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

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2020

Volume 7

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, Waimea Valley Arboretum and the University of Hawaii's Lyon Arboretum in the spring of 2013 and the spring of 2018.

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Introduction

In the summer of 2012, and in the spring of 2018 I contacted the Hawaii Department of Land and Natural Resources (Forestry Division) 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. The Goal was to collect only from cultivated specimens growing in 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 (Mesoneuron kaviaensis)***
- ***Hibiscus brackenridgeii brackenridgeii***
- ***Hibiscus brackenridgeii***
- ***Hibiscus clayii***

Currently *Polycias racemosum* and *Hibiscadelphus distans* are in the garden. 1 seedling of *Sesbania tomentosa,* two seedlings of *Mesoneuron kauaiense* are in the nursery. These 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 National Tropical Botanic Gardens

The Honolulu Botanical Gardens

The Waimea Valley Botanical Garden

University of Hawaii's Lyon Arboretum

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 2020

Due to the additional collections made in May 2018, there are new species that have been added to the list of those currently held in our seedbank, with the best represented species still being *Sesbania tomentosa.* The majority of the seed produced came from plant 4-1.

In the spring 3 *Mesoneuron* seeds were planted all of which germinated and are alive. X *Hibiscus clayii* were planted, but only two germinated with one surviving until winter, when the sole surviving seedling died. None of the Abutilon planted germinated.

Collection Year	Genus species	Remaining Seed in Seed Bank	Plants Alive at Present
2018	Abutilon eremitopetalum (Waimea Valley)	48	0
2018	Abutilon menziesii (Koko Crater)	4	0
2018	Abutilon menziesii (Waimea Valley)	21	0
2018	Abutilon sandwicense (Waimea Valley)	34	0
2013	Hibiscadelphus distans (NTBG)	4	1
2018	Hibiscus brackenridgei sbsp. Mokuleianus (Waimea Valley)	29	0
2018	Hibiscus brackenridgei subsp. brackenridgei (Waimea Valley)	14	0
2018	Hibiscus clayi (Waimea Valley)	14	0
2018	Mezoneuron kauaiense (Lyon Arboretum)	18	0
2013	Mezoneuron kauaiense (Waimea Valley)	3	0
2013	Polycias recemosum (NTBG)	1	1
2013	Sesbania tomentosa (Original Collection from NTBG)	18	0
2014-2016	Sesbania tomentosa Plant #1	494	0
2014-2016	Sesbania tomentosa Plant #2	84	0
2014-2016	Sessbania tomentosa Plant #2&3	64	0
2014-2016	Sesbania tomentosa Plant #3	60	0
2014-2016	Sesbania tomentosa Plant #4	877	0
2017-2018	Sesbania tomentosa Plant#4-1	8,918 seeds +1,501 pods	0
2017-2018	Sesbania tomentosa Plant #4-2	1,151.46 seed + 92 pods	0
2017-2018	Sebania tomentosa Plant #4-3	1,484.73 seeds +148 pods	1
	Total Seeds in seed bank	1741 bean pods at 10.7 avg = 18,628.7 + 13,094.19 seeds =31,908.86 seeds	3

I should clarify that *S. tomentosa* numbered 1 through 4 in the chart above, are from years prior and that #4 is the plant whose progeny produced the most seed. Hence 4-1, 4-2 and 4-3.

As discussed in the previous 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. Currently there is 1 third generation *Sesbania tomentosa* alive in the nursery. This plant has been assigned the number of 4-3-1. This plant will be planted in the garden this spring. With the now large volume of seed in the seed bank for this species, we have decided to not plant more of this species this year. We will focus our efforts on some of the other species now in the seed bank. We wanted to have at least one in the garden to discuss during tours.

Our *Polycias racemosum* was, until September, still in a 15 gallon pot. In September a slope directly across from the Polynesian garden was chosen as the ideal spot for planting. The slope is roughly 30 feet above the Polynesian Garden and shaded for much of the morning by the 3 story Natural Sciences building approximately 18 feet to the east. The Building is close enough to the slope that it provides some warmth overnight, particularly during the winter.

