CORDYLINE FRUTICOSA: THE DISTRIBUTION AND CONTINUITY OF A SACRED PLANT

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Abstract. Humans have continually interacted with and transformed their surroundings. *Cordyline fruticosa* Chevalier 1919, was among the many plants Polynesians brought with them as they voyaged from western Polynesia to eastern Polynesia. Polynesian culture is historically associated with *C. fruticosa*, which was centered around the ancient marae, or temples. The distribution of the large, sterile, green leaf variety was studied at marae and contemporary areas such as homes and businesses on Mo'orea, French Polynesia. I expected to find the sacred green variety around marae and the ornamental red varieties in contemporary locations. No *C. fruticosa* plants were found around marae sites. Contrary to predictions, the green variety of *C. fruticosa* was more prevalent at the contemporary sites than the red varieties. Local Tahitians were consulted on current attitudes towards and uses of *C. fruticosa*. These elders indicated that the sacred green variety continues to be utilized in religious, medicinal, and cultural ways, perhaps explaining its prelevance over red varieties.

Key words: Cordyline fruticosa, *ti, distribution, marae, culture, sacred, islands, Mo'orea*

INTRODUCTION

The isolation of oceanic islands makes them a good model system for studying biology and geomorphology (Vitousek, 2002). Human interactions with the environment continue to contribute highly to the modification and transformation of islands (Lepofsky et al, 1996). Oceanic islands are susceptible to disturbance (Fosberg, 1963). The dynamics among the physical environment, biological environment, and anthropogenic factors on islands can help to understand the relationships between organisms, which can contribute and influence decisions about cultural and historical preservation and land use and conservation issues. Voyaging from the west of the Pacific to the east, the Polynesians brought and introduced many organisms to the islands in the Pacific. One such plant, *Cordyline fruticosa* Chevalier 1919, can be found throughout East Asia to the eastern Pacific (Fig. 1; Hillebrand, 1888).

FIG. 1. *Cordyline fruticosa*, ti. Photo Alexandra Title.

Studies of introduced taxa brought by the voyaging Polynesians could be a source of evidence to understanding the culture and colonization of islands. Though the origin of *C. fruticosa* is not known, it may have originated in Southeast Asia and then may have been domesticated in New Guinea

(Hinkle, 2005). *C. fruticosa* is a highly important plant throughout the Pacific Islands today as well as in the past. The Polynesians have been traced back to the Austronesian people originating in South East Asia around 60,000 – 40,000 years ago, with the first wave of people migrating to the Sahul region (Kirch, 2000). One branch of Austronesian people named after their pottery style, Lapita, migrated into near Oceania around 1500 BC. By 1200 BC, the Polynesians began to migrate East (Kirch, 2000).

The large green non-variegated form of *C. fruticosa* was thought to have been carried by the early Polynesians from the west to the east, for use for food, religious purpose, and clothing (Whistler, 1992). Current molecular phylogenetic studies show *C. fruticosa* is more closely related to the *Cordyline* species from North Queensland Australia (Hinkle, 2005). *C. fruticosa*, ti, is dependent on humans for dispersal on Mo'orea. The use and cultural knowledge of the ti plant has declined over the years.

Previous archaeological studies show that the green variety of *C. fruticosa* is utilized in more ways than the other color varieties and can be found more abundant on Mo'orea, including locations such as marae, known occupied sites and along trails. Archaeological charcoal dating discovered ti in the Opunohu Valley (Lepofsky et al, 1996). My informal observations have identified young *C.fruticosa* plants along trails and contemporary occupied areas, such as homes and businesses. The presence of *C. fruticosa* is not known in unoccupied areas. The cultural relevance of the green variety goes back thousands of years compared to the more recent color varieties that are more ornamental (Merrill, 1945). The ornamental red varieties are more abundant around homes and are believed to provide protection and good luck. The utilization of the different varieties of *C.fruticosa* determines where it is grown and distributed.

What is the role of *C. fruticosa*, in the structure and communities on islands and Mo'orea? How does the physical, biological, and natural environment affect the distribution of *C. fruticosa*? Are humans the direct influence of ti distribution? Did the cultural relevance of *C. fruticosa*, initiate the distribution?

There is a difference between the green and red *C. fruticosa* distribution between building sites in the communities. This project will test whether the different varieties of *C. fruticosa* are distributed by humans according to its historical use and contemporary knowledge.

METHODS

Background

From here on I will now address *C. fruticosa* by its English name ti. The ti plant was one of many plants brought by the Polynesians from their immediate homeland in West Polynesia to the Society Islands (Prebble, 2008). Previous studies show that the west Pacific variety of ti plant produces viable seeds (Hinkle, 2005). The ti located in the eastern part of the Pacific does not produce viable seeds. This loss of viability correlates with a wave of migration of Polynesians from Samoa and Tonga to the East. "If *C. fruticosa* is not native, it is curious why only the green form is found in the bush when cultivated color varieties, which are

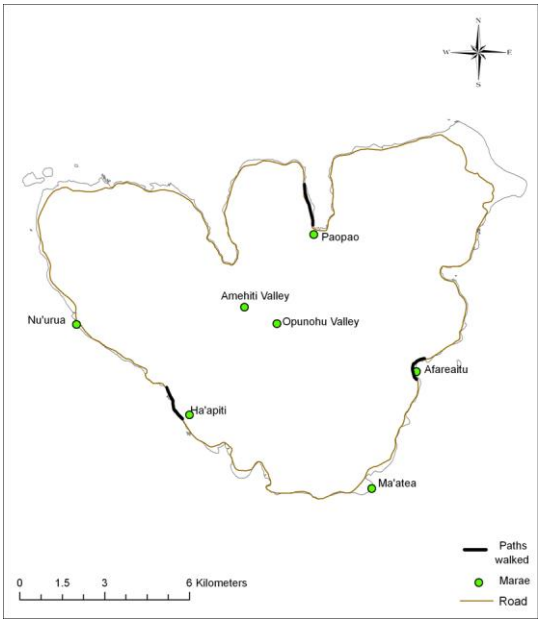

FIG. 2. Map of study sites on Mo'orea, French Polynesia. Geospatial Innovation Facility.

Table 1. Marae and control sites that were surveyed for the presence of *C. fructicosa*.

Site name	GPS Coordinates
Opunohu Valley complex sites 1-3	199958E 8059057N
Amehiti Valley site 4	17 31'40.8S 149 51'19.5W +/- 5m
Amehiti Valley site 5	17 31'47.S5 149 51'09.0W +/- 5m
Umarea Marae (at Afare'aitu) site 6	203931E, 8057067N
Nu'upure Marae (at Ma'atea) site 7	202335E, 8052924N
Nu'urua Marae (at Ha'apiti) site 8	191707E, 8058716N

clearly capable of sexual reproduction, do not appear to be