WR Committee

From: Art Medeiros <artcmedeiros@gmail.com>
Sent: Monday, March 19, 2018 4:24 PM
To: WR Committee
Cc: Auwahi office and admin
Subject: Re: WR-5, Watershed Management and Protection
Attachments: Auwahi-DWSFY16-WC0874-second quarter progress report.pdf; Auwahi-DWSFY16-WC0874-third quarter progress report.pdf; Auwahi DWSFY16 WC0874 final report.pdf; Auwahi-DWSFY16-WC0874-first quarter progress report.pdf; Auwahi-DWSFY17-WC0908-second quarter progress report.pdf; Auwahi-DWSFY17-WC0908-third quarter progress report.pdf; Auwahi-DWSFY17-WC0908-first quarter progress report.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Aloha no

As requested, here are quarterly and final grant reports for 2016 and 2017 to DWS from the Auwahi Forest Restoration Project. No final report has been prepared for 2017 as of yet as funds close out at the end of this month. FY2018 spending has not begun and as such there are no reports.

mahalo, Art

Arthur C. Medeiros, Ph.D
Program Manager
www.auwahi.org
Auwahi Forest Restoration Project

Working with `Ulupalakua Ranch to protect Auwahi, one of Hawai'i's last and best sanctuary forests...

On Mar 16, 2018, at 8:36 AM, WR Committee <WR.Committee@mauicounty.us> wrote:

Mr. Medeiros,
Please review attached correspondence for response to the Maui County Council's Water Resources Committee. The hard copy is being mailed to you as well.
Thank You,
Water Resources Committee staff

<Correspondence to Auwahi Forest Restoration Project 03-15-2018.pdf>

Auwahi Forest Restoration Project first quarter progress report to the Maui County Department of Water Supply for Watershed Grant Contract #WC0874

Progress from May 18, 2016 – August 18, 2016

PROJECT BACKGROUND

In 1997, working with `Ulupalakua Ranch, regional scientists and conservationists, the Auwahi Forest Restoration Project (Auwahi project for short) began evaluating the potential of restoration of non-native pastoral lands back to the native watershed forest. Successes in reforestation at an initial experimental restoration area spurred the interest and increasing commitment of the ranch in watershed restoration. Watershed conservation on `Ulupalakua Ranch lands is intended to enhance regional water resources, moderating drastic annual fluctuations of water availability, characteristic of southern Haleakalā, as well as protecting biological and cultural resources.

The Auwahi project has developed numerous restoration techniques, of these, the most successful and widely used by other watershed protection groups is the use of native shrubs as nurse plants or ecosystem engineers to deter re-invasion by non-native species. The restored understory creates semi-shaded, moist microhabitats conducive for establishment of native tree seedlings, and allows for a dramatic reduction in the use of herbicide required for invasive weed management. With this technique, after 15 years, cover of native species increased (10%-98%) while non-native species decreased (87%-2%). These reforested plots now demonstrate improved hydrologic function compared to adjacent non-native grassland plots.

After nearly 20 years in operation, the Auwahi project is regarded by many natural resource managers as one of the most successful reforestation effort in the Hawaiian Islands. The project provides a tangible demonstration site of long-term watershed forest restoration achievable with appropriate management techniques. Techniques developed at Auwahi are now accepted as important management options, expanding an often limited toolbox used throughout the State by multiple land managers.

Working in close collaboration with `Ulupalakua Ranch, the Auwahi project, with a staff of four, coordinates restoration, management and research activities at Auwahi forest interacting with regional scientists and coordinating community volunteer efforts. The Auwahi project is founded on the principles that with responsible supervised leadership, community volunteers can engage in meaningful highly significant volunteer labor. Community volunteer events provide an uncommon type of high impact environmental education while directly involving participants in the process of restoring Maui's watershed areas. Since 2000, over 1,800 Maui residents and visitors have donated over 38,000 hours in planting more than 130,000 native tree seedlings back into Maui's watershed. During our regular volunteer trips, the community learns about Maui's watersheds and participates in its protection and restoration, while tracking the growth of new restored watershed areas.

TASKS COMPLETED DURING FIRST QUARTER

Goal/Objective #1. Manage ungulates in high priority areas.

Conduct fence inspections of existing fences at Auwahi. The Auwahi project inspects and maintains all its restoration exclosure fences to ensure that ungulates are excluded from these areas. The entire length (two miles) will be inspected by staff on foot or by 4x4 vehicle. Auwahi project will conduct fence inspections every three months and as needed after severe weather. Fence breaches and/or animal ingress will be noted and mapped. Minor fence repairs will be made immediately upon discovery during fence inspections. Any major repairs will be made as soon as the appropriate materials, tools and staff can be deployed to the site.

During this first quarter we inspected all Auwahi restoration area perimeter fences. No repairs were required this quarter. The fences are in good condition.

Goal/Objective #3. Expand out-planting of native species to rebuild watershed function.

Plant 2,000 native trees with community volunteers on conservation-dedicated lands at Auwahi forest, Maui. Forest restoration at Auwahi continues with outplanting of high quality seedlings from seeds collected regionally and grown by Native Nursery Inc., Ho'olawa Farms, and 'Ulupalakua Ranch nurseries under strict phytosanitation protocols. Seed source and outplanting site are tracked. Auwahi staff and community volunteers will plant 2,000 high quality native tree seedlings in dedicated conservation areas. The current planting strategy is to augment tree diversity in previously planted areas until the project has adequate funds to take on a new exclosure.

On the three volunteer trips this quareter we have planted 340 native plants of four different species (*Alectryon macrococcus var. auwahiensis, Chrysodracon auwahiensis, Nestegis sandwicensis, and Osteomeles anthyllidifolia*) in the Auwahi restoration areas.

Figure 1. Volunteers gather around a newly planted mahoe seedling.

Figure 2. Trays of 60 healthy mahoe seedlings to be planted on July 30, 2016 volunteer trip in Auwahi III exclosure.

Goal/Objective #4. Control high priority invasive plant species.

Control priority invasive plants within Auwahi restoration areas.

The Auwahi project focuses its weed management efforts both within fenced restoration areas and outside of fences where incipient populations of priority invasive species threaten watershed forest restoration trajectories. Two priority species that pose the greatest threat to Auwahi restored forests are tree poppy or bocconia (*Bocconia frutescens*) and glycine *(Glycine wightii*). The Auwahi project will conduct priority invasive species control within the forest restoration areas to limit the establishment of priority invasive weeds and their seed banks in order to optimize the survival of native forest seedlings and restoration trajectories.

This quarter we conducted sweeps through Auwahi restoration areas to control bocconia and glycine. On our volunteer restoration trips we opportunistically controlled these priority species with many hands pulling many seedlings of bocconia as well as other invasive species inside the restoration exclosures. Due to an unusually wet period during summer months, there have been increases in bocconia recruitment and especially concerning is the advancement of glycine. Due to this situation, we have initiated a collaborative effort with `Ulupalakua Ranch operations and managers to conduct flash grazing with a large heard of cattle around the perimeter of Auwahi to graze down glycine and attempt to stimulate a denser kikuyu grass mat as weed prevention. We are finding this technique very successful in suppressing target weeds. Flash grazing appears to be an excellent method to prevent weed spread, seed bank establishment and minimizes herbicide use in adjacent non-restored pasture lands.

Figure 3. Large herd of cattle flash graze the perimeter of Auwahi forest restoration areas to suppress target weed species, especially glycine and bocconia in the adjacent pastures.

Goal/Objective #6. Build support for watershed management by conducting educational, outreach, and volunteer opportunities.

