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

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2019

Volume 6

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 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 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 2019

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 July two seed of the *Mezoneuron* from the Lyon Arboretum were planted, though by October neither survived. We have some suspicions as to why, and will try a few more this spring. In October, 6 seeds of *Abutilon sandwicense* were planted in the green house. None of these have germinated so far, but it can take months for these to germinate, so we will remain optimistic. With nearly 14 or so days of freezing temperatures this winter, two of the remaining *Sesbania* tomentosa in the garden died, though some seed was produced and salvaged. Those are included in the chart below.

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 are now living in the garden and producing 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. There is 1 second generation *Sesbania tomentosa* currently alive in the garden. 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. Instead of replacing those plants we have lost, we will focus our efforts on some of the other species now in the seed bank.

Our *Polycias racemosum* is still a short 15 gallon plant, but it is growing well. The plant is nearly large enough to be planted in the ground, though the trick will be finding a suitable location where it can flourish. In the coming years one of the buildings adjacent to the Polynesian Garden is slated to be removed and we hope to plant it then. The Hawaiian Garden at the front of campus has been considered, though there is not enough room for the tree's full-grown dimensions in this garden. This location does also get rather cold during the winter, as does the Polynesian Garden, though not any colder than the nursery location. The issue is whether there is enough room for the canopy to develop as the species definitely should be planted under a canopy to protect it from the California Sun in summer and winter frosts.

***Polycias racemosum* in the nursery March 2019.**

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 the majority of the blooming occurred in the late winter, spring and fall months. With weeks of temperatures into the 90'sF and above, the plant did not seem to be fond of the summer heat we had in 2018. During the heat waves growth seemed to stop, blooming ceased and the plant dropped many of its leaves.

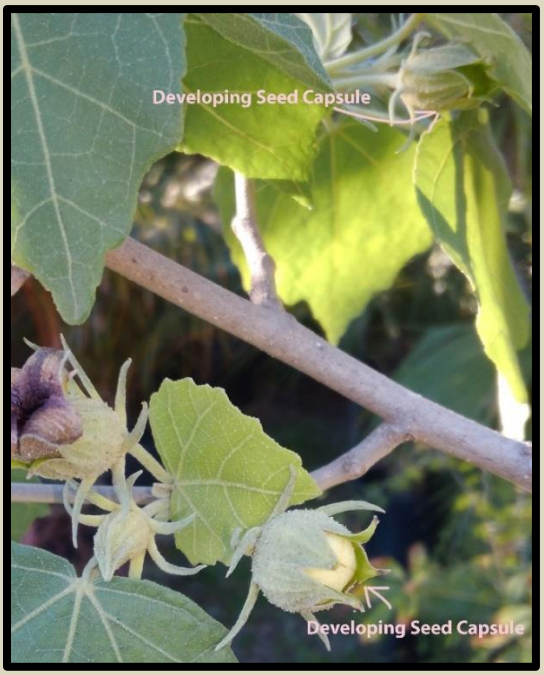
This year for the first time we noticed seed capsules developing on the plant, with two capsules located within 5-6 inches of each other. They were first spotted in December, but might have begun developing as early as November. By the first week of January one capsule seemed close to being mature, while the other seemed to have stopped developing, likely due to the cooler weather. By mid-February no new capsules had developed and there was no measurable difference in size noted on either of the ones present since inspected in January. As was the

case last year, blooming continued despite the cold. By mid-March a third capsule was discovered near the terminal growth point on the central leader, and based on its size, this capsule was likely present in December, but because it was so high up on the plant it was not seen until March.

