host of other Polynesian plants are providing visitors a chance to see how beautiful and diverse our world is and hopefully entice at least a few to take some active role in the efforts to protect the species.

The Following Botanical institutions provided seeds for nearly all of the Hawaiian Native plants in these gardens.

The National Tropical Botanical Garden

NTBG -- The Honolulu Botanical Gardens

The Waimea Valley Botanical Garden

Campus Nursery & Soil Type for Planting

Refer to Volumes 1 and 2 for more information on the campus nursery and soil types used for planting.

Seed and Seedling Status, As Of Spring 2017

As with last year, the chart below shows that only ~~3~~ three species are still represented in the seed bank at the college. However, a seed viability test was done with approximately 19 seeds collected from the last seed pods on the #4 *Sesbania tomentosa* before it died in the spring of 2016. The result was that all the seeds, except for one, germinated and we now have ~~5~~ five plants back in the Polynesian Garden from that viability test. The others from the test unfortunately died from various causes. The three species held in the bank collectively yield a total of 1,605 seeds, with the best represented species being *Sesbania tomentosa.*

Genus species	Remaining in Seed bank	Plants Alive at Present
Caesalpinia kaviaensis	3	0
Sesbania tomentosa (original collection)	18	0
Sesbania tomentosa Plant #1	494	0
Sesbania tomentosa Plant #2	84	0
Sesbania tomentosa Plant #2&3	64	0
Sesbania tomentosa Plant #3	60	0
Sesbania tomentosa Plant #4	877	0
Sesbania tomentosa Plant #4-1	0	1
Sesbania tomentosa Plant #4-2	0	1
Sesbania tomentosa Plant #4-3	0	1
Sesbania tomentosa Plant #4-4	0	1
Sesbania tomentosa Plant #4-5	0	1
Hibiscadelphus distans	4	1
Polycias recemosum	1	1

The total number of seedling T&E species from the original collection is two, with five second generation *Sesbania tomentosa* currently growing in the garden.

As discussed in the last three editions of this report; *Sesbania tomentosa* has been a vigorous grower, both in the ground and in containers, often reaching sexual maturity within six to nine months of germination.

Our *Polycias racemosum* has grown substantially faster since we moved it out of the greenhouse and into the shade house in the spring of 2016. It is still a

small five gallon plant, but is growing well. Interestingly, it seems that *Polycias racemosum* may have two pronounced growth spurts that tend to occur during the spring and fall. This is typically when Southern California's average temperatures most closely resemble those of the plants native Hawaiian habitat, specifically those temperatures of the Na Pali Coast State Park area on Kauai. [1] Coincidentally, these times of year are also when day length in Southern California, is most similar to the average day length in Hawaii.

The *Hibiscadelphus distans* was also removed from the greenhouse this spring and placed in the shade house. It also fared much better outside. Despite a mild insect issue during the summer, it grew strongly all year. Interestingly, it also had pronounced growth spurts during the fall and showed no signs of duress from the winter cold.

Caesalpinia kaviaensis is still worth trying in Southern California Botanic Gardens and thankfully we do still have three seeds on which to experiment.

***Polycias racemosum* in the nursery February 2017.**

***Hibiscadelphus distans* in the nursery February 2017. I moved the plant into the sun for the picture, but you can also see by the large number of weeds in the background how much precipitation we received here thus far this year.**

Pest Problems

As is often the case, plant pests tend to be problematic in closed environments like greenhouses and hothouses.

The plant pests listed below have shown an affinity for the plant species currently being grown in the greenhouse during 2016.

- *Tetranychus sp.* -**Red Spider Mite**
- *Pseudococcus sp.* - **Mealy Bug**
- *Yellow/Brown Scale*

At least three specimens of *Sesbania tomentosa* in the Polynesian Garden during the summer of 2016 did develop a mild to moderate infestation of *Graphocephalla atropunctata* (**Blue-green Sharp Shooter**), which caused some defoliation. The plants

were promptly treated with a systemic insecticide, which quickly resolved the issue.