Conduct 6 volunteer trips. The Auwahi project will continue to engage with the community in meaningful volunteer work and outreach efforts. Not only do these events provide opportunities to educate the public about the value of watersheds, they also directly involve participants in the actual process of caring for, and contributing to restoring these important areas. Volunteers are provided an overview of the importance of forest restoration and Maui's natural history, the identification of plants, ethnobotanical resources and findings from recent ecohydrology research efforts at Auwahi. Volunteers participate in a variety of management and research activities including weed control, out-planting and seed collection.

This quarter the Auwahi project conducted three volunteer restoration trips in Auwahi forest restoration areas on May 21st, June 25th and July 30th. On these trips 61 volunteers contributed 436 hours collecting seeds of *Peperomia tetraphylla*, *Santalum haleakalae* var. *freycinetianum*, and *Leptecophylla tameiameiae*, pulling invasive plants, and planting 340 native plants of four different species in the Auwahi restoration areas.

Figure 4. Group of volunteers gather to learn about native watershed forests before entering Auwahi II restoration area on June 25th where they planted some incredibly rare mahoe (*Alectryon macrococcus var. auwahiensis*) saplings back into Auwahi for the first time since 2000.

Figure 5. Handful and bag full f pūkiawe (*Leptecophylla tameiameiae*) fruit, an important native nurse shrub that we would like to propagate and outplant in Auwahi.

In addition to our volunteer trips, we also hosted 3 outreach and education tours of Auwahi forest restoration area on July 18th, August 13th and 21st for the Frost Family Foundation, `Ulupalakua Ranch landowning Erdman family, and the Hālau Ke`alaokamaile. On these trips, 54 participants learned about the natural history of Auwahi and leeward watershed forests, the history of the Auwahi project, results from scientific research conducted at Auwahi, and ethnobotanical significance of Auwahi.

For nearly two decades we have practiced meticulous decontamination of gear by scrubbing boots and inspecting backpacks for hitch-hiking seeds. Now due to the immediate threat to our watershed forests posed by rapid `ōhi`a death (ROD) we have initiated a specific ROD decontamination protocol of scrubbing each participants boots with alcohol before they enter Auwahi. Before each trip to Auwahi we educate participants about ROD, its threats and the consequences of losses of our native watershed forests due to invasive species.

Figure 6. Before volunteer trips all participants decontaminate boots and backpacks to prevent the spread of invasive plants and ROD in watershed forests.

Auwahi Forest Restoration Project's final report to Maui County's Department of Water Supply for the Watershed Grant Program FY 2016

WC-0874 May 19, 2016 through May 18, 2017

BACKGROUND

In 1997, working with `Ulupalakua Ranch, regional scientists and conservationists, the Auwahi Forest Restoration Project (Auwahi project for short) began evaluating the potential of restoration of non-native pastoral lands back to the native watershed forest. Successes in reforestation at Auwahi 1, the initial 10-acre experimental restoration area, spurred the interest and increasing commitment by the ranch dedicating pasture lands to watershed restoration. Watershed restoration on `Ulupalakua Ranch lands is intended to enhance regional water resources, moderating drastic annual fluctuations of water availability, characteristic of southern Haleakalā, as well as protecting biological and cultural resources.

The Auwahi project has developed numerous restoration techniques, of these, the most successful and widely used by other watershed protection groups is the use of native shrubs as nurse plants or ecosystem engineers to deter re-invasion by non-native species. The restored understory creates semi-shaded, moist microhabitats conducive for establishment of native tree seedlings, and also allows for a dramatic reduction in the use of herbicide required for invasive weed management. With this technique, after 15 years, cover of native species increased (10%-98%) while non-native species decreased (87%-2%). These reforested plots now demonstrate improved hydrologic function compared to adjacent non-native grassland plots.

After nearly 20 years in operation, the Auwahi project is regarded by many natural resource managers as one of the most successful reforestation efforts in the Hawaiian Islands. The project provides a tangible demonstration site of long-term watershed forest restoration achievable with appropriate management techniques. Restoration techniques developed at Auwahi are now accepted as important management options, expanding an often limited toolbox used throughout the State by multiple land managers.

Working in close collaboration with `Ulupalakua Ranch, the Auwahi project, with a staff of four, coordinates restoration, management and research activities at Auwahi forest interacting with regional scientists and coordinating community volunteer efforts. The Auwahi project is founded on the principles that with responsible supervised leadership, community volunteers can engage in meaningful highly significant restoration work. Community volunteer events provide an uncommon type of high impact environmental education while directly involving participants in the process of restoring Maui's watershed areas. Since 2000, over 4,500 Maui residents and visitors have donated over 38,000 hours in planting more than 130,000 native tree seedlings back into Maui's watershed. During our volunteer trips, the community learns about Maui's watersheds and participates in its protection and restoration.

GOALS/OBJECTIVES

1. Protect and restore native Hawaiian watershed forest at Auwahi with ungulate-free restoration sites. Inspect and maintain two miles of existing fencing at Auwahi to ensure no ungulate incursion.
2. Continue on-going forest protection and restoration of a rare, highly-diverse watershed forest at Auwahi through the planting of 2,000 native trees with community volunteers.
3. Maintain forest restoration sites and encourage optimal native watershed forest recovery at Auwahi by controlling priority invasive plants within Auwahi restoration areas and preventing the introduction and spread of invasive weeds and diseases.
4. Build public understanding of the importance and value of native watershed forests by engaging community participants in native watershed forest restoration on six (6) safely led educational volunteer restoration trips.

BENEFITS TO MAUI COUNTY AS A RESULT OF THIS PROJECT

Build public understanding of the importance and values of native watershed forests through informative restoration work trips and public outreach events.
Engage people of Maui County in informative, hands-on watershed forest restoration.
Through volunteer restoration, participants learn about the relationship between healthy watershed forests and water resources and their responsibility in protecting Maui's native watersheds.
Invest in future watershed forest protection and restoration by connecting community members to native watershed forests.
Develop and refine native forest restoration techniques also used at other sites statewide to convert non-native vegetation to native watershed forests.
Demonstration site as a successful example of converting non-native pasture lands to native watershed forest with associated improvements of hydrologic function within a decadal time scale.
Quantitative documentation of the positive impacts of native forest restoration on watershed function, including evidence of increased soil moisture, increased fog drip/rain water infiltration, decreased runoff, and potential aquifer recharge.
Since 2000, more than 130,000 native seedlings have been outplanted and 4,607 volunteers have contributed more than 38,000 hours on more than 300 forest restoration work trips.
Auwahi Forest Restoration Project has a high return on investment on watershed protection as County DWS funds are leveraged at least 6:1 against state, federal and private grants.

TASKS COMPLETED FOR FY 16

Protect native Hawaiian watershed forest areas at Auwahi with well-maintained fences.

The Auwahi project inspected and maintained all its restoration exclosure fences for any ungulate incursions. The entire length (two miles) of all fences was inspected for integrity every three months by staff on foot or by 4x4 vehicle. During the course of this grant no fence breaches and/or animal ingress occurred, only minor repairs were required and the fences remain in good condition.

Aerial image of fenced Auwahi forest restoration areas with Auwahi 1 (upper) and Auwahi 2 (lower) in the foreground and Auwahi 3 to the right in the background. A perimeter fence encompasses all three exclosures.

Continue on-going forest protection and restoration of a rare, highly-diverse watershed forest at Auwahi to rebuild watershed function through the planting of 2,000 native trees with community volunteers.