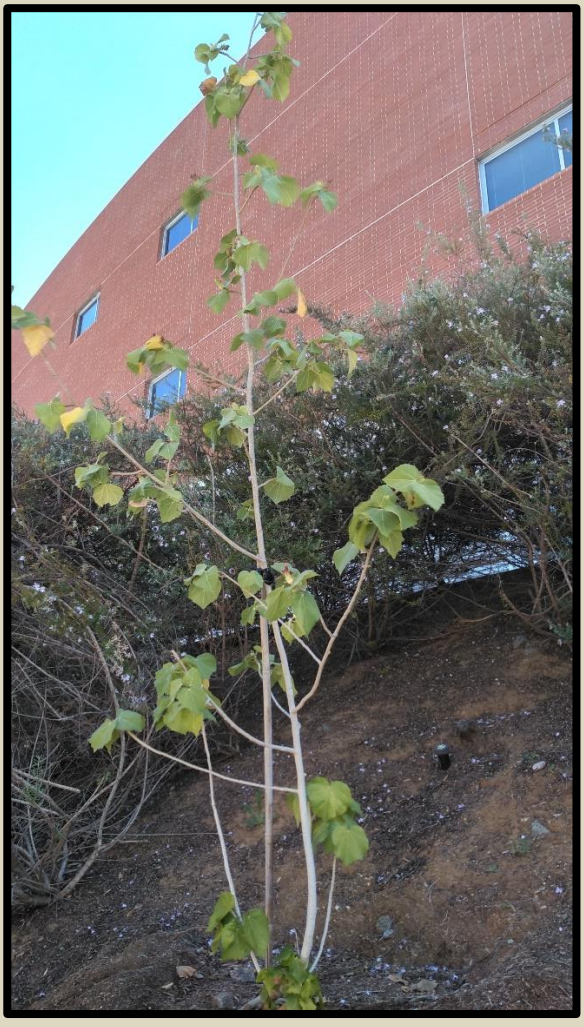
The previous image is of *Polycias racemosum* after being planted in the ground, September 2019. Below is the same plant in early January 2020.

The *Polycias racemosum* was planted in the native soil, which drains fairly well and the root zone was top mulched with a standard planting mix that we have used all over campus with great results. The location provides morning shade to the plant with afternoon sun, much of which is filtered sun.

The *Hibiscadelphus distans* performed well this year. Steady growth occurred again in spring and fall, with blooms on the plant intermittently throughout the year, though as seems to be the norm, the majority of the blooming occurred in the late winter, spring and fall months. Like last year, growth was limited, with most of the growth occurring during spring and fall. The *Hibiscadelphus* was finally planted in the ground on the same steep slope as the *Polycias* on the west side of the NS building, adjacent to the Polynesian Garden. As mentioned before, this spot tends to be a bit warmer in the winter and slightly cooler in the summer. With morning shade and a bit more full sun in the afternoon than the *Polycias*, as the *Hibiscadelphus* is lower on the slope.

While our *Hibiscadelphus distans* did produce seed capsules in late 2018 early 2019, none of the 5 seeds gathered germinated. We have discussed hand

pollinating the flowers, but have not yet had an opportunity to try this. Interestingly; like last year, we noticed ants, in amongst the flowers. They were most likely *Linepithema humile* (**Argentine Ants**). Though no seed capsules formed this year. Something else that we noticed this year is it seems no pollen is present on the anthers. Which if true, could be an interesting discovery. We will continue to monitor this over the coming years.



HIbiscadelphus distans in the garden, September 2019.

Pest/Disease Problems

Until September of 2019 none of the plants listed on our permit were in the garden. As mentioned earlier, in September a suitable location was found for the *Polycias* and the *Hibiscadelphus*. No pests or disease issues were found during the year on either of these plants.

1 *Sesbania tomentosa* planted from seed in the spring survived and to eliminate the issues with red Spider Mite, that so often are an issue in the greenhouse, this plant was moved into a well-lit area of our shade house structure. The three *Mesoneuron* plants in the green house did struggle from Golden Scale, and a mild issue with Greenhouse white fly. Unfortunately one of the three died after a hot holiday weekend. I can only assume the insects had the plant stressed and the heat wave put it over the edge. We were able to control the pests by spraying them off with a hose and relocating the plants to the shade house for a few weeks during the early fall. They were placed back into the Greenhouse at the end of October early November. During the winter, one of the plants seemed to have a very mild issue with a fungus that we occasionally see on plants in the Greenhouse during the colder months, the fungus bears a striking resemblance to *Botrydis cinerea*, though we have not confirmed this. The one *Hibiscus clayii* seedling we had also died from what was likely this same fungus.

Response to Cold

The weather this year has been slightly warmer than last year, with far fewer days of frost than last year. Rain fall was high during the fall months, tapering off through the midwinter and then returning with some heavy storms in February and March.

As mentioned above, the *Mesoneuron* did show signs of a fungal infection on a single petiole by late December. As the temperatures dropped over the winter, both plants did exhibit leaf drop. Both plants were still alive by March, with one, at the time of writing beginning to produce new leaves.