Historically Red spider mite has been voracious on the foliage of the *Sesbania tomentosa* in the green house, but until this year it has not been a problem in the landscape. Oddly, the infestation of *Graphocephalla atropunctata* (**Blue-green Sharp Shooter**) on the *Sesbania tomentosa* this year was followed by a Red Spider Mite infestation, which we had never before seen on this species. To combat the Red Spider Mite, we sprayed the plants with horticultural oil, which we followed ~~3~~ three weeks later with a weekly washing down, using a garden hose for the next two weeks. The end result was increased vigor on many of the plants. However, at least three of the initial plantings died.

Response to Cold

As mentioned before; *Sesbania tomentosa* is fast growing and tolerant of air temperatures to at least 29 degrees Fahrenheit. However, these plants are not tolerant of prolonged drought and seem slightly temperamental to prolonged root temperatures in the low 40s high 30sF.

This winter was very wet in California, with one series of storms dumping in excess of four inches of rain over the course of seven days. Thankfully, it was mild as far as cold temperatures are concerned. Shockingly, we had only three to four nights of temperatures between 36 and 34 degrees F. Though many of the *Sesbania* plants are now (in early February) showing some bronzing of foliage and some leaf drop. This has been the norm for all of the landscape *Sesbania* plants at the end of winter here in Southern California. From past experience I expect all but one to survive.

As mentioned above, since being placed in the shade house at the beginning of Spring 2016, the *Hibiscadelphus* and *Polycias* have showed no signs of stress from the cooler ambient temperatures they experience. Based on this year's observations of growth, it seems the plants may actually prefer the cooler temperatures, particularly during the heat of summer. Initially I (admittedly foolishly) assumed that *Hibiscadelphus* and *Polycias* would not be much bothered by the summer heat we experience here on campus, which can occasionally rise above 100F. Though as the years have passed it seems at least with our two specimens that they do not like being in the warm greenhouse. They often get infested with pests when kept in our greenhouse during the warmer months. When kept outdoors the growth has been steady, strong and generally free of insect infestations; particularly during the Spring and Fall months.

Response to Shade

As a result of being placed in the shade house, it seems we may have stumbled across an insightful bit of horticultural knowledge this year, as again from anecdotal observations; it is possible the three plant species may have specific preferences or tolerances with regards to the amount of sun light they receive.

It seems that *Hibiscadelphus distans* and *Polycias racemosum* seem to prefer shade over full sun here in Southern California, which seems concurrent with the previous assumption that they may prefer cooler temperatures. As a side note, it is fairly common knowledge among palm enthusiasts here in Southern California that most Pritchardia palms prefer protection from our high summer temperatures, particularly when those temperatures rise above 95F. This is a reality that becomes more frequent the further one goes inland from the coast.

A quick look at average temperatures on www.weather.com for the San Marcos, California area and the Na Pali Coast State Park area of Kauai definitely seem to further support the idea that at least *Polycias*, if not *Hibiscadelphus* are never subjected to temps above the mid 90'sF in the wild. From this, one could then surmise that again, at least *Polycias* may not have the inherent ability to cope with such high temperatures and so shade plantings

may yield the best results for those specimens held in Ex-situ botanical collections here in California.

Interestingly, despite being more coastal with consistently cooler summers, the San Diego Zoo has all of their *Polycias racemosa* planted in partial shade. Many of which I noticed for the first time flowering in 2016.

Alternately, *Sesbania tomentosa* may not prefer shade at all. [4] As we lost at least four of the nine or so plants we planted in the spring. The plants in the garden that are currently growing the strongest are in full sun. They are also planted with either a 2-3" layer of sand as inorganic mulch, or a 2-3" layer of lava rock mulch. It is possible this may have had an unexpected positive impact on their establishment. There was also discussion amongst staff here at the college about whether the large Ash tree they were planted under may have affected the establishment of the plants…. It may have, but Ash trees are not known to be allopathic. So my assumption is that most likely they perished from one of the following: moisture and nutrient competition, or a lack of adequate sun light. Based on the success of those in full sun, I am inclined to believe that lack of sunlight is the determining factor. Particularly when one considers that at least two of the plants doing well received nearly full sun, but were still near, or in the Ash trees' drip line. To further support the "shade is bad" hypothesis: during the winter, one of these two plants nearest the Ash trees' roots began to receive fewer hours of full sun, due to the sun being lower on the horizon and simultaneously began to drastically decline.