Forest restoration at Auwahi continued with the planting of 2,021 high quality seedlings from seeds collected regionally and grown by Native Nursery, Ho'olawa Farms, and 'Ulupalakua Ranch nurseries under strict phytosanitation protocols. The seedlings and saplings were strategically planted to augment tree diversity throughout existing restoration areas.

Many of these seedlings were in larger tree pots requiring special care to transport the seedlings from the vehicles through the forest to planting sites. The goal of these tree plantings is to increase tree species diversity and forest structural complexity among the native shrub understory. The diverse assortment of native trees will create mixed canopy structure

allowing for increased forest function through diverse habitat for pollinators and dispersers. Creating more diverse rooting structure beneath the soil will facilitate greater water infiltration. More diverse forest structure will increase the site's resilience to disturbances such as weather and climate perturbations.

During this year's community-based volunteer restoration trips we planted 15 different species of native watershed forest species (*Alectryon macrococcus var. auwahiensis, Alphitonia ponderosa, Chrysodracon auwahiensis, Coprosma foliosa, Mariscus hillebrandii*, *Melicope knudsenii*, *Myoporum sandwicense*, *Myrsine lessertiana, Nestegis sandwicensis, Nothocestrum latifolium*, *Ochrosia haleakalae*, *Osteomeles anthyllidifolia, Sophora chrysothalma, Streblus pendulinus, Xylosma hawaiiense*) in the Auwahi restoration areas.

Selection of diverse native tree seedlings to outplant in Auwahi forest restoration areas.

Control priority invasive plants and diseases within Auwahi restoration areas.

To maximize native seedling survival and optimize native watershed restoration trajectories the Auwahi project focuses its weed management efforts on limiting the establishment of priority invasive weeds and their seed banks by strategically controlling priority invasive species within the forest restoration areas and adjacent non-restored lands. Two priority species that currently pose the greatest threat to Auwahi forest are the tree poppy or bocconia (*Bocconia frutescens*) and glycine *(Glycine wightii*).


Bocconia frutescens (left) tolerant of deep shade, is a priority forest invader within the Auwahi restoration areas. Bocconia is native to Central America and produces large numbers of bird dispersed seeds within one year. *Glycine wightii* (right) is a priority invasive species because as a nitrogen fixer it threatens to change forest soil chemistry in favor of invasive species. Glycine has recently made elevational advances and invaded pastures surrounding Auwahi.

Volunteers assisted in removing priority invasive plants on our community-based forest restoration trips with many hands effectively pulling thousands of seedlings of bocconia and other weeds inside the restoration exclosures. In addition, Auwahi project staff conducted sweeps through Auwahi restoration areas to systematically control bocconia and glycine.

Despite diligent work to control burgeoning populations of glycine and bocconia in Auwahi, this year's exceptional rainfall brought visible increases in both species populations. The advancement of glycine has been especially concerning and prompted a new collaborative effort with `Ulupalakua Ranch operations and managers to conduct "flash grazing" with a large herd of cattle around the perimeter of Auwahi to stimulate denser kikuyu grass mat as weed prevention and to suppress weeds such as glycine and bocconia. This technique has proven very successful in suppressing target weeds. Flash grazing appears to be an excellent method limiting the expansion of priority weeds, decreasing invasive seed set and seed bank establishment and ultimately decreases human labor and minimizes herbicide inputs.

For nearly two decades we have practiced meticulous decontamination of gear by scrubbing boots and inspecting backpacks and gear for hitch-hiking seeds. Now, due to the immediate threat to our watershed forests posed by rapid `ōhi`a death (ROD), we have initiated a specific ROD decontamination protocol of scrubbing each participant's boots with alcohol before entering Auwahi in addition to our general invasive weed prevention protocol. Before each trip to Auwahi we educate participants about ROD, its threats, and the consequences of losses of our native watershed forests due to invasive species.

For two decades we have practiced meticulous decontamination of gear by scrubbing boots and inspecting backpacks and gear for hitch-hiking seeds. Now due to the immediate threat to our native forests posed by rapid `ōhi`a death (ROD) and other potential disease we are also implementing specific ROD decontamination protocol before all trips to Auwahi by scrubbing each participants boots with

alcohol before anyone enters restoration areas. This ROD decontamination is in addition to our general invasive weed prevention protocol of scrubbing boots and inspecting all gear for hitch-hiking seeds. Before each volunteer trip to Auwahi we educate participants about ROD, its threat to forests and the consequences of losses of our native watershed forests due to invasive species.

Build support for watershed management by conducting educational, outreach, and volunteer opportunities.

This year, the Auwahi project engaged 191 volunteers from the community on 12 community-based restoration trips with volunteers contributed 1,752 hours collecting seeds of native species, pulling invasive plants, and planting more than 2,000 individuals of 15 different native plants species in Auwahi restoration areas. These events provide opportunities to educate the public about Maui's natural history, native plants, ethnobotanical resources, and findings from recent ecohydrology research efforts at Auwahi. On restoration trips volunteers learn about the value of native watershed forests and, perhaps more importantly, directly involve participants in the actual process of caring for, and contributing to restoring these important watershed areas.

Volunteers often develop a powerful sense of connection and responsibility for Maui's watersheds while on restoration planting trips. People from all walks of life have been woven into Auwahi forest and are passionate about restoring Maui's native watersheds.

Volunteers gather after a rewarding day of planting seven different species of trees

including one incredibly rare sapling of *Melicope knudsenii*, with only two trees remaining in the wild. This kind of experience is very powerful and lasts with many for a lifetime.

Volunteers gather around a rare native Sandlewood (*Santalum haleakalae* var. *lanaiense*). tree working together to snip and catch falling seeds.

In addition to our volunteer trips, the Auwahi project conducted guided educational tours of Auwahi to local and international groups including hula hālau, artists, scientific researchers, private groups, and University of Hawai`i, Maui classes. On these trips, participants learned about the natural history of Auwahi and leeward watershed forests, the history of the Auwahi project, results from scientific research conducted at Auwahi, and ethnobotanical significance of Auwahi.

The Auwahi project also hosted and participated in eight off-site outreach events and presentations about native watershed forest restoration at Auwahi with local, regional and international participation.

Kamehameha Kapalama middle school students gather at the summit of Haleakalā to greet the sun at the beginning of a day of learning through guided hikes, as well as exploration and educational workshops with hands-on interactive opportunities led by Auwahi project staff.

More than 160 Kamehameha 6th grade students from two separate *holoholo* trips visited Haleakalā and learned about the value of native watershed forests culturally, biologically, and economically. Students engaged in rotating stations to learn about Hawaiian native biota,

natural history and traditional Hawaiian uses for many native species. After witnessing native `ōhi`a watershed forests and sampling the nectar of `ōhi`a blossoms that is vital for Hawai`i's native birds and insects, they left with a personal understanding of what was at risk with current threats of ROD to the Hawaiian Islands.

Auwahi project staff and community leaders coordinated rotating stations with hands-on workshops giving students the opportunity to learn details about native Hawaiian forest plants and how they were used by native Hawaiians traditionally.

Students mimic native birds as they dip their tongues into `ōhi`a blossoms (above right) and explore the diversely colored blossom from `ōhi`a of leeward forests (below).

STAFF EMPLOYED

This grant supported 69% of one staff person, the Auwahi Forest Restoration Project (AFRP) Research Specialist, at 50% FTE. The original contract was to support this position at 46% as a 75% full time status, but the position was changed to 50%. The total hours worked with DWS funds during the fiscal year were 717 hours. The total amount of funds spent for salary (including benefits and fringe) was $25,001.

