Coral Reef Conservation Fund 2011 - Submit Final Programmatic Report (Activities and Outcomes)
Grantee Organization: The Kohala Center
Project Title: Pelekane Bay Watershed Restoration (HI)

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| **Project Period** | 07/01/2011 - 06/30/2012 |
| **Award Amount** | $68,373.00 |
| **Matching Contributions** | $96,000.00 |
| **Project Location Description (from Proposal)** | The Pelekane Bay watershed encompasses 11,000 acres on the leeward slopes of Kohala Mountain, on the northwest coast of Hawaii Island. Habitats range from dry shrublands to rain forest. |
| **Project Summary (from Proposal)** | Implement biological and physical management practices in the Pelekane Bay Watershed to reduce land-based sediment inputs to the bay. |
| **Summary of Accomplishments** | To date, over 10,000 plants have been installed within restoration areas, 12 tons of sediment have been removed from sediment dams and sequestered, 3 new dams have been built, and the goat fence has been maintained. Goat population has been reduced to a single herd of less than 8 animals. A 35-acre drainage with bare ground has been treated with more than 70 rolls of erosion control fabric, seeded with native seed. |
| **Lessons Learned** | Ongoing severe drought conditions have forced us to keep almost all of our plantings on irrigation, and to streamline the irrigation system to best use our limited supply of irrigation water. Plants that died have been replaced with new ones, so that each drip line is watering a live plant. We have experimented with planting small seedlings of drought-tolerant species in natural drainages (wetter areas) to see if they can survive without irrigation. We will need to revise our survivorship monitoring to include replacement of plants over time. Without rain, we have both the positive effect -- no sediment moving into the bay -- but also the negative impact of no growth in vegetation to reduce area of bare ground. |

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| Conservation Activities | Treatment of Critical Erosion Areas |
| Progress Measures | Acres of exposed soil revegetated |
| Value at Grant Completion | 30 acres |
| Conservation Activities | Sediment Check Dam construction |
| Progress Measures | Other (Number of dams constructed) |
| Value at Grant Completion | 20 |
| Conservation Activities | Outplanting into restoration exclosure |
| Progress Measures | Other (Number of native plants) |
| Value at Grant Completion | 5000 |
| Conservation Activities | Maintenance of feral goat-free watershed |
| Progress Measures | Acres where BMPs have been applied on land |
| Value at Grant Completion | 6600 |

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| Conservation Outcome(s) | Amount of sediment sequestered by check dams |
| Conservation Indicator Metric(s) | Other (Tons of sediment) |
| Baseline Metric Value | 0 |
| Metric Value at Grant Completion | 800 |
| Long-term Goal Metric Value | 7200 |
| Year in which Long Term Metric Value is Anticipated | 2020 |
| Conservation Outcome(s) | Native woody plant cover in exclosure |

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|---|---|
| Conservation Indicator Metric(s) | Other (% cover of native plants) |
| Baseline Metric Value | 0 |
| Metric Value at Grant Completion | 10 |
| Long-term Goal Metric Value | 60 |
| Year in which Long Term Metric Value is Anticipated | 2030 |
| Conservation Outcome(s) | Bare Soil |
| Conservation Indicator Metric(s) | Other (Acres bare soil) |
| Baseline Metric Value | 500 |
| Metric Value at Grant Completion | 450 |
| Long-term Goal Metric Value | 100 |
| Year in which Long Term Metric Value is Anticipated | 2021 |

**Final Programmatic Report Narrative**
**KWP's Pelekane Bay Watershed Restoration - Phase 2**

**Instructions:** Save this document on your computer and complete the narrative in the format provided. The final narrative should not exceed ten (10) pages; do not delete the text provided below. Once complete, upload this document into the on-line final programmatic report task as instructed.

## 1. Summary of Accomplishments

In four to five sentences, provide a brief summary of the project's key accomplishments and outcomes that were observed or measured.