None of these observations can be clearly validated scientifically, but they do provide some circumstantial insight. Ideally these assumptions could lead us to conducting some formal experiments, under controlled conditions in the future. The results of which could help to clarify the specific needs and tolerances of the plants concerned.

Moving forward we will err on the side of caution and plant all future plantings of *Sesbania* in full sun. This will ensure that the *Polycias,* as well as the *Hibiscadelphus,* are planted in shaded areas once they are ready for out planting.

Nitrogen Fixation in Sesbania tomentosa

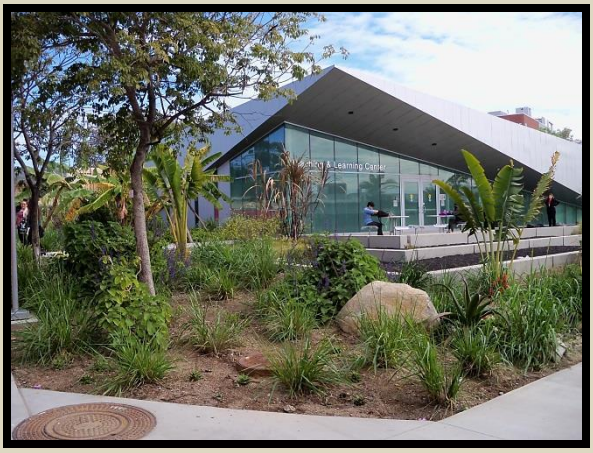
It seems one of the benefits of planting *Sesbania tomentosa* in the garden has been its capacity to infuse nitrogen into the soil, by way of a symbiotic relationship that exists with *Sesbania* roots and a species of nitrogen fixing bacteria. [2]

It was noted by some of the staff that while "Plant #4" was growing strongly in the landscape, so too was the Banana nearby. As soon as #4 died, the Banana's growth was seemingly reduced. Also, we have seen with the most recent plantings of *Sesbania*, that other plants of various Genera nearby (which were not growing particularly fast initially), responded with a noticeable increase in growth, color and over all vigor, once a nearby *Sesbania* plant began to grow into the landscape.

This photo shows a *Sesbania* seedling from the seed trial with pronounced root nodules. These nodules are the source of nitrogen fixation in to the surrounding soil.

As with a few of the other scientifically unquantified statements made above, this too should be further researched with the scientific method to attempt to substantiate these claims.

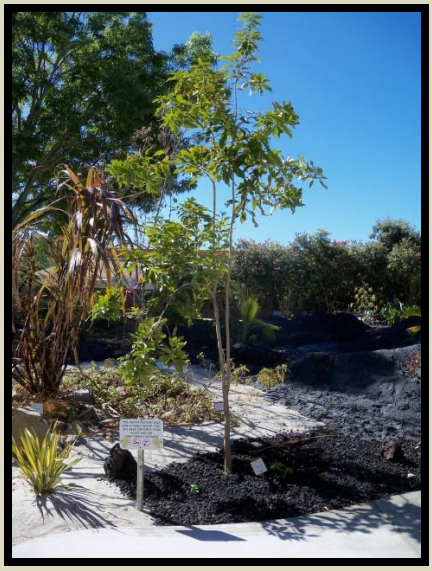
Garden Areas As Of January 2016



A view of the South Plaza of the Teaching & Learning Center, February 2017.

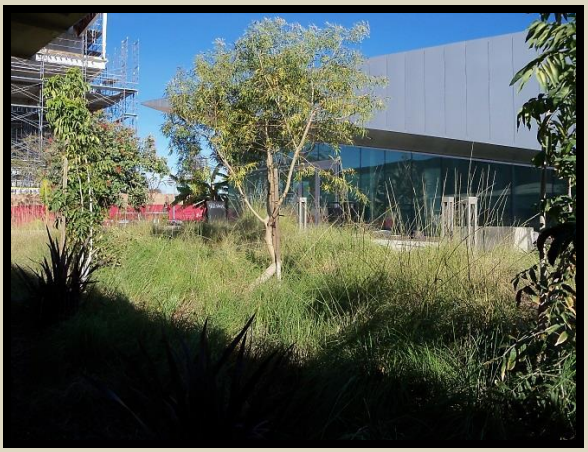
The image above shows a new look for the TLC buildings' South Plaza. To reduce our water use, the old lawn was removed and California Native grasses along with plants native to Madagascar were planted. Madagascar plants were chosen instead of Polynesian plants because the plants in the adjacent planters are from Madagascar. So we opted to use this small corner to continue the Madagascar theme.