AFRP Research Specialist-plans, coordinates and implements Auwahi forest restoration and management, directs research for Auwahi Forest Restoration Project. Coordinates data collection, analysis and works with collaborators to publish important findings. Assists in developing restoration plans and assists in communications with landowner and partners.

INVENTORY OF EQUIPMENT

No equipment over $500 was purchased with DWS funds.

County of Maui
Department of Water Supply

FORM 4.5

Watershed Protection Grants

Fiscal Year 2016

Leveraged Funds

Organization Auwahi Forest Restoration Project

SOURCE OF FUNDS	Type of Entity (government/ private/ nonprofit)	Amount of Funds Leveraged	
		Cash	In Kind
Hawaii Tourism Authority	State	$50,000	
Frost Family Foundation	Private	$55,000	
Hawaii Community Foundation-Community Restoration Program	Non-profit	$38,180	
US Fish and Wildlife Service	Federal	$43,000	
US Natural Resource Conservation Service	Federal	$7,000	
`Ulupalakua Ranch	Private	$73,000	
Sempra Wind Energy	Private	$25,000	
Community volunteers			$38,824
TOTAL		**$291,180**	**$38,824**

FUNDING NEEDED AND WHAT YOU COULD DO IF THERE WAS MORE FUNDING

With 50% additional funds ($18,500) the Auwahi project could increase the number of community based native watershed plantings annually from 12 to 18 volunteer trips annually or the Auwahi project could conduct 3 community outreach events at Ulupalakua Ranch. With 100% additional funds ($37,000) the Auwahi project could increase the number of community based native watershed plantings annually from 12 to 24 volunteer trips annually generating a trip every two weeks. The impact of each Auwahi planting trip on the Maui community is amplified through photo and comment sharing related to our native tree planting trips on our social network platforms such as Facebook, Instagram, Twitter (see Auwahi Forest Restoration on Facebook www.facebook.com/auwahiforestrestoration for recent examples) and has significant impact on local, national and even international audiences. In addition, greater levels of funding from DWS offer leveraging opportunities increasing cumulative revenues for watershed forest restoration.

In addition to community outreach, the current phase of restoration at Auwahi, emphasizing the strategic outplanting of multiple species of native tree saplings, will increase the site's ecological resilience to perturbations from weather (e.g. drought, hurricanes) and climate. Heightened resilience to disturbance and diversification of forest structure are essential elements in the restoration of hydrologic function.

CONSEQUENCES OF A DECREASE IN FUNDING

Though relatively limited, DWS funds awarded to the Auwahi project fund critical operational elements (fuel, phones, internet). Because of this, reductions of awarded moneys would result in loss of matching funds and likely have disproportionate impacts on organizational function and lead to a significant reduction in the number of socially significant volunteer tree planting trips offered.

Auwahi Forest Restoration Project second quarter progress report to the Maui County Department of Water Supply for Watershed Grant Contract #WC0874

Progress from August 19, 2016 – November 18, 2016

PROJECT BACKGROUND

In 1997, working with `Ulupalakua Ranch, regional scientists and conservationists, the Auwahi Forest Restoration Project (Auwahi project for short) began evaluating the potential of restoration of non-native pastoral lands back to the native watershed forest. Successes in reforestation at an initial experimental restoration area spurred the interest and increasing commitment of the ranch in watershed restoration. Watershed conservation on `Ulupalakua Ranch lands is intended to enhance regional water resources, moderating drastic annual fluctuations of water availability, characteristic of southern Haleakalā, as well as protecting biological and cultural resources.

The Auwahi project has developed numerous restoration techniques, of these, the most successful and widely used by other watershed protection groups is the use of native shrubs as nurse plants or ecosystem engineers to deter re-invasion by non-native species. The restored understory creates semi-shaded, moist microhabitats conducive for establishment of native tree seedlings, and allows for a dramatic reduction in the use of herbicide required for invasive weed management. With this technique, after 15 years, cover of native species increased (10%-98%) while non-native species decreased (87%-2%). These reforested plots now demonstrate improved hydrologic function compared to adjacent non-native grassland plots.

After nearly 20 years in operation, the Auwahi project is regarded by many natural resource managers as one of the most successful reforestation efforts in the Hawaiian Islands. The project provides a tangible demonstration site of long-term watershed forest restoration achievable with appropriate management techniques. Techniques developed at Auwahi are now accepted as important management options, expanding an often limited toolbox used throughout the State by multiple land managers.

Working in close collaboration with `Ulupalakua Ranch, the Auwahi project, with a staff of four, coordinates restoration, management and research activities at Auwahi forest interacting with regional scientists and coordinating community volunteer efforts. The Auwahi project is founded on the principles that with responsible supervised leadership, community volunteers can engage in meaningful highly significant volunteer labor. Community volunteer events provide an uncommon type of high impact environmental education while directly involving participants in the process of restoring Maui's watershed areas. Since 2000, over 1,800 Maui residents and visitors have donated over 38,000 hours in planting more than 130,000 native tree seedlings back into Maui's watershed. During our regular volunteer trips, the community learns about Maui's watersheds and participates in its protection and restoration, while tracking the growth of new restored watershed areas.

TASKS COMPLETED DURING SECOND QUARTER

Goal/Objective #1. Manage ungulates in high priority areas.

Conduct fence inspections of existing fences at Auwahi. *The Auwahi project monitors the entire perimeter (two miles) of all the restoration exclosure fences to ensure that ungulates are excluded from these areas. The fence line is inspected by staff on foot or by 4x4 vehicle. The Auwahi project will conduct fence inspections every three months and as needed after severe weather. Fence breaches and/or animal ingress will be noted, mapped, and fixed. Minor fence repairs will be made immediately upon discovery during fence inspections. Any major repairs will be made as soon as the appropriate materials, tools and staff can be deployed to the site.*

During this second quarter we inspected all Auwahi restoration area perimeter fences. No repairs were required this quarter. The fences are in good condition.

Goal/Objective #3. Expand out-planting of native species to rebuild watershed function.

Plant 2,000 native trees with community volunteers on conservation-dedicated lands at Auwahi forest, Maui. *Watershed forest restoration at Auwahi continues with outplanting of high quality seedlings from seeds collected regionally and grown by Native Nursery Inc., Ho'olawa Farms, and 'Ulupalakua Ranch nurseries under strict phytosanitation protocols. Seed source and outplanting site are tracked. Auwahi staff and community volunteers will plant 2,000 high quality native tree seedlings in dedicated restoration areas. The current planting strategy is to augment tree diversity in previously planted areas until the project has adequate funds to take on a new exclosure.*

This quarter volunteers planted 482 seedlings of 3 native tree species (*Alectryon macrococcus var. auwahiensis, Xylosma hawaiiense,* and *Polyscias oahuensis)* in the Auwahi watershed restoration exclosures. Many of these seedlings were in larger tree pots requiring special care to transport the seedlings from the vehicles through the forest to planting sites. The goal of these tree plantings is to increase tree species diversity and structure complexity among the native shrub understory. This diverse assortment of native trees will create a mixed canopy structure with individuals of many shapes and sizes leading to increased forest function through diverse habitat for pollinators and dispersers as well as to create diverse root structure beneath the soil to facilitate greater water infiltration.

Xylosma hawaiiense (*maua*) seedling planted under diverse native shrubs with UH Maui Horticulture class on October 29th.

Incredible *mahoe* saplings requiring careful transport, site selection, whole preparation and planting.

Volunteers carefully transport *mahoe* (*Alectryon macrococcus var. auwahiensis*) saplings into Auwahi 1 restoration area.

