Forest Restoration in the Hakalau Forest National Wildlife Refuge

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Introduction

The Hakalau Forest is a National Wildlife Refuge located on the Windward side of Mauna Kea, on Hawai'i Island. It was established in 1985 to study Hawaii's Native forest birds and find solution to manage and protect them and their natural habitat. The Hakalau forest in about 32,733 acres and is home to a diversity of birds and plants native to Hawaii. Located at elevations between 2000 to 6000 ft., the refuge is above the mosquito line of the Big Island, protecting the birds from introduced mosquito-borne diseases like the Avian Malaria. The restoration of the Hakalau forest is a crucial task to allow endangered bird populations to reproduce and allow the growth of native plants. This restoration work consist mainly in the out planting of native trees to recreate a forest. They are highly reliant on the *Acacia koa* who's leaf system plays an important in restoration work.

Figure 1 : *Acacia koa* (Koa) in the Hakalau Forest National Wildlife Refuge , Big Island, HI

Restoration and Conservation work

The *Acacia koa* or Koa, is an endemic flowering tree to Hawaii who belong to the legume family. Legume have nodules on their root system which are home to nitrogen fixing bacteria (*Rhizobium spp.*). Planting koa is a natural way to fertilize soil in nitrogen without having to use chemical fertilizers [3]. The Koa "leaves" are modified petiole with a characteristic sickle shape that collect the moisture naturally present in the air. Droplets of water form at the end of the phyllodes and drop to the ground, providing water to the plants growing under the Koa. In addition to these two abilities, the Koa grow relatively fast (2.2 m/year) make it an ideal candidate for forest restoration works.

Ecology Club at KCC's experience in the Hakalau Forest

In Fall 2018, the Ecology Club at KCC worked with the refuge staff on a site of the Hakalau forest that was out planted with Koa in 1997. In 2018, the Koa trees are tall enough to cover and shade frailer native plants. We hope that the with the nitrogen and water provided by the Koa, those plants will be able to grow and thrive in their new habitat. We planted a total of 512 plants. Immediate results cannot be seen, however, a similar project has be done a few years before. We can use this site as our theoretical "after" stage of our project.

Table 1 : Native species of plants out planted by the Ecology Club members in Fall 2018

Name of the Plant	Hawaiian Name	Number of individuals
Acacia koa	Koa	16
Metrosideros polymorpha	'Ōhi'a Lehua	444
Cheirodendron trigynum	'Ōlapa	12
Vaccinium reticulatum	'Ōhelo	32
Chenopodium oahuense	'Aweoweo	8

Figure 2 : *Clermontia lindsayana* ('Ōhā Wai) propagated in the greenhouse of the Hakalau Forest NWR.

Restoration Effort : the Example of the Oha Wai

The *Clermontia lindsayana*, or 'Ōhā Wai, is a critically endangered plant that is being reintroduced to the wild through the efforts of multiplication of researchers, and volunteers at the Hakalau Forest NWR. Only 24 of them are naturally present in the wild (pers. comm. B. Horiuchi).

In 2008, a particular line of Ohia Wai, under the identification of JJ0382698 CLE LIN, has been out planted in the wild under Koa trees. The results show that the reintroduction was successful, and the Ohia Wai are now about 4 to 5 ft tall. This example confirms that restoration work are successful and demonstrate the importance volunteer work in the refuge.

Figure 3 : *Clermontia lindsayana* ('Ōhā Wai) successfully reintroduced in the Hakalau Forest in 2008.

Conclusion

Restoration of native forest is a slow process that takes time. Results only show after several decades. However it is an important process that helps preserving Hawaii's native species of birds and plants. We, as the second generations of planter, are witnessing the positive impact of the labor of the first generation. Planting Koa trees is a key element before being able to plant anything else in the forest. The Koa's botanical abilities are highly enhancing the viability of planted trees which encourage us to continue the restoration by planting other forest plant species but also other Koa so that we can pass on the duties to future generations.

References

1. Native Plants Hawai'i, *Acacia koa*, Retrieved from : http://nativeplants.hawaii.edu/plant/view/Acacia_koa
2. Pejchar, L., & Press, D. M. (2006). Achieving conservation objectives through production forestry: the case of Acacia koa on Hawaii Island. *Environmental Science & Policy*, *9*(5), 439-447.
3. Pearson, H. L., & Vitousek, P. M. (2001). Stand dynamics, nitrogen accumulation, and symbiotic nitrogen fixation in regenerating stands of Acacia koa. *Ecological Applications*, *11*(5), 1381-1394.

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