The image above shows a portion of the adjacent Madagascar planter.



***Sapindus oahuensis*. This tree was moved to the Polynesian Garden in the summer of 2016 to accommodate a building remodel. It has done very well since the relocation.**

There are so many species to see in the garden that to include them all would be impossible here. I have included a few images below of some of the more unique species to California that are currently growing in the garden.



***Acacia koaia*; a native to the Hawaiian Islands. A month before this photo was taken this tree was twice as big. Sadly, it fell over during one our wet and windy winter storms. After removing 50% of the foliage, we decided to leave the tree in place with the hopes that if the existing crown dies, it may re-sprout from the root base. Thankfully our other specimen of this species is still growing strong and we have been able to place seed in the seed bank for future plantings.**

As discussed last year, drought conditions are common place events in California. In San Marcos at the main campus, it is rare to receive more than 18 inches of precipitation per year. As a result, water management strategies are a significant concern and play a major role in the garden design. The newly installed stream that flows though the "faux" lava field, is flowing because we were able to capture rain water off of the nearby Math Center roof. We have stored 1,500 gallons underground in a tank. The water is then pumped through the stream bed during the day, shut off at night, and then completely drained back into the underground tank until the timer turns the flow back on in the morning.

An early morning view of the faux lava and the flowing stream, February 2017.

The faux lava field was then partially surrounded by white sand, black cinder, and dark landscape mulch. To educate visitors about New Zealand's inclusion into the Polynesian culture, we also installed some granite. Granite, not being naturally found on the other Polynesian islands, is found on the south island of New Zealand; its presence there is said to be a result of it once being part of south eastern Australia. Eventually the south island separated from the continent due to the natural geological forces explained by the theory of plate tectonics. [5]

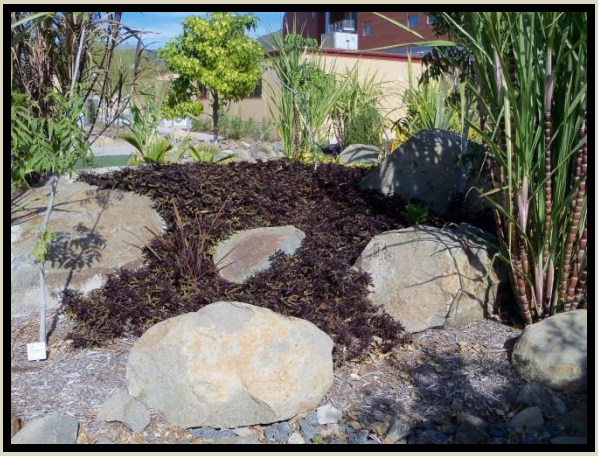
Based on the positive response from the community, the mix of lava rock, white sand, a flowing stream along with the unique Polynesian plants in the landscape, seem to have effectively created the look and feel of the Pacific Islands. Since completed, the garden has become a popular attraction/destination for students, faculty and staff. The garden was also partially featured in San Diego's Union Tribune in December of 2016 (http://www.sandiegouniontribune.com/news/education/sd-me-palomar-trees-20161207-story.html) when they were here covering the campus gardens. Additionally, the article featured the fact that the "main campus" located in San Marcos, California is now a Certified Arboretum with Arb Net.

The end of the stream terminates at a white sand beach. What looks like a fire ring on the right, is actually the disguised water storage tank lid.

Looking east into the Polynesian Garden, February 2017.

With this portion of the Polynesian Garden now complete, we are looking at areas nearby to plant other plants from Hawaii and the rest of Polynesia that we have in the nursery. As the campus continues to redevelop land, there is no doubt that adjacent space will come available for future plantings. As a result of the new open spaces, a trip back to the Hawaiian Islands in the future will be in order. This time hopefully gathering seed from other native Hawaiian species that might act as ambassadors for conservation and education.

The image above is of a variety of Sweet Potato, various types of Sugar Cane, and a Screw Pine (center, Back). Among the granite rock is a small Fierce Lancewood (Pseudopanax ferox) tree in the bottom, front, right side of the photo.