Volunteers help to carefully collect seeds from native trees to be used for future watershed forest restoration trips.

Volunteers carefully selecting planting sites among the dense native *a'ali'i* shrub understory. Adding tree canopy complexity will help the forest recover function by increased habitat for pollinators and diversified root structure.

Goal/Objective #4. Control high priority invasive plant species.

Control priority invasive plants within Auwahi restoration areas.
The Auwahi project focuses its weed management efforts both within fenced restoration areas and outside of fences where populations of priority invasive species threaten watershed forest restoration trajectories. Two priority species that pose the greatest threat to Auwahi restored forests are tree poppy or bocconia (Bocconia frutescens) and glycine (Glycine wightii). The Auwahi project will conduct priority invasive species control within the forest restoration areas to limit the establishment of priority invasive weeds and their seed banks in order to optimize the survival of native forest seedlings and restoration trajectories.

This quarter, more than 60 community volunteers assisted in removing priority invasive plants on our volunteer restoration trips; many hands effectively pulling many weeds inside the restoration exclosures. We are also partnerhing with `Ulupalakua Ranch and using a flash graze technique to suppress target weeds in the Auwahi area. This quarter we conducted one collaborative effort with ranch operations and managers to move a large heard of cattle around the perimeter of Auwahi to graze down glycine and stimulate recruitment of a denser kikuyu grass mat as weed prevention. This flash grazing method decreases the potential for priority weeds to establish seed banks and minimizes herbicide use in adjacent non-restored pasture lands.

Due to the immediate threat to our watershed forests posed by rapid `ōhi`a death (ROD) we are continuing with specific ROD decontamination protocol scrubbing each participants boots and gear with alcohol before anyone enters Auwahi. This ROD decontamination is in addition to our general invasive weed prevention protocol of scrubbing boots and inspecting all gear for hitch-hiking seeds. Before each volunteer trip to Auwahi we educate participants about ROD, its threats and the consequences of losses of our native watershed forests due to invasive species.

Flash grazing entails moving a large herd of cattle quickly through the Auwahi area to graze kikuyu grass mats and control priority invasive species. This effective technique is decreasing the use of herbicide required to control priority invasive species.

Cattle in Auwahi forest area eating glycine off the fence line and in the grass matrix. `Ulupalakua Ranch owner Sumner Erdman advises that grazed kikuyu grass forms a denser grass mat and therefore acts as a more effective barrier to priority invasive species without using herbicide.

Goal/Objective #6. Build support for watershed management by conducting educational, outreach, and volunteer opportunities.

Conduct 6 volunteer trips. *The Auwahi project will continue to engage with the community in meaningful volunteer work and outreach efforts. Not only do these events provide opportunities to educate the public about the value of watersheds, they also directly involve participants in the actual process of caring for, and contributing to restoring these important areas. Volunteers are provided an overview of the importance of forest restoration and Maui's natural history, the identification of plants, ethnobotanical resources and findings from recent ecohydrology research efforts at Auwahi. Volunteers participate in a variety of management and research activities including weed control, out-planting and seed collection.*

This quarter the Auwahi project conducted two volunteer restoration trips in Auwahi forest restoration areas on September 24th and October 22nd. In addition we gave three guided educational tours of Auwahi to Hālau Ke`alaokamaile on August 21st, John Innes and colleagues of Landcare Research, New Zealand on October 12th, and UH Maui Horticulture class on October 29th. On these trips to Auwahi 63 Maui community members, cultural practitioners, and international researchers contributed 40 hours outplanting 482 native trees in the restoration areas at Auwahi, learning the significance of native forest restoration on watershed lands.

The Auwahi project also hosted and participated in five outreach events this quarter. Project Manager Dr. Arthur Medeiros spoke at the IUCN kickoff event on August 28th at Pu`u Mahoe and the Hui No`eau for the Mālama Wao Akua art exhibit hosted by the East Maui Watershed Partnership September 15th. On September 13th the Auwahi project presented information about Hawaiian natural history and watershed forest restoration to the Roots school of Haiku. After this presentation multiple students and faculty contacted us about conducting follow up restoration work and student research projects related to watershed restoration. The Auwahi project hosted and organized a presentation by John Innes of Landcare Research, New Zealand on October 13th titled "Lessons from New Zealand in protecting native biota on islands from invasive species; pest control and restoration in Aotearoa" at UH Maui campus with practical implications for Natural Resource managers in Hawaii. On November 18th, Auwahi Project staff traveled to New Zealand to participate in, learn from, and present Auwahi research at the International Society for Ecological Restoration in Australasia conference.

Dr. Arthur Medeiros giving a presentation at Fleming Arboretum for Maui's IUCN events

UH Maui Horticulture class trip to Auwahi to learn about watershed restoration and Hawaiian forests on October 29th. During this trip students planted 85 tree seedlings of *ohe mauka* (*Polyscias oahuensis*) and *maua* (*Xylosma hawaiiense*).

Kumu Keali`i Reichel of *Hālau Ke`alaokamaile* planting an IUCN red list critically Endangered *mahoe* (*Alectryon macrococcus var. auwahiensis*) on a guided tour of Auwahi for cultural practitioners on August 21st.

Auwahi Forest Restoration Project third quarter progress report to the Maui County Department of Water Supply for Watershed Grant Contract #WC0874

November 19, 2016 – February 18, 2017

TASKS COMPLETED DURING THIRD QUARTER

Goal/Objective #1. Manage ungulates in high priority areas.

Conduct fence inspections of existing fences at Auwahi. The Auwahi project monitors the entire perimeter (two miles) of all the restoration exclosure fences to ensure that ungulates are excluded from these areas. The fence lines are inspected by staff on foot or by 4x4 vehicle. Auwahi project will conduct fence inspections every three months and as needed after severe weather. Fence breaches and/or animal ingress will be noted, mapped, and fixed. Minor fence repairs will be made immediately upon discovery during fence inspections. Any major repairs will be made as soon as the appropriate materials, tools and staff can be deployed to the site.

During this third quarter we inspected all Auwahi restoration area perimeter fences. No repairs were required this quarter. The fences are in good condition.

Goal/Objective #3. Expand out-planting of native species to rebuild watershed function.

Plant 2,000 native trees with community volunteers on conservation-dedicated lands at Auwahi forest, Maui. Watershed forest restoration at Auwahi continues with outplanting of high quality seedlings from seeds collected regionally and grown by Native Nursery Inc., Ho'olawa Farms, and 'Ulupalakua Ranch nurseries under strict phytosanitation protocols. Seed source and outplanting site are tracked. Auwahi staff and community volunteers will plant 2,000 high quality native tree seedlings in dedicated restoration areas. The current planting strategy is to augment tree diversity in previously planted areas until the project has adequate funds to take on a new exclosure.

This quarter we conducted one volunteer restoration trip to Auwahi to control weeds, no trees were planted. We had a pause in community-based volunteer trips for preparing for and attend the Society of Ecological Restoration Australasia conference. After the holidays the Auwahi project had one of our Restoration Technicians, a key field person, leave for graduate school leaving a field crew of one which we deem as unsafe for field work at the remote Auwahi forest field site. We are currently recruiting a Restoration Technician and hope to get back in the field within the next month.

Goal/Objective #4. Control high priority invasive plant species.