## 2. Project Activities & Outcomes

### Activities

- *Describe the primary activities conducted during this grant and explain any discrepancies between the activities conducted from those that were proposed.*

The key activities conducted during this grant period include the following, all of which were proposed:

| Activity | Proposed | Completed |
|---|---|---|
| Treatment of Critical Erosion Areas | 5 acres | 4.8 acres |
| Sediment Check Dams | 20 built | 33 dams emptied of sediment, 7 dams re-built, 3 dams newly built |
| Outplanting into restoration areas | 5000 plants | 8031 plants |
| Maintenance of goat-free watershed | 6600 acres | 6600 acres |

1. ***Sediment Check Dam Construction*** - We stabilized the sediment in 7 large dams, and rebuilt them to more than double their original capacity. In addition, we cleaned the sediment out of about 33 smaller dams, and built three new dams.

2. ***Treatment of Highly Eroding Areas*** - We applied erosion control fabric over 4.8 acres in one of the most bare areas on the watershed, called Paddock 4A. These fabric applications treat a drainage basin covering about 37 acres.

3. ***Restoration of Native Vegetation*** - We seeded the erosion control fabric with native seeds, but the lack of rainfall on the watershed resulted in little or no germination. More importantly during this ongoing drought, we irrigated and maintained about 20,000 native plants that had been installed previously. A total of 8031 new plants were planted in the fenced (and goat & cattle-free) restoration exclosure during this grant period, 4208 planted with irrigation and 3823 without. (This differs from a total reported on the interim report, because we erroneously reported plantings from a couple months before the grant began.) Irrigated outplanted species include Aalii, Alahee, Akia, Aweoweo, Hoawa, Iliahi, Ilima, Koaia, Kului, Mamane, Pohinahina, Ulei. Native species planted without irrigation include those planted in the wetter, upper part of the watershed: Akala, Akia, Dryoteras, Hapu'u, Hoawa, Iliahi, Joinvillea, Koaia, Kului, Kolea lau li'I, Kolea lau nui, Kului, Maile, Manono, Naenae, Naupaka kuahiwi, Ohawai, Ohia, Olomea, Olopua, Pilo, Tetraplasandra, Ulei.

From survivorship monitoring, we can report an average of 58% survival of our plantings in the irrigated restoration area, with a range from 0% in areas where we had major irrigation failures (e.g. clogged pipes, water tanks smashed in a windstorm), to 100% survival in areas with efficient irrigation and good conditions (e.g.protection from wind).

4. ***Goat-proof Fence Maintenance*** - Along with KWP partner Parker Ranch, we performed monthly fence checks and maintenance on 18 miles of perimeter fencing. We also removed about 12 goats that entered the watershed when a trespasser (probably a hunter) cut a hole in the fence.

5. ***Rotational Grazing Management*** - Parker Ranch rotated their cattle through all the paddocks on the watershed, and grazed almost all non-native grasses that could have become fuel during this fire-prone dry time. In order to prevent over-grazing, the ranch removed all cattle from March 2010- June 2011, and then again in August 2012.

6. ***Community Outreach and Education*** - We held 24 community volunteer work days over the grant period, engaging a total of 451 adults and children, who donated a total of 2413 hours of work. We worked with 6 local public, charter, and private schools, engaging more than 200 students on the watershed with science field trips and service learning projects.

**Outcomes**

- Describe progress towards achieving the project outcomes as proposed. and briefly explain any discrepancies between your results compared to what was anticipated.

| Outcome | Proposed | Completed |
|---|---|---|
| Amount of sediment sequestered by check dams | 800 tons total | (~600 tons from Phase 1) + 304 tons in Phase 2 = **904 tons total** |
| Native plant cover in exclosure | 10% | monitoring sites **range from 0-30% native cover** (see narrative below for explanation.) |
| Bare soil | 450 acres | **422 acres** (see narrative below for explanation.) |

- Provide any further information (such as unexpected outcomes) important for understanding project activities and outcome results.

**Native plant cover** - We assessed the amount of native plant cover within the exclosure by looking at the data for three monitoring sites within the exclosure, as well as one site that is just outside the fence, in an area with native shrubs, but inside a grazed pasture.