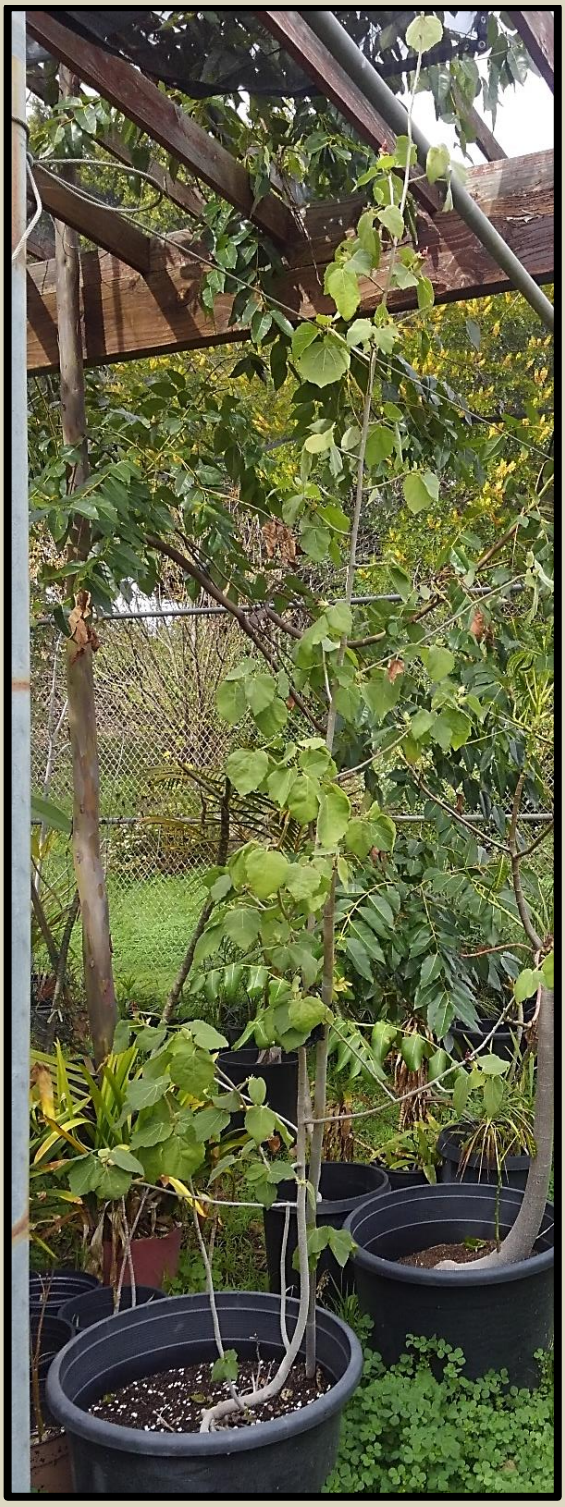
Last year we had discussed hand pollinating, but never got around to it. Interestingly; like last year, we noticed ants, in amongst the flowers. They were most likely *Linepithema humile* (**Argentine Ants**). The question remains, who/what did the pollination of the two flowers this year. We will continue to monitor this over the coming years. While the current capsules are still too young, we are hopeful that we might at least get some viable seed from our plant this year.

A close up of Hibiscadelphus distans with ants in amongst the petals of the flower.

***Hibiscadelphus distans* with developing seed capsules. In December.**



***Hibiscadelphus distans* with developing seed capsules. In January.**



***Hibiscadelphus distans* in the nursery March 2019. We moved it to a location with a bit more sun this year to test its sun tolerance. Oddly, it seems as a larger and older specimen it can tolerate more sun.**

Pest Problems

This year the plants in the garden struggled with the same two or three pests that attack them every year, though generally the infestations are mild.

The plant pests listed below have shown an affinity for the plant species currently being grown in the nursery and landscape during 2017.

- *Tetranychus sp.* -**Red Spider Mite**
- *Graphocephalla atropunctata* – **Bluegreen sharpshooter**

The three specimens of *Sesbania tomentosa* in the Polynesian Garden during the summer of 2017 again developed a mild to moderate infestation of *Graphocephalla atropunctata* (**Blue-green sharpshooter**), which caused some mild defoliation. The plants were promptly treated with a systemic insecticide, which quickly resolved the issue.