Control priority invasive plants within Auwahi restoration areas.
The Auwahi project focuses its weed management efforts both within fenced restoration areas and outside of fences where populations of priority invasive species threaten watershed forest restoration trajectories. Two priority species that pose the greatest threat to Auwahi restored forests are tree poppy or bocconia (*Bocconia frutescens)* and glycine (*Glycine wightii*). The Auwahi project will conduct priority invasive species control within the forest restoration areas to limit the establishment of priority invasive weeds and their seed banks in order to optimize the survival of native forest seedlings and restoration trajectories.

This quarter we have been working hard to control priority invasive plants, especially burgeoning populations of glycine and bocconia in Auwahi III that are thriving with this year's rains. Although flash grazing has assisted greatly in keeping invasive species around the perimeter of Auwahi down, we found many new populations of glycine within the restored forest areas in Auwahi III. On January 17th a volunteer weed removal trip was conducted at Auwahi III focused on eliminating all new populations of glycine. Twenty populations of glycine were pulled, bagged and removed from the exclosure. There were some immature seed pods but no mature seeds, the locations of these populations will continue to be monitored to prevent establishment of this modifying weed. To date, we have controlled all the glycine and seeding bocconia in Auwahi III.

Due to the immediate threat to our watershed forests posed by rapid `ōhi`a death (ROD) we conduct specific ROD decontamination protocol of scrubbing boots from all people entering the Auwahi forest areas with alcohol before anyone enters Auwahi.

Bocconia frutescens in Auwahi restoration areas is a priority invader as it is tolerant of deep shade and is a forest invader. This species native to Central America produces large numbers of bird dispersed seeds within one year. We have been working diligently to control all bocconia before they develop mature seeds.

Glycine wightii recently has made elevational advances, invading pastures surrounding Auwahi. We are working to control glycine around the perimeter of Auwahi fences and in all restoration areas. Glycine is a priority invasive species because as a nitrogen fixer it threatens to change forest soil chemistry to favor invasive species.

Goal/Objective #6. Build support for watershed management by conducting educational, outreach, and volunteer opportunities.

Conduct 6 volunteer trips. The Auwahi project will continue to engage with the community in meaningful volunteer work and outreach efforts. Not only do these events provide opportunities to educate the public about the value of watersheds, they also directly involve participants in the actual process of caring for, and contributing to restoring these important areas. Volunteers are provided an overview of the importance of forest restoration and Maui's natural history, the identification of plants, ethnobotanical resources and findings from recent ecohydrology research efforts at Auwahi. Volunteers participate in a variety of management and research activities including weed control, out-planting and seed collection.

This quarter the Auwahi project conducted one volunteer restoration trip to strategically control glycine in Auwahi forest restoration area on January 17th, five volunteers contributed 40 hours of important weed control. The timing of glycine removal was critical in collect all immature seeds and preventing glycine from establishing a seed bank in Auwahi III. Thanks to this rapid response no seed bank of glycine was established at this time.

In addition to Auwahi field work, we gave three off-site presentations about native watershed forest restoration at Auwahi; two of these were international scientific presentations and one was an education presentation with interactive workshops for Kamehameha 6th graders.

In November, Auwahi Project staff traveled to Hamilton, New Zealand to participate in, learn, and present at the International Society for Ecological Restoration in Australasia conference. We gave a well-attended oral presentation on November 21nd and presented a poster on November 20st with background, research findings and take homes from 20 years of forest restoration at Auwahi forest. The international scientific audience of restoration professionals was interested and curious to learn more about conversion of non-native grasslands to native forests at Auwahi and the implications for hydrological processes. We were fortunate to have colleagues who gave us a tour of Maungatautari, a globally recognized successful forest restoration and ecotourism sites near Hamilton where we learned about restoration

methodologies and lessons they have learned. We made many new contacts and came back to Maui with interesting ideas for further restoration in Auwahi.

On February 9th, the Auwahi project worked with Kamehameha Kapalama middle school in their annual *holoholo* to Maui. The *ho'ike* involved numerous Maui community members volunteering to put on a choreographed educational session where groups of students rotated through educational stations learning about native forest plants and their cultural context. The event had a great impact on both the students and volunteer instructors, ending in a powerful 'talk story' group session. In sum, 180 Oahu 6th grade students came to Maui and learned about the powerful role places like Auwahi forest played in the lives of early Hawaiians. One of the core goals of the Auwahi project is to help develop informed young leaders in the Maui community. These youth will undoubtedly play a critically important role in the perpetuation of Hawaiian forests and culture.

Kamehameha students gather at the summit of Haleakalā to greet the sun at the beginning of a day of learning through exploration and educational workshops with hands-on interactive opportunities.

Students learned about the value of native watershed forests culturally, biologically, economically. Students got to witness `ōhi`a in its native watershed forests then experience the nectar of `ōhi`a blossoms that are vital for Hawai`i's native birds and insects. They left with a personal understanding of what was at risk with current threats of ROD to the Hawaiian islands.

We are continually humbled and surprised by the connections formed between the human community and the forest. Some of our greatest lessons this year came from 6th graders asking pointed questions or making comments as signs of deep understanding. Our efforts at Auwahi with Maui youth and their families are intended to enrich community understanding about Hawai`i's unique natural resources, instill a sense of *kuleana*, and assist in development of knowledgeable and connected young leaders with an understanding of Hawaiian cultural context.

Auwahi Forest Restoration Project first quarter progress report to the Maui County Department of Water Supply for Watershed Grant Contract #WC0908

March 30, 2017 – June 30, 2017

TASKS COMPLETED DURING FIRST QUARTER

Goal #1. Plant native trees with community volunteers on native watershed forest restoration lands at Auwahi forest.

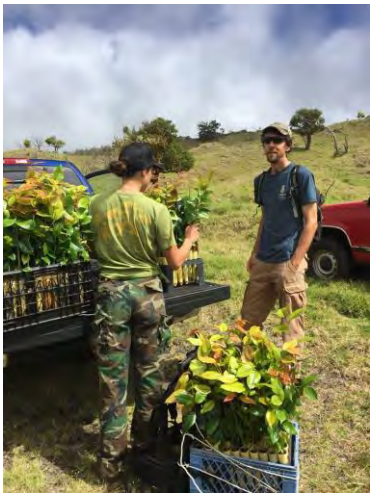
Task 1: Gather seeds to maximize genetic potential and mother lineages of remnant native trees in Auwahi. Clean and process seeds and distribute to plant propagators.
Task 2: Plant 3,000 high-quality native tree seedlings in dedicated restoration areas.
Task 3: Control priority invasive plants quarterly within restoration areas.

During the first quarter, Auwahi project staff and volunteers collected seeds from rare *ʻaiea* (Nothocestrum latifolium) trees from lower Auwahi. We selected maternal trees at low elevation to maximize genetic potential for drought tolerance in this species which has been suffering population decline due to drought stress over the last decade. Thanks to higher than average precipitation this year many trees produced fruit. *ʻAiea* is an important species to perform assisted elevation migration to help this species tolerate climate change and associated drought challenges.

ʻAiea seeds gathered in April (above left) sprouting as small germinants (above right) in June will be ready in roughly 9 months for outplanting in Auwahi.

Since March 30, 888 native tree seedlings of 8 species have been strategically planted within

forest restoration areas in Auwahi. Native tree seedlings and saplings are outplanted at variable pot sizes, some as big as a few gallons (see middle image below). In Auwahi, some substrates with deeper soils are better suited to have larger tree pots. Larger tree pots require more time and care to transport sapling safely beneath the dense native shrub canopy to suitable planting locations.