***Mesoneuron kauaiense*, in the late summer early fall of 2019.**

Like in years past, it seems both *Hibiscadelphus distans* and the *Polycias racemosum* are not bothered by our winter weather, and the *Hibiscadelphus* may actually prefer the cooler weather.

***Pritchardia hillebrandii* with frost damage early 2019. This species if not under a canopy suffers some frost damage every year. However; growth is rapid and complete recovery has typically occurred by mid-summer. The same palms can be seen below in early January of 2020.**

***Pritchardia remota* with inflorescences, January 2020. We first noticed these in September of 2019. Though they still have not opened by late February.**

Garden Areas as of March 2018

With each passing year the garden takes on a new look and feel as the plants continue to grow and flourish. Many plants in the garden are now reaching maturity, while others still have many years to go before they can begin to contribute their floral beauty to the garden and hopefully contribute seed to the seed bank.

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

The blooms of *Sapindus oahuensis*, a tree species endemic to Oahu, Hawaii growing in the Polynesian Garden on campus.

The image below shows the same tree a few weeks later with tiny green fruits developing.

Above are the fruits after they have fallen from the same tree a little over a year later.

Discussion on Pollination of Hawaiian T&E Plant Species

This year we continued to work on trying to answer the question of why/how our *Brighamia insignis* plants in the garden are producing seed. Although we did make some interesting observations, which are discussed below, we still have no clear definitive answer as to why viable seeds are being produced annually.

A paper released in August of 2019, coauthored by Seana Walsh from the National Tropical Botanical Garden indicated that self-pollination may occur intermittently. [1] I have noticed over the years that some flowers seem to have shorter styles, leaving the stigma fairly close to the pollen. Although strictly hypothetically speaking, the potential for self-pollination could be greater in those flowers, over ones with a longer style. It is possible these flowers could also be more likely pollinated by insects as well. Both statements would need to be quantitatively measured though before this could be proven or negated.

With the plants in our nursery reaching a larger size, I was able to get them planted in the landscape in March 2020. They were planted on the same slope as the *Hibiscadelphus* and the *Polycias.*

By having more *Brighamia* in the landscape this will hopefully provide us with a larger number of flowers to analyze from which we can better quantify all the variability of flower morphology. That said; as mentioned in last year's annual report, in the fall and winter of 2017, we did have two students look at overall floral tube length compared to fruit/capsule development. They found no obvious correlation. It would be good to look at style length and more specifically the distance from the stigma to the filament/anther… Not sure we would find anything, but it would be a fairly simple thing to check. Also; I have noticed that some flowers do not develop a visibly protruding style and stigma at all. Which is curious to say the least! Again, I have not had a chance to look deeper into this, but I wonder if these flowers may be functionally male, or are the female portions of the flower held deeper in the tube, below/behind the anther..?

We did have some seed production this year. Beth Pearson was able to gather and count 1,690 seed from our plants this year. In addition, a leaf sample was sent out for DNA analysis, though we have not yet received the DNA results. Beth Pearson was also able to conduct a quick study of pollen viability. Following the "Alexander's staining technique" as modified by Seanna Walsh.[1] Preliminary data produced an average of 84% viable pollen.

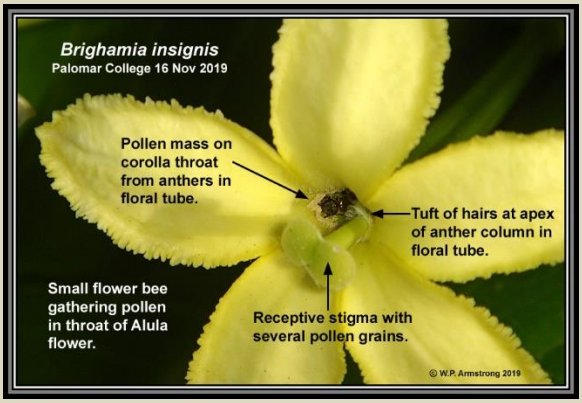
Seedlings grown from the batch of seed collected in 2018 can be seen in the photo above. 78 +or- 5 seeds were planted in December. These are the survivors as of March 10th, 2020.