Though we have historically seen Blue-green Sharp Shooters on the plants during the warmer months, we have occasionally seen the *Homalodisca vitripennis* the (**Glassy-wing sharpshooter**) on the *Sesbania* plants as well, though rarely if ever in significant numbers. In the 2015 Annual Report, I briefly mentioned the possibility of Pierces Disease being vectored to the *Sesbania* plants in the landscape by the **Glassy-wing sharpshooter**. We received permission from the USFWS to send out samples to a plant pathology Lab to be tested for **Pierces disease** in 2018. All the samples from the three plants submitted came back as negative for *Xylella fastidiosa*, (which is the bacteria that causes **Pierces disease**). Since the bacteria was not found in our samples and has never been recorded as being vectored via seed, we can assume the seeds should be free of the disease as well. It was determined though, that the plants were positive for two fugal agents. *Alternaria alternata* and *Fusarium oxsporum*. Both of these diseases are reported to be common throughout the globe and are typically known to attack many species across a diverse range of Genera

and Families. [1], [2], [3], [4] Until it can be verified that these fungi are not a threat to plants in Hawaii, and that our seed is not infected with either of the fungi species, it would be prudent at this point to not consider moving our seed back to the islands. The other issue to consider if the seed is ever requested for restoration work, is that the genetic diversity of our seed will likely be low, due to the fact that they were harvested from only a few plants with the same parental lineage. That said; the seed will be kept in our seed bank until they are requested by approved institutions.

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 30s Fahrenheit.

This year heavy storms began to arrive in November and have been consistent, with at least one rain event nearly every two weeks. The first of the frost arrived in December and was present the morning following most of our storm events. One storm provided over 5 inches of rain in a 24hr period. One or two nights/early mornings in late December dipped to a few degrees below 30. While we have had more mornings with frost than we have had in years, possibly a decade. The lowest temperature ever recorded was during the 2006-2007 winter, when the campus reached a record of 24f.

Sadly two of the *Sesbania tomentosa* plants in the garden did die this winter, both of which died from apparent root rot, no doubt from one of the afore mentioned fungi. Last year at this time 4-1, the largest specimen, looked to be on the decline. Fascinatingly it recovered and began to re-leaf and bloom. Unfortunately it was one of the plants to die this winter, with root rot the most likely cause. 4-3 at this time last year looked equally as bad, but as the weather warmed it grew back with vigor and stretched out into the sun. It is now the last specimen in the garden, and does not look good, but again we will leave it to see if it will recover again.

Rotten roots of *Sesbania tomentosa* 4-1 in January of 2019.

After many years of trial and error I think we can now safely say that at least in California *Sesbania tomentosa* is short lived. The cold winter weather is definitely a factor, as may be the heavy soils. It is possible the combination of the two promote the growth of the fungi and once the plants are stressed they succumb.

Again this year it seems *Hibiscadelphus distans* prefers the cooler weather, as blooms are only present in the winter, spring and fall.

***Pritchardia hillebrandii* with frost damage. 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.**

***Scaevola taccada* and *Pritchardia remota* with mild frost damage. Both will recover by early summer and fall respectively.**

Response to Shade

As the *Hibiscadelphus distans* grew, it was moved to a larger pot and as a result became exposed to a bit more sun than in the last few years. Growth was not measuredly faster than in the previous year, however; flowering was substantially more prolific, though this could be a function of age and size of the plant, not directly due to more sun exposure. At this point I would still contend that *Hibiscadelphus distans* and *Polycias racemosum* seem to prefer at least some shade over full sun here in Southern California, which seems concurrent with the previous assumption that they may prefer cooler temperatures that are likely more similar to those of their native range.

Alternately, *Sesbania tomentosa* still seems to not prefer shade at all. All the plants that have been planted in the shade over the years, died within a few months, or stretched out towards the sun.

Garden Areas as of March 2018

Despite the cold, growth has been steady in the garden this year. We also were able to get the entire Polynesian Garden registered as a Wildlife Habitat, with the National Wildlife Federation. In part, due to the large trees, flowing water and use of natives amongst the Polynesian plants.

The image above shows the north side of the newly constructed Library. The plants in this bed will focus on California natives and utilize many of the same grasses planted nearby in the Madagascar and Polynesian Gardens. The black liner in the photo is the underlayment for a storm water bio retention basin. The goal being that the water will filter through the soil and plant roots before reaching the drain at the bottom and then flowing down stream.

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.