We have % cover data from the summers of 2010, 2011 and 2012 for all these sites. The percentages show in the table below are averages of the cover for 30 subplots at each site.

| Year | Site 3 | Site 4 | Site 5 | Site 6 | Site 6 Notes |
|---|---|---|---|---|---|
| 2010 | 0% | 0% | 0% | 5.00% | |
| 2011 | 0.95 | 0.63 | 0 | 30.04 | Cattle removed 15 months prior |
| 2012 | 16.68 | 0.92 | 0 | 0.25 | Cattle returned to watershed |

Sites 3, 4 and 5 are within the 400-acre riparian restoration corridor. Site 3 is in the upper part of the corridor, and includes a section of the irrigated planting area. Site 4 is in the middle of the corridor where non-native grasses predominate. However, there is some natural regeneration of native plants taking place. Site 5 is towards the bottom of the corridor, in an area that is totally dominated by non-native fountain grass.

Site 6 is just outside the restoration corridor, in the pasture. Those data are being included to demonstrate the impact of cattle grazing on the presence and persistence of native plants.

Site 3 showed a dramatic increase in the amount of native plant cover. This is consistent with an outplanted area, and no impacts from grazing/browsing animals. Site 4 shows an increase in native cover due to natural regeneration. Even with the competition with non-native grasses, there was an increase in the cover of native plants in areas that hadn't been planted. Site 5 demonstrates that once an area is totally infested with fountain grass, it is nearly impossible for native plants to regenerate. Site 6 had a huge increase in the amount of native plant cover during the time that cattle were removed from the watershed, from 0.05% in 2010, to more than 30% in 2011. Unfortunately, the return of the cattle, combined with the ongoing drought, reduced that native cover to only 0.25% in 2012.

**Bare Soil** - To determine the change in bare soil extent from 2010 to 2012, Landsat 7 satellite imagery was used. Six images were analyzed using ENVI analysis software. A maximum likelihood classification scheme was employed by selecting ten pixels containing persistent bare soils common to the six images.

(*Note*: Landsat 7 images are incomplete in coverage since the May 2003 failure of the scan line corrector SLC on the satellite. As a result, gaps or blank stripes can be seen in the imagery. This can be compensated by analyzing multiple images while insuring none of the calibration pixels fall into the gaps on any date. Since the gap position changes slightly from one orbit of the satellite to the next, the gap of one image can be filled by the good pixels from another nearby date. )

Each classification image returns a "1" for a pixel determined at 99.5% probability to contain bare soil, and "0" for a pixel containing anything else. The two images for each year are then added pixel by pixel. The resulting image will show values of 2 where both images identified the pixel as bare soil, "1" where one or the other image identified the pixel as bare soil, and 0 where both images identified the pixel as other than bare soil.

*Results*:

Image classifications showed a declining trend in the coverage of areas classified as bare soil. The decline in bare soil areas is shown consistently in both categories of classification (identified once or twice in two images). Reductions in the extent of bare soil areas are significant. For instance between 2010 and 2012 the area classified as bare soil in both images was reduced by half.

| year | bare1 pixels | bare2 pixels | outside pixels | total pixels | bare1_ac acres | bare2_ac acres | outside_ac acres | total_ac acres | bare1_% percent | bare2_% percent |
|---|---|---|---|---|---|---|---|---|---|---|
| 2010 | 2624 | 985 | 60410 | 64019 | 583.6 | 219.1 | 13434.9 | 14237.5 | 4.10% | 1.63% |
| 2011 | 2368 | 631 | 61020 | 64019 | 526.6 | 140.3 | 13570.5 | 14237.5 | 3.70% | 1.03% |
| 2012 | 1897 | 513 | 61609 | 64019 | 421.9 | 114.1 | 13701.5 | 14237.5 | 2.96% | 0.83% |

Table 1: Results of Landsat 7 image classification. Bare1 are pixels classified as bare soil in either of the two images analyzed for each year. Bare2 are pixels classified in both images as bare soil.