Due to high precipitation over the last few seasons, priority invasive plants have made advances in elevation and in cover throughout the Auwahi forest restoration areas. To combat the expansion of these weeds, Auwahi staff have contributed 62 people days to conduct systematic priority invasive species sweeps within all restoration areas. Weed control has been a priority for a few volunteer restoration trips with one trip dedicated solely to removing priority invaders.


Community volunteers assist in pulling priority invaders (images above) out of Auwahi forest. This help is critical in limiting the spread of invasive species in the restored forest and also helps to significantly diminish the amount of herbicide used on watershed lands. Volunteers leave Auwahi with increased understanding about some of Maui's worst invasive plant species.

Goal #2. Continue to conduct educational outreach through volunteer forest restoration opportunities, outreach events, and scientific presentations.

Task 1: Conduct 6-12 volunteer trips at the Auwahi forest restoration site on `Ulupalakua Ranch. The ratio of staff to volunteers is generally 1:5. Volunteers are provided an overview of the importance of native watershed forest restoration and Maui's natural history, the identification of plants, ethnobotanical resources and findings from recent ecohydrology research efforts at Auwahi. Volunteers participate in a variety of management and research activities including weed control, out-planting and seed collection.

Task 2: Conduct 6-12 community outreach events and/or scientific presentations regarding significance of restoration efforts on ecology and hydrology of Maui's watershed forests. Auwahi Forest Restoration Project presents informational booths at community events and scientific conferences throughout the year. Published research, interpretive posters, and a variety of other media are available to the public.

The Auwahi project conducted four volunteer restoration trips in Auwahi forest since March 30th. On these restoration trips, 68 volunteers contributed 516 hours toward seed collection, priority weed control, and outplanting native tree seedlings.

University of Hawai`i Maui Biology 424 class comes to plant native trees in Auwahi, April 15th.

Another productive day in Auwahi planting 100s of *maua* (Xylosma hawaiiense) seedlings despite heavy rains.

Community volunteers join hands to plant and weed in Auwahi II restoration area, June 17th.

Community volunteer restoration trips not only restore native forests and the natural capitol of these lands, providing increased aquifer recharge, but these trips also increase social capitol forming social ties between volunteers who may not otherwise cross paths.

Goal #3. Provide access to Auwahi as a demonstration site to decision makers and other interested public policy makers (county, state and federal) and funders.

Task 1: Offer guided tours of Auwahi forest to decision makers and other interested public policy makers as a demonstration site.

During the first quarter, one guided tour of Auwahi forest restoration area was conducted for Natural Resource Conservation Service, Maui branch to demonstrate the successful outcomes of the innovative technique of using “flash grazing” with `Ulupalakua Ranch cattle as a weed prevention measure in forest restoration on private lands.

Auwahi Forest Restoration Project second quarter progress report to the Maui County Department of Water Supply for Watershed Grant Contract #WC0908

July 1, 2017 – September 30, 2017

TASKS COMPLETED DURING SECOND QUARTER

Goal #1. Plant native trees with community volunteers on native watershed forest restoration lands at Auwahi forest.

Task 1: Gather seeds to maximize genetic potential and mother lineages of remnant native trees in Auwahi. Clean and process seeds and distribute to plant propagators.
Task 2: Plant 3,000 high-quality native tree seedlings in dedicated restoration areas.
Task 3: Control priority invasive plants quarterly within restoration areas.

During the second quarter there was an unusually high production of seed from various ecologically important forest species at Auwahi. Auwahi project staff and volunteers collected four gallon ziplock bags full of *pilo* (Coprosma cordicarpa) seeds from maternal trees in Auwahi II exclosure. *Pilo* is a critically important secondary species for restoration in Hawaiian forests providing mid-story foliage and abundant seed resources on some years. In addition to *pilo*, we also collected bags full of *'ūlei* (Osteomeles anthyllidifolia) and *maile lau li'i* (Alyxia oliviformis) both woody vines with important nectar resources for pollinators. We maximize the number of maternal trees we collect from for each species.

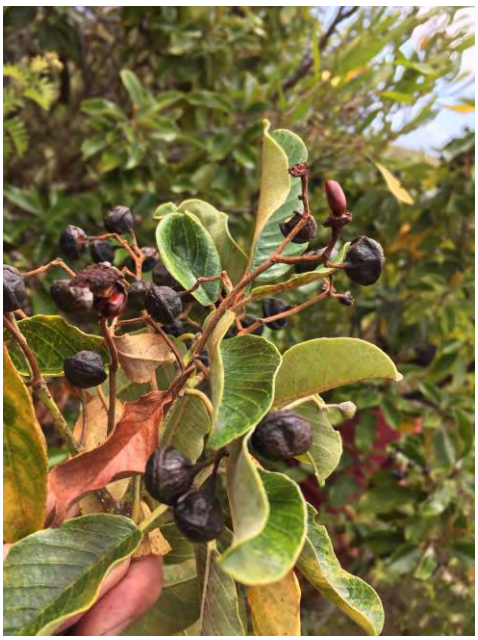


Seeds gathered in Auwahi (above) are processed and distributed to native plant propagators with seedlings generally available for outplanting in roughly 12-18 months.

Since July 1, 766 native seedlings of 10 species have been strategically planted among the

understory of Auwahi (below left) augmenting primary restored areas with greater species diversity, a more complex forest structure and enhanced hydrologic function.

Some saplings from native trees planted in Auwahi over the last two decades have started to produce seeds that are much more robust with more abundant seed crops than the remnant senescing trees. For example, a *kauila* (Alphitonia ponderosa) sapling planted in 2005



(above right) had an incredible seed crop (above left) this year with very plump and healthy

looking seeds. The remnant individuals of this species notoriously bear non-viable seeds in Auwahi. Previously there was only two or three *kauila* trees that produced viable seeds and were accessible for collection. This year we will be able to collect from this vigorous sapling and within the next ten years there will be more than 100 *kauila* saplings to gather seed from. The renewed genetic stock of this species will benefit Maui's leeward forests of the future.

Similar to *kauila*, *ʻiliahi* (Santalum haleakalae var. lanaiensis), another rare species in Auwahi, has also recently begun to bear fruit from healthy young outplanted trees. The photo above (left) is of a sapling planted in 2005 now bearing plump viable seeds (above right). Future forest seed resources of these two species look much better thanks to forest restoration at Auwahi.

During the second quarter, the Auwahi project conducted a volunteer trip designated solely to weed control to combat priority invasive species that had significantly expanded in cover in one portion of Auwahi II exclosure. Following this control work, primary succession native shrubs were planted to replace the non-native invaders with fast growing native shrubs to lock out light. Auwahi staff contributed 83 people days this quarter to conduct systematic priority invasive species sweeps within all restoration areas.

In much of the restored native shrub understory, which was a 3-foot thick layer of kikuyu grass just 5-10 years ago, *'akoko* (Euphorbia celastroides) and *pilo* seedlings are emerging through native leaf litter (below left).

Palapalai (Microlepia strigosa) fern (above right) is beginning to recolonize understory areas of restoration areas in Auwahi. Ferns have been the slowest group of plants to recover, but they are returning. Native fern propagation is challenging and techniques are largely unsuccessful for most species ferns making outplanting ferns nearly impossible at this time. The native ferns recolonization at Auwahi suggests an increased biotic resistance (ability to naturally deter weeds through competition) in older restoration areas.

Goal #2. Continue to conduct educational outreach through volunteer forest restoration opportunities, outreach events, and scientific presentations.

Task 1: Conduct 6-12 volunteer trips at the Auwahi forest restoration site on `Ulupalakua Ranch.

Task 2: Conduct 6-12 community outreach events and/or scientific presentations regarding significance of restoration efforts on ecology and hydrology of Maui's watershed forests.