Discussion on Pollination of Hawaiian T&E Plant Species

During my trip to Oahu in May of 2018 I had the amazing opportunity to attend and speak at the Hawaii Native Seed conference. This proved to be a fantastic opportunity to make the acquaintance of many bright and wonderful people who are working diligently to save Hawaii's unique and rare flora. During the course of conversation the subject of invasive species came up many times, as did plant pollinators, and it prompted me to look closely at some things I typically took for granted. I apologize if I jump around a bit over the next few paragraphs, but I promise to get to a point where I will explain my thought process and where it led me.

In California, the palm tree we know as the Mexican Fan Palm (*Washintonia robusta*) is a non-native species, though it is very closely related to the only palm truly endemic to California. *Washingtonia filifera* or the California Fan Palm. In fact, despite its ornamental value, *W. robusta* is considered a nuisance and invasive weed in many parts of the south west. This due to its rapid growth and the tens of thousands of seed a single plant can produce each year.

So how do these palms have anything to do with Hawaii? Well, in 1997 when I first visited Oahu I discovered *W. robusta* grew very nicely in the state. However; the species was not weedy like it is in California. In fact, over the years I could find little to no seedlings under any of the specimens I found on the islands. I always thought that to be peculiar, and assumed it must be related to some environmental conditions, or maybe a pathogen. On this most recent trip I made to the islands, I again (like every time before) noticed that under each *Washintonia robusta,* I was lucky if I found more than 10- 12 seedlings. In my own yard in north San Diego County I pull at least 10-20 times that number every 5-6 months. In California, as soon as the palms begin to bloom, bees are typically swarming around the flowers. Shortly after that the tiny fruits develop and then seeds begin to fall. What didn't dawn on me then, was that I saw few bees on the entire inflorescence of any Washingtonia palm I have seen blooming in Hawaii.

Let's hop back to Sesbania tomentosa for a bit. You see, it seems those growing *Sesbania tomentosa* on the islands have a very difficult time producing fruits,

much less seed (peers com). Apparently the plants are often attacked by stem boring beetles, the fruits and seeds are most often decimated by seed weevils, and that is if they are lucky enough to even get bean pods to develop at all (peers comm). As I pondered these statements it dawned on me that in the summer and fall of 2017, I had seen countless bees swarming the *Sesbania tomentosa* in our Polynesian Garden on campus. In fact, I recalled every year when the plants were in full bloom the bees were seemingly happy to visit the beautiful flowers of the Ohai.

***Sesbania tomentosa* in the Polynesian Garden. This is plant 4-1 on the seed list, which provided us with the majority of the seed harvested in 2018. The photo was taken in September 2017.**

So are the bees in California pollinating the Ohai flowers? Have they allowed us to harvest seed every year? With 2018 providing us with tens of thousands of seed! The answer is quite possibly yes!!

***Sesbania tomentosa* at the Palomar College San Marcos Campus Summer/Fall 2017. Notice the bee in the lower left corner.**

A close up of the more mature flowers with exposed stamens, anthers and pistils. The bee on the bottom left is likely an *Apis* species.

Ok, so now I can begin to tie all this together. I had been pondering all this while on a walking tour of the beautiful grounds of the University of Hawaii, Manoa campus. At some point during my train of thought, someone pointed out a single bee hovering over flowers on a nonnative shrub nearby. Which was awesome!!! The problem was that it was the only bee to be seen anywhere in the general vicinity, on a shrub loaded with flowers! At this point I finally put it all together and realized I had rarely seen many bees on any of the Hawaiian Islands over the many years and trips I had made. I am sure I saw them, but was positive that I had never seen them in swarms, like I so often do here in California. I later asked a few friends who live on the islands and they agreed, swarms of bees are not a common thing to see on the Islands.

