Rano Kao & Ava Ranga Uka

Rapa Nui Report 2014

Candace Gossen, PhD - April 11, 2014

Previous research on the island

In 2002 I came to Rapa Nui for the first time to work with Chris Stevenson and the lithic mulch of Vaitea. In 2005 I came back for my own expedition, a PhD focused on coring the crater lake Rano Kao to look for answers on what happened to the trees. Were there other causes besides humans cutting down all of the ancient forests and causing ecocide as the theories were telling? The 9 meters of sediment core retrieved produced a natural history of plants and lake water changes over the last 15,000 years. The details of the last 1,000 years were locked into the floating mat, therefore I returned in 2008 to core the mat again in hopes to find greater detail about a curious climate event in the year 1456AD where the palm pollen had also disappeared. The oxygen isotope results unfolded a pattern of cold and dry events at 637 years on average, and every 719 years a dry/hot event would occur. The length and intensity of these events varies over time. The fossil pollen uncovered 20 trees including 4 new unidentified palms, for a total of 40 native plants that existed on the island. More than half of these plants are now extinct. What happened to the trees cannot be exact, but the climate event of 1456AD was strong enough to cause the palm trees to become dormant, and this is the only weakness of the trees. Lasting 115 years, I believe this cold/dry event caused a disruption in the ability for the palms to pollinate and seed, in which eventually caused those that were living to disappear without new seedlings to follow. There are many causes that affect change, in ecology everything is connected, so it is certainly not without responsibility of the humans that cut some of the trees for food and building, as well as need for space to plant other food sources, including the introduction of insects that came along with them, and rodents that ventured into their boats. However what is now being uncovered is a respect and reverence for the palms as a sacred source. This year's report is about the last 5 weeks on the island in search for more answers to these ideas.

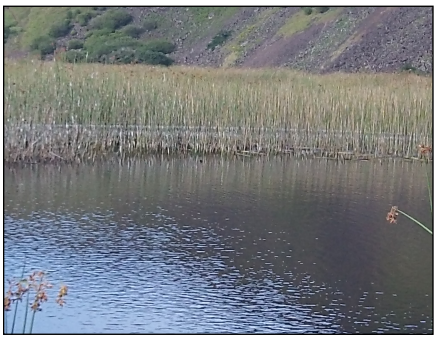


1. **29 March 2014 Objective - Rano Kao water depth, evaporation and volume. To compare with previous results from 2005 and 2008 and detect the rate of change in lake water evaporation.**

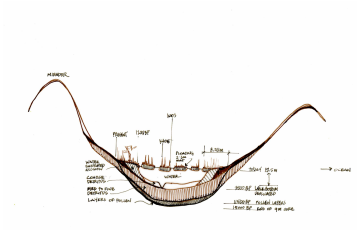
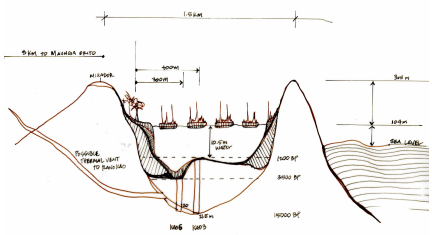
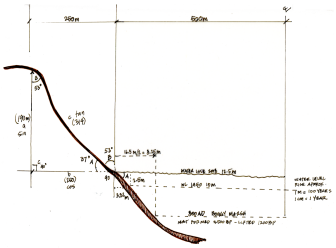
Max, Cristian, Francisco of CONAF and myself took the south path from the mirador, thought the Acacio forest, onto the mat and to the center of the lake. 2 water bottles were filled for further analysis in the lab and 8 depth readings were obtained and are noted on the

map as follows:

Results of the water tests indicate that the lake water depth now is 10.5 meters. This is 2 meters less than measured in 2005 and 2008 which was 12.5 meters. Possible cause to the loss may be increased solar radiation and evaporation. The water samples taken from the lake will be tested for current evaporation. The rate in 2005 was (2.53+) and in 2008 (2.68+) with current rainfall at (-1.61). The photo on the left below also shows a "bathtub" ring left behind by minerals in the water on the totora that matches the 2m depth loss of the lake water. The 2008 breach of the outside wall of Rano Kao crater (middle photo) is of concern also. This



event may have triggered an unseen slow leak within/outside the caldera. The photo to the right shows a brown discoloration in the water outside of the crater below the collapse of an unknown source.