**3. Lessons Learned**

Describe the key lessons learned from this project, such as the least and most effective conservation practices or notable aspects of the project's methods, monitoring, or results. How could other conservation organizations adapt similar strategies to build upon some of these key lessons about what worked best and what did not?

• How can you succeed in habitat restoration during the worst drought of the century? We are now in the 8th year of an exceptional drought. Rain gauges on the watershed this past year show a range from 6% - 23% of normal annual rainfall. Our original plan for restoration was to irrigate our plantings for the first year or two, gradually "weaning" them off water

as they got established. That plan has had to be revised over and over again, as we face the challenge of so little precipitation. Our goal now is to just keep our plants alive, but the irrigation system that was designed for a year at most is now entering its third year, and requires regular maintenance. Other natural disasters have challenged us, too. We had a severe windstorm in fall 2011 that literally picked up one of our 300 gallon water tanks, smashed it into pieces, and blew those pieces downhill a half mile. We have found which parts of the system work well, and we have inundated those planting areas with as many plants as we can, and have abandoned those sites where nothing seems to be working.

• The drought has been both a blessing and a curse. Because there have been no storm events, there has been no overland flow, and the amount of sediment in the bay has probably decreased due to natural flushing, with no new sediment being delivered. However, the lack of rainfall means that the watershed is extremely dry. Even a light mist of rain turns the ground green for a couple days, but there hasn't been enough precipitation to sustain vegetation.

Our reaction to the drought has been to prepare the watershed for the next big storm event with physical structures. By sequestering the collected sediments, building ever more and larger sediment dams, and laying erosion control fabrics, we are preparing for future collection of hundred of tons of sediment that would otherwise have ended up in the bay.

• The impact of feral goat eradication is larger than expected. The decrease in bare ground shown by the interpretation of satellite imagery demonstrates that despite severe drought and with ongoing intensive grazing, there is a net positive result from removing feral animals. Maintenance of the fence is our #1 priority for maintaining this positive trend on the watershed.

• From the vegetation cover monitoring, it has become even more clear that fountain grass is a "game changer." Where the fountain grass cover was greatest, we saw no increase in cover of native plants. We are considering revising our strategy to include experimental fountain grass control to see if it will stimulate regeneration of native plants without need for outplanting and irrigation.

**4. Dissemination**

Briefly identify any dissemination of project results and/or lessons learned to external audiences, such as the public or other conservation organizations. Specifically outline any management uptake and/or actions resulting from the project and describe the direct impacts of any capacity building activities.

• Land-based Sediment Pollution panel speaker at NOAA West Hawaii Coral Reef symposium (about 100 attendees).
• Presentation to Chair of State Department of Land and Natural Resources about Pelekane Bay watershed project.
• Member of Core Planning Group for South Kohala Coastline Conservation Action Planning (CAP) process 2010-2012
- final plan includes Pelekane Bay watershed action items, including feral goat fencing and control, sediment check dam construction, rotational grazing for fire management, & revegetation with native species.
• Consulted with North Kohala Community Action Planning group and Pono Pacific field crew (Akoakoa restoration site) about two coastal restoration projects. Recommended physical barriers for sediment control along with outplantings.
• Presented an information poster at the Nahelehele Dry Forest Symposium (200 attendees) and Run For the Dry Forest event (300 attendees).
• Information booth at the Kohala Country Fair (1000 attendees).

**5. Project Documents**

Include in your final programmatic report, via the Uploads section of this task, the following:

- 2-10 representative photos from the project. Photos need to have a minimum resolution of 300 dpi;
- Report publications, Power Point (or other) presentations, GIS data, brochures, videos, outreach tools, press releases, media coverage;
- Any project deliverables per the terms of your grant agreement.

***POSTING OF FINAL REPORT:*** *This report and attached project documents may be shared by the Foundation and any Funding Source for the Project via their respective websites. In the event that the Recipient intends to claim that its final report or project documents contains material that does not have to be posted on such websites because it is protected from disclosure by statutory or regulatory provisions, the Recipient shall clearly mark all such potentially protected*