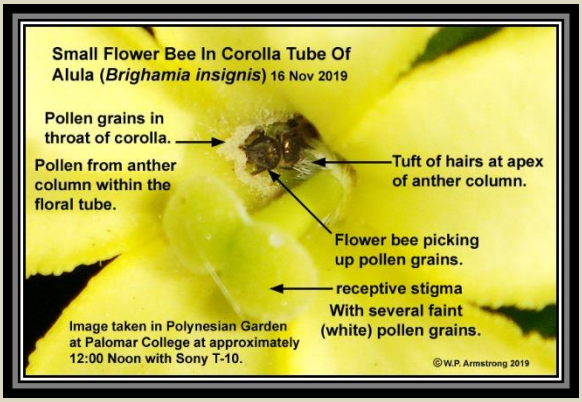
Flowers of *Brighamia insignis* at the San Diego Botanical garden. The photo above was taken late in the bloom season. Interestingly it seemed that all the flowers open on this particular plant had no stigma visible. While they may be present below the anther, it's interesting that there are no stigmas visible and that these flowers are close to senescing (dying).

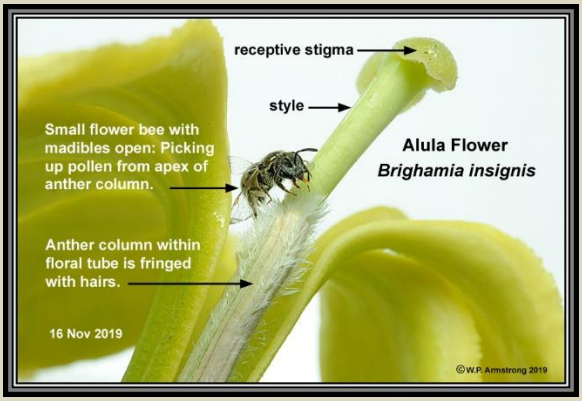
Brighamia insignis **flowers taken in the Polynesian Garden at Palomar College. Notice the ant near the corolla. This has been a recurring observation every year since the plants began blooming. The other interesting thing is that the flower in the lower bottom right does not have a visible stigma.**

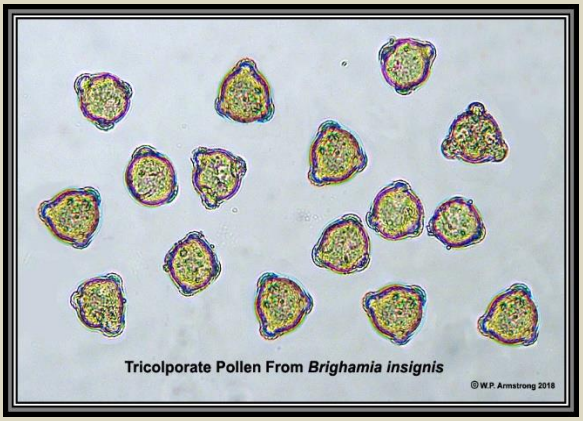
Wayne Armstrong also made an interesting observation this year. He noticed a bee of the genus *Lasioglossum* in the floral tube of one of the *Brighamia* flowers and after capturing the image, he gathered the whole flower with the bee in question to try and get a positive id on the bee species. Karl Magnacca was able to help us with identifying the genus. Wayne monitored the bee by placing the flower in a glass covered jar over the next few days. The amazing images below are from his work on this.

https://www2.palomar.edu/users/warmstrong/AlulaImagePage2.htm









Educational Outreach

An example of the new garden plant labels. [13]

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.

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 **4** 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.

Conclusion

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.

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.

A Few Special Thanks

Thanks to Wayne Armstrong for his work on the floral anatomy of *Brighamia insignis* and his help with trying to discern what might be pollinating our plants.

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Dustin Wolkis from NTBG for sending me the invite to the Hawaiian Native Seed Conference, it was a fantastic event! Mike Demotta from NTBG for his continued support and the seed we have to work with. And Seana Walsh for sharing her work with us concerning *Brighamia.*

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The San Diego Botanical Garden, for taking the time to show me their *Brighamia* plants and discussing the complexities of Ex-situ conservation with me.

The Palomar Community College Administration, Grounds staff, college staff, faculty, the Friends of the Edwin and Francis Hunter Arboretum, students and community who provide us with the much needed support. As well as everyone else who is working diligently to preserve Hawaii's native flora and fauna.

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[1] Pollination biology reveals challenges to restoring populations of Brighamia insignis (Campanulaceae), a critically endangered plant species from Hawai'i. Seana K. Walsh a, b, Richard J. Pender b, Robert R. Junker c, d, Curtis C. Daehler b, Clifford W. Morden b, David H. Lorence

[2]
https://www2.palomar.edu/users/warmstrong/AlulaImagePage1.htm
https://www2.palomar.edu/users/warmstrong/AlulaImagePage2.htm

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

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