Volume = ((pi * h2)/3) * (3r-h)

In 2005 & 2008, the lake 12.5m deep
In 2014 - 10.5m deep

Loss of 2 meters

In 2008 = 1650m3 of water
In 2014= 1605 m3 of water

Difference = 45m3 = 45,000L less
over 6 years = 45,000 = 20L a day loss
through evaporation or some unknown

2. Location of palms and other plants in the crater

Enrique Pakarati shared with me that he had planted in 1996-97 400 small Jubaea palms on the island, 4 of which were planted in Rano Kao and the others in Vaitaea. We located only one at Rano Kao at the location S27.10.885 W109.26.376. It may be 30 years old now, being it was planted as a small tree and I have calculated the Jubaea grows 1cm/yr over its 300 year lifetime it could achieve 3m in diameter and 30 meters tall. This tree at Rano Kao is 1 meter tall at the top of stem and 25 cm wide approx. (see slideshow for photos of Jubaea plant)

3. Location of "springs and basins" as noted from Patrick McCoy 1976

After researching in the Museo bibliotics on previous notations of water on the exterior of the crater Rano Kao, I discovered McCoy's thesis of 1976. Within it there is good detail of the structures that were within Rano Kao at that time and before, but none survive today. All of the erosion on the inside of the crater has shifted and taken the terraces and houses with it. There are 4 basins Vai Atare Runga and Raro noted on the map, which are historical and relating to the Williamson & Balfour sheep company. Kenny (CONAF) showed me to this location near the forest. Otherwise there are numerous (tarhetas) and basins that are still visible today. All of the stories from the elders however, share the same experience of traveling down to the lake with their grandmothers to wash clothes, take baths, wash their hair, collect totora for floor mats in the houses, seeds, and spend the day or even a week in the crater with their families. Amongst the ruins of the (tarhetas) I found a mahute pounder which supported the necessary location near to water and to the plants and trees that grew within the crater walls.

4. Quebrada survey

A walking survey from the top of Terevaka down to the end of the quebrada at O'pipiri was conducted to learn about the areas of water, evidence of other developed sites around possible ancient water, and available sites that may be a good choice for taking sediment cores. 4 cores were retrieved from the best locations where enough sediment was located for the half-meter coring tube. Most of the locations at the bottom of waterfalls were rock. These 4 cores will be sampled and sent to Wilfrid Laurier University Isotope laboratories to analyze the changing water levels of this area. To my knowledge this area has been known only to a few without a focus on its available water and how that water was used in the past. And if it was possible that this stream in the past collected enough water to run downhill freely. What I hope to find out is if these cores will show drought cycles and warer deposits. I will also

analyze the pollen and ecological evidence as I have done in the past lake cores and see what kind of plants via pollen and other remains ended up there.

5. Clay mineral at archaeological site of Ava Ranga Uka

While my stay on the island was with the German Archaeological Institute team working at Ava Ranga Uka, I offered my archaeology services to uncover a trench that contained a white clay-like substance with unknown origin. The report to Burkhard Vogt follows:

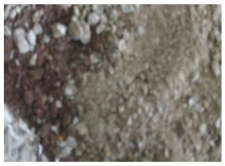
Removal of top layer of rocks

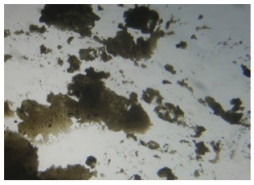
At first layer of clay, 70cm

At Second layer of clay 80cm

Trench T1.4 summary from Candace Gossen 3/29/2014
Upon clearing first layer of stones, some obsidian pieces <2cm collected in soil
Reaching 70cm first layer of "clay like" layer (soft, plastic, elastic, sticky)
with characteristics of ash (volcanic origin).
Experimentation was conducted (see following page).
Suggest chemical analysis
As shown in photo below after rainfall, when clay is put into water it dissolves

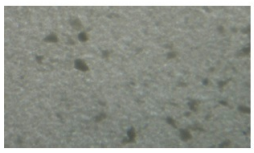
clay layer profile, lower layer (yellow/orange), upper-white





Blocks of the clay material were baked in the oven and pressed into powder Clay turns to chalk like substance, but not acting like a pigment. Iron (red) present in photo above.

At the Museo, a low power scope was available. First smearing the clay in a petri dish, micro charcoal pieces were visible in the clay.

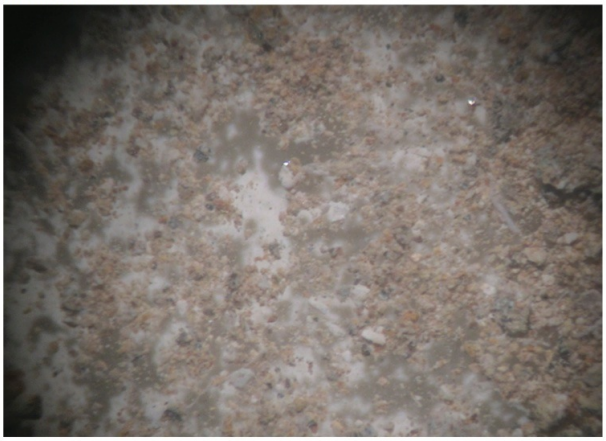


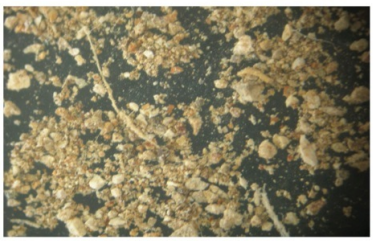
Looking for structure of chemistry, once mixed with water, patterns were visible