Later on the same tour of the UH, Manoa campus, I was led to a planting of some beautiful growth forms of *Sesbania tomentosa*. This form had fantastic silver green foliage instead of the green foliage of the form we have historically grown at the college. The flower color was a tad bit more orange than red and what struck me was again no bees. Granted the plants had only a few flowers on them, but it was actually something else that I thought was so strange. There were no reproductive parts of the flower visible. This was in stark contrast to what I recalled our plant

produced. I even recalled taking a photo of our plant that day in 2017 when I noticed the bees swarming our plants, and was certain I had managed to take one photo of a bee about to land on the stamens of a particular flower. (Image seen above) It was not until I got home and compared the images that I discovered *Sesbania tomentosa* flowers do not have exposed pistils and stamens until the last stage of development. The primary reproductive parts of the flowers remain covered until just before the flower petals are about to senesce (fall off) from the flower. This can also be seen in the image above.

***Sesbania tomentosa* at the University of Hawaii Monoa, May 2018.**

Another interesting revelation was that the flowers are a vibrant red before the pistils and stamens are accessible externally. Which seemed odd, as to my recollection many flowers are most vibrant when the above flower parts are most receptive. This flower color variability is fairly common in the plant world [5], but typically from my experience pollen and stigmas are most viable/receptive when the flowers are at their most colorful stage. Flower color has been shown to have a direct correlation with pollen availability and flower odor, which directly affects the likelihood of visitation by specific pollinators. So it is likely that the bees may be attracted to the scent over the color of the flower, though the color may be seen by the bees differently then we perceive it, as their eyes perceive color similarly to ours, though more in the blue and infrared spectrum. [6], [7], [8]

I then got to wondering, where are the pollinators on the Islands, specifically the bees?

A relative of the Polynesian native *Hibiscus tiliaceus*; this *Taliparti elatum* from Jamaica shows the inverse colors from *Sesbania*. Starting out orange and fading to red.

It turns out the Hawaiian bees are mostly endemic (found no place else naturally) and in fact, due in part to habitat destruction, many are now listed as endangered, particularly the lowland species. [9] The 6 bees now listed by the USFWS are in the genus *Hylaeus*. Karl Magnacca states at the time his article for the University of Hawaii Master Gardener program was written, “63 known species of bees are endemic to the Hawaiian islands”. Many of these bee species had specific Hawaiian plants that they would pollinate and had specific habitats that they required to nest in. He also states that *Sesbania tomentosa* was also pollinated by at least one of these species. His article can be seen here.

https://www.ctahr.hawaii.edu/uhmg/news/V9-Magnacca-NativeBee.pdf

It’s easy to surmise that as the lowland rain forest was denuded for agriculture and urban sprawl many if not most of the other species of plants the bees depended on were removed from the ecosystem, only to be replaced by no native plant species that the bees could not or would not harvest pollen from, and could not nest in. [10] This from an article found on the web and confirmed when I had a chance to discuss Hawaiian bees with Dr. Jason Graham, who is working on the plight of Hawaiian native bees. His Facebook page can be seen here.

https://crownbees.com/blog/help-hawaiian-bees/

Jason and I also discussed the probability that in some cases the introduction of pests and pathogens may also have played a role in the decline of the local flora and more specifically the native bees.

It is possible that in the Polynesian garden on campus, there could be a link between bee activity and the availability of pollen from other plants in the surrounding area. For instance, *Sesbania* flowers were seen on the plant intermittently through the year, (minus the winter months) though bee activity on the Ohai seemed to be at its peak in the late spring and summer months. During this time of year the many *Metrosideros collina* trees have already been blooming for a few months. In addition, spring and summer is the time of year countless other plants are blooming on campus, including the sweet potato varieties in the garden. It is possible that the bees might be attracted by the profusion of pollen from the other nearby plants and while in the vicinity they visit Ohai in the garden. If this hypothesis could tested and shown to have some semblance of supportive data, it could be further fuel the argument that in the wild the decimation of the other native plant species that once attracted the native Hawaiian bees, has contributed to the decline of *Sesbania tomentosa.*

Another struggling species that the loss of Hawaii's bees and habitat could very likely be linked to is *Pritchardia munroi*, a critically endangered species of Loulu palm from Molokai. Frustratingly this palm species seems to rarely produce viable seed, even in cultivation at the many botanical gardens on the islands. In addition the many native and endangered species of Hibiscus and Abutilon (which are members of the *Malvaceae* family) do not produce much if any viable seed. Particularly when compared to the number of blooms the plants produce annually. When I was collecting seed from the gardens last year I found very few viable seed on any of the endangered *Malvaceae* species. In some cases seed was present, but when I conducted a float test to check for viable seed, nearly all floated on the waters surface. For most plant species non-viable seed floats, so to be sure these *Malvaceae* were not an exception, I checked the floating seed for embryos by cutting a few open. Sadly all of those cut open were empty and the few I cut open that sank, did in fact have an embryo inside.