The Auwahi project conducted four volunteer restoration trips in Auwahi forest since July 1st. On these restoration trips, 80 volunteers contributed 640 hours toward seed collection, priority weed control, and outplanting native tree seedlings.

On July 1st volunteer trip (above) volunteers spent the day removing Bocconia frutescens from an infested area in Auwahi II. During this trip, thousands of sprouting Bocconia were removed as well as some mature individuals with immature seed heads. This area was GPSd and will be monitored routinely to control any Bocconia that germinate. On the July 15th volunteer trip (below), native seedlings were planted in the area where Bocconia was removed.

August 12th volunteer trip

Community volunteers from all walks of life plant native trees and collect loads of *pilo* seeds in Auwahi, September 30th.

Auwahi staff member Robert Pitts (above left) leads volunteers to planting sites with a rack of native seedlings. Stuart Zinner (above right) is one of Auwahi's most dedicated volunteers participating in Auwahi planting trips for nearly 20 years and personally responsible for planting thousands of native trees. Stuart is one of many dedicated community members that routinely volunteer their Saturdays to restore Maui's native watershed forests. This level of investment in social capitol from the Maui community is hopeful for the future state of our island.

The Auwahi project, the US Fish and Wildlife Service (USFWS), and the US Department of Agriculture, Natural Resource Conservation Service (NRCS) presented the Erdman Family, landowners for Ulupalakua Ranch and Auwahi forest, with a Conservation Achievement award on July 25th. The event honored the Erdman family's commitment to watershed protection and restoration for over twenty years. The event began with a presentation about the Erdman's uncommon land ethic and the history of watershed forest restoration in Hawai'i that began with their commitment to restore Auwahi forest (below left). After the ceremony, Pacific Regional heads of USFWS and NRCS were given a guided tour of Auwahi (below right). The event was recognized in the Maui News (http://www.mauinews.com/news/local-news/2017/07/ulupalakua-ranch-erdmans-honored-for-unprecedented-forest-conservation-project/) and statewide on Hawaii Public Radio (http://hawaiipublicradio.org/post/auwahi-forest-failure-restoration-success-20-years).

Dr. Arthur Medeiros, Auwahi Program Manager, gave a presentation at the Hui No'eau about watershed forest restoration at Auwahi on September 28th.

Goal #3. Provide access to Auwahi as a demonstration site to decision makers and other interested public policy makers (county, state and federal) and funders.

Task 1: Offer guided tours of Auwahi forest to decision makers and other interested public policy makers as a demonstration site.

In addition to the guided tour for the Pacific Regional heads of USFWS and NRCS during the Erdman Conservation Achievement Award event, the Auwahi project hosted a guided tour of Auwahi forest restoration area for artists interested in producing art for the East Maui Watershed Partnership art contest, Mālama Wao Akua, on August 7th.

Auwahi Forest Restoration Project third quarter progress report to the Maui County Department of Water Supply for Watershed Grant Contract #WC0908

October 1, 2017 – December 31, 2017

TASKS COMPLETED DURING THIRD QUARTER

Goal #1. Plant native trees with community volunteers on native watershed forest restoration lands at Auwahi forest.

Task 1: Gather seeds to maximize genetic potential and mother lineages of remnant native trees in Auwahi. Clean and process seeds and distribute to plant propagators.
Task 2: Plant 3,000 high-quality native tree seedlings in dedicated restoration areas.
Task 3: Control priority invasive plants quarterly within restoration areas.

This quarter, roughly 10 pounds of *halapepe* (*Chrysodracon auwahiensis*) fruit with seeds were gathered from 7 maternal lineages, from both upper and lower elevation individuals to maximize genetic potential for draught tolerance and climatic variation. We also collected about 5 pounds of *pilo* (*Coprosma foliosa vontempsky*) seed from 23 individuals of this mid-story shrub/tree. In addition to these large gathering events, our staff also gathered lower quantity of seeds from various species encountered during field work in Auwahi forest.

Since October 1, 842 high-quality native tree seedlings from 13 different species were planted in dedicated restoration areas. The addition of diverse species is critical to augment the native shrub understory and make these native watershed forest areas more resilient to inclement weather and non-native weed invasion. The variety of species being planted also contribute to pollinator resources and add root structure diversity allowing for increase infiltration of rain water into deeper soils.

The Auwahi project routinely conducts systematic priority invasive species control in all three restoration areas as well as in the non-native grassy area between the established restoration exclosures. Invasive plant control has targeted both woody and herbaceous species, prioritizing the tree poppy, bocconia (*Bocconia frutescens*), and glycine *(Glycine wightii*) which pose the greatest threats to the long-term ecological trajectories at Auwahi forest.

This quarter, the `Ulupalakua Ranch's main cattle herd flash grazed the perimeter of Auwahi forest restoration exclosures on October 13th-16th to assist with invasive weed control through non-native grass suppression and to non-native woody species browsing.

Goal #2. Continue to conduct educational outreach through volunteer forest restoration opportunities, outreach events, and scientific presentations.

Task 1: Conduct 6-12 volunteer trips at the Auwahi forest restoration site on `Ulupalakua Ranch. The ratio of staff to volunteers is generally 1:5. Volunteers are provided an overview of the importance of native watershed forest restoration and Maui's natural history, the identification of plants, ethnobotanical resources and findings from recent ecohydrology research efforts at Auwahi. Volunteers participate in a variety of management and research activities including weed control, out-planting and seed collection.

Task 2: Conduct 6-12 community outreach events and/or scientific presentations regarding significance of restoration efforts on ecology and hydrology of Maui's watershed forests. Auwahi Forest Restoration Project presents informational booths at community events and scientific conferences throughout the year. Published research, interpretive posters, and a variety of other media are available to the public.

Five volunteer forest restoration trips were conducted by the Auwahi project since October 1st. On these restoration trips, 65 volunteers contributed 520 hours toward seed collection, priority weed control, and outplanting of native tree seedlings.

Kamehameha *Ipukukui haumana* program volunteer restoration trip to Auwahi. Students enthusiastically assisted with planting native trees and weeding after learning about their role in protecting and restoring native watershed forests of Maui.

November 25th volunteer restoration trip participants planted an especially diverse assortment of 13 native plant species to augment plantings in Auwahi I and III restoration areas. In addition to planting and removing invasive plants, volunteers also gathered seeds from *Santalum haleakalae* var. *lanaiense*.

University of Hawai`i Maui Student Ohana for Sustainability club volunteers plant native trees in Auwahi, December 16th.

Auwahi Forest Restoration Project gave three public presentations about Hawaiian natural history, value of Maui's native watershed forests, and our responsibility to protect and restored these forests. One presentation was given over the Paia Youth and Cultural Center's radio station, KOPO 88.9FM. This interview/presentation was rebroadcast a number of times

on this radio station. The Auwahi project Program Manager, Arthur Medeiros, gave two informative talks to the Rotary Club and at East Maui Watershed Partnership's Mālama Wao Akua Art Show at the Hui No'eau (below).

Goal #3. Provide access to Auwahi as a demonstration site to decision makers and other interested public policy makers (county, state and federal) and funders.

Task 1: Offer guided tours of Auwahi forest to decision makers and other interested public policy makers as a demonstration site.

Two guided tours of Auwahi forest restoration area were conducted for Natural Resource Conservation Service (NRCS) and Hawaiian Cultural experts from the University of Hawai`i Manoa campus, Department of Anthropology, to demonstrate a successful Hawaiian watershed forest restoration project.