Trench T1.4 summary from Candace Gossen 3/29/2014
My thoughts: Because this clay layer is present above crunchy, broken rock, with charcoal flecs mixed in, there are two possibilities at present thought:
1. This is natural caused by chemistry of volcanic rock decomposing, and moving with water sub-surface, layering with various changes in water depth over time. The appearance of charcoal may be of original origin of ash (volcanic) formation long before it was deposited in this pit and migrates within the mix of the clay chemistry.
2. If human modification is possible, this ash may be deliberately taken from a deposit site, and layered specifically above burned material hence the cracked rock below the clay surface mixed in with larger charcoal pieces periodically.

However, because this was a small test pit and the bottom of the paenga was not reached, there may still be another layer below which may provide more evidence. The profile shows two layers in opposition of each other (see page 1) with depth thickness at 6cm to 1cm and not covering the entire pit, but an area within the pit behind the paenga, downstream of the basin.

In the clay mix dissolved in water under microscope, volcanic glass, perhaps mica flecs are present.





In dry form under microscope

Smeared onto rock in wet sticky form from pit, allowed to dry in sun it acts like clay, moisture depleted and cracking.

Trench T1.4 summary from Candace Gossen 3/29/2014
With my work in the desert SW, Caliche is common. Water is responsible for most of the changes in the parent rock material and the formation of clay. Wind-blown dust add to the new characteristics and chemistry as well. Calcic horizons, formed by calcium carbonate are common in the desert, or under drought conditions usually less than 100 cm from the soil surface. Calcium carbonate first appears as thin, white, thread-like accumulations where small roots have extracted soil water and caused the calcium carbonate to precipitate. These weakly-developed calcic horizons can form within a few thousand years. Accumulation produces thicker, continuous coatings, eventually filling the soil interstices between the rocks and the calcic horizon becomes plugged, restricting the downward movement of water.

Modeled into clay figures, sun dried it turns hard as stone, however when wetted it dissolves again.

6. Talk at the Museo

A talk was scheduled at the museum to share the findings of the research from Rano Kao and what I had discovered during my 5 weeks here on the island this year. The powerpoint from this evening on 3 April 2014 is on the disk with this file. 20 copies were given to the library on CD by request of the participants and one is kept on file at the (biblioteca) for anyone wanting a copy.

7. Day of Water at Vaimoana

A day of water was scheduled at the Vaimoana, and many came to participate. Thank you for arranging this event it has stirred much conversation and opportunity.

8. Water sources on the island

Historical documents claim that the people at one time drank salt water as reported by Captain Cook in 1774, however what is known by most of the islanders and certainly the elders is that there are many freshwater springs that exit to the coast via following the bedrock of the island and mixing with the saltwater. At low tide however, the fresh water can be obtained. Many have told me that moss is present at this spots and it was used as a filter to get clean water naturally. There are numerous basins that are part of the antiquity that are not in use today, but were wells or collection basins at one time. I have begun a map of these

locations and will continue to focus on noting these places where markers (petroglyphs) for water (vai) such as the via ondias de mar is located in Vaihu, and wells, basins, holes, caves, waterfalls, and coastal springs are located to improve the knowledge of water sources, to monitor changes, and to understand a great deal more about survival on this island over times.

9. Future proposals

Future proposals include a whole island map, a 3D LiDar scan with documentation on the aquifer and all of its attributes to possible below ground crater connections. Proposing the planting of native trees and plants should be monitored along with the water sources to determine the best places to ensure success of survival of the plant. If the core samples turn out good evidence then other areas will be chosen to continue this work. Further data collection of the weather stations should be obtained. Chris Stevenson set up, and turned over to Sonia Haoa, who then passed on to Tahira, and possibly Sasipa, but with my 5 weeks of stay, and all of my attempts to get the cable and HOBO to download data, I was unsuccessful. I do believe these are extremely important, as an average weather collection at Mataveri does no justice to the enormous amount of rain that falls on Terevaka and little follows on other areas of the island. I propose that CONAF acquire these weather stations and diligently download from these stations the available solar, rainfall and ground temperatures. I have collected data from 2010-2012, but nothing has been collected since that time. In the slideshow, there is a chart on the data from the Ava Ranga Uka weather station. I would like to one day be part of the planting of the Jubaea, and to return the other trees and plants that were found in the pollen record long ago. I would also welcome the opportunity to work with CONAF to a greater focus for longer periods of time, and to complete the ancient plant medicine book from the results of the pollen record over the last 15,000 years.

Thank you to all that helped this season, and for my long return of 6 years to the same friendly and very productive people I call friends.

I look forward to working with you again real soon,
thank you
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