In the spring of 2018 Wayne Armstrong; a former botany instructor and board member for the FEFH Arboretum, did a small article in the Friends of the Edwin and Francis Hunter Arboretum newsletter. The article covers the *Brighamia insignis* (**Alula**) plants that we have had for years. These were grown from seed provided by the San Diego Zoo. Interestingly in the fall of 2016 one of the plants produced capsules that contained tiny seed. We decided to gather the seed to see if it was viable. To our surprise the seed was indeed viable. As a result of the planting effort we ended up with a few seedlings from the experiment.

Roughly 2 year old Seedlings of *Brighamia insignis* in the nursery. Grown from the seed harvested in 2016 off of the plants grown from the seed originally provided by San Diego Zoo.

Seed Capsules developed again in 2017 and in the fall of 2018 two of our Alula plants produced seed that looked to be viable. In March of 2019 some of the seed from 2017 was planted to test viability. If they are viable we should have seedlings again within a few months.

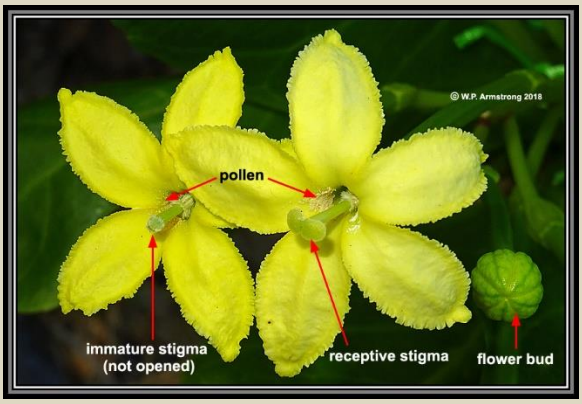
The question remains, what is doing the pollinating? Some have assumed it might be ants, while others have suggested it might be a California native hawkmoth? Whatever is doing the pollinating on campus, it is apparently not present on the Hawaiian

Islands to pollinate the plants in the wild. Without a pollinator, no seeds can develop. In addition to habitat destruction the lack of a pollinator has driven this species to inevitable extinction in the wild, as apparently only one specimen remains alive in habitat. [11] The plant is thankfully popular in cultivation, but sadly is not likely to ever be found in the wild again.

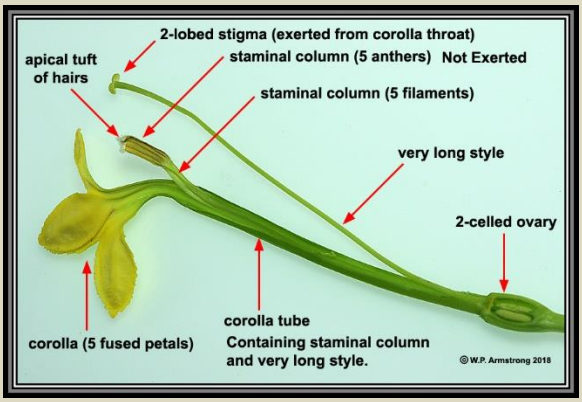
This year in an attempt to answer the question of what is pollinating our Brighamia insignis, we were able to have two students help Beth Pearson, our Botany/Biology instructor here on campus monitor the flowers as they developed. The results were interesting, but arguably not all that conclusive. However; we can say from video footage taken with a camera set to go off once every second, that many different insects seemed to have visited the flowers at night. During the day, only ants were seen on the flowers. The ants were seen crawling on most of the external surfaces of the flower, in some cases through the pollen, which is found at the opening of the floral tube. [12] They may have also traveled down the floral tube, possibly looking for nectar. At this point we can confidently say the ants have traversed through the pollen, though we cannot confidently say the pollen was transferred to the stigma at the end of the pistil, when the stigma was receptive. Until we can confirm pollen will stick to the ants and then confirm the ants, while laden with pollen have traversed across the receptive stigma, there is no way to conclusively state that the ants are pollinating the flowers.