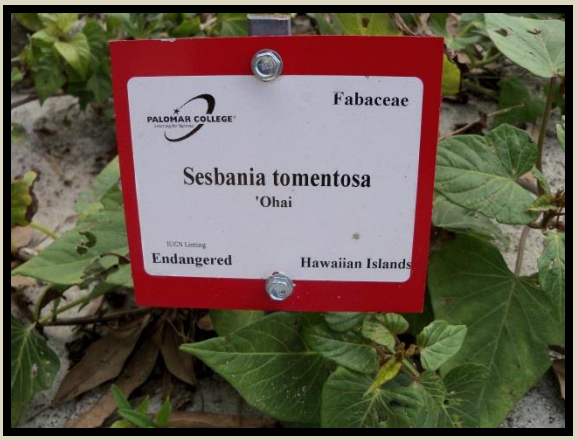
The purple ground cover growing amongst the boulders is yet another variety of Sweet Potato. This variety does not seem to be affected as much by the cold as does the lime green variety shown above. Sugar Cane is a again in the back ground and at right center of the photo. The small tree to the left is a Soap Berry tree and the tree in the distance is the Kukui nut mentioned here last year.

A view of where the stream originates, February 2017.

This is the view from the Natural Sciences building west terrace, looking west over the Polynesian Garden, with the new Library under construction in the background.

Developing seed pods on one of the *Sesbania* plants from the seed viability trial. This photo was taken in February 2017.

Educational Outreach



An example of the new garden plant labels. [3]

As mentioned in reports from years' past, each species when they are planted in the garden are given a plaque or label. These labels provide some basic information concerning the plant. The scientific name of the plant is given, as well as the plant's common name (often in Hawaiian or another Polynesian language), the place of origin, botanical family and the IUCN Red List status or USFWS listing status. By giving visitors insight to what they are looking at, these labels help to educate the public and have the effect of engaging them in thought and further discussion. This year we changed the color of the label plates to better draw attention to those plants in the collection that are vulnerable, threatened or endangered. We did this by placing the label on a yellow plate for plants considered by the IUCN to be vulnerable or threatened and those that are endangered were placed on a red plate. The remaining plants in the collection are named in the field with a standard white label, placed on a white plate.

Growing T&E plants is a great undertaking and it comes with a responsibility to share knowledge and findings with others, as well as to take advantage of educational opportunities when they arise. Ex-situ and in-situ conservation efforts are important, but so is educating the public about why botanical

institutions do the work we do. The intent of growing these species on campus (first and foremost) was to create a unique garden to showcase plants from Hawaii and Greater Polynesia that are in peril; this hopefully encourages people to become active in conservation efforts wherever they may live. This year, at least **six** formal tours, with 20-30 attendees on each tour, were shown the Polynesian Garden; countless other individuals were given personal tours of the garden. This year again, I personally saw students stopping to read the signs and then looking up plants on their cell phones.

At this point, collectively, these approaches only scratch the surface of the possibilities. But they do meet our goal of conservation through education and cultivation. As time progresses, we will certainly improve upon our educational program and hope that the end result will be that our visitors are one step closer to contributing to a society that is willing to sacrifice, even if just a little, to preserve our planet's beautiful biodiversity.

Conclusion

The opportunity to grow unique and rare plants such as the Hawaiian T&E species listed above has provided us new insight to their cultural requirements and tolerances. As we move forward in our efforts to grow many of these rare and unique species, we will no doubt continue to learn more about their adaptability and survivability in new habitats. This information may help in conservation efforts, but will at least provide us with an opportunity to share our discoveries with others. And no doubt, for some species that can adapt to California's climate, they will have the chance to serve as ambassadors for conservation to the students, staff, faculty and the community.

Bibliography

[1] www.weather.com

[2]http://www.uhbeeproject.com/materials/Native_Plant_Pollinator_Garden.pdf

[3] The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **03 March 2015**.

[4]http://nativeplants.hawaii.edu/plant/view/Sesbania_tomentosa

[5]https://www.gns.cri.nz/Home/Our-Science/Earth-Science/Regional-Geology/The-Geology-of-New-Zealand

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