In the fall of 2018 Wayne Armstrong was able to conduct a fairly comprehensive dissection of the *Brighamia insignis* flowers and ovaries. That can be seen at the link below.

https://www2.palomar.edu/users/warmstrong/AlulaImagePage1.htm



Courtesy of Wayne Armstrong, who took this photo in the fall of 2018 in the Polynesian Garden on Campus.



Courtesy of Wayne Armstrong, who took this photo in the fall of 2018 in the Polynesian Garden on Campus.

The two images above were taken and provided by Beth Pearson in the fall of 2018. Notice the ants on and in the flowers of *Brighamia insignis*.

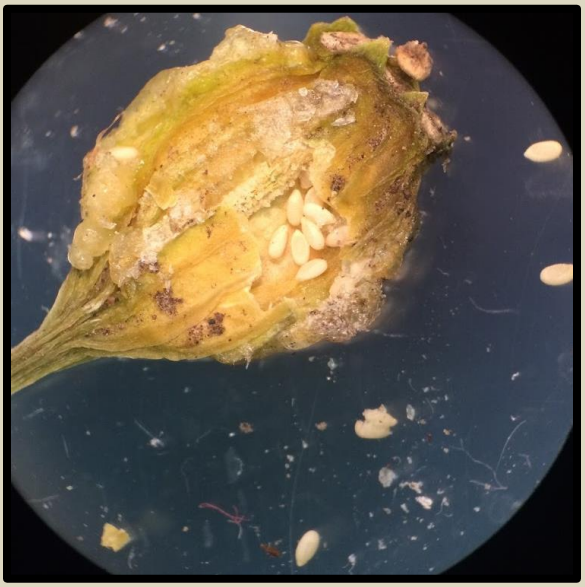
All of the 7 dark and admittedly blurry images below are from the 2nd of three videos taken by a camera placed in the garden to monitor the *Brighamia* flowers at night.

Because the images are too difficult to be truly helpful, we will continue to work to try and get better images next fall. Though the video clearly shows that many small insects are visiting the blooms. Many of the insects are small, possibly no bigger than 2-3 centimeters or 2/32 of an inch, while others may be as large 4 or 5 millimeters or roughly 1 and ½ to nearly 2 inches long. If you look at the top center of the first image, you will see what looks to be a small possibly orange insect. In the following image it is right center, in the next image it is bottom right; seemingly flying through the air. Then right center again.

The links to the video above and the other videos taken in the fall of 2018 are below.

https://photos.google.com/share/AF1QipMew_qfd5w6k1fSRMwbwaOn3HwMmeUTIkF9b-lo1aUByPH_iPnFt-dZ2Sz9DdRTDg/photo/AF1QipOvbfXceT1eW5rl3YQelM1c0vyOLBcAMI7Uebub?key=WkFEQmdYMFdqYzAyb0pMRkowcVQ2QXdYZlNhT1dR

This year our two of our 5 *Brighamia* in the garden produce seed capsules and yielded at least 3,582 seed, which we have added to our seed bank. The plants no doubt produced more, but the seed capsules mature sporadically and the tiny seed drops out quickly. We also noticed that the two specimens that bloomed received more sun throughout the year and were a bit on the drier side than the other three specimens in the garden. Interestingly; one of our plants in the nursery had been knocked over by the feral cats that roam the area and thus was not getting the same amount of water as the others. That drought stressed plant began to produce flower buds, as can be seen in the image below, though they did not continue to develop and aborted as the season went on. The effect of variable environmental factors on the blooming cycle of *Brighamia insignis* will definitely be something we continue to look at this coming year.



Seed capsule and seed of *Brighamia insignis* harvested from one of our plants in the garden.

***Brighamia insignis* in the nursery with what look to be floral buds developing.**

***Brighamia insignis* in the garden with floral buds in early development.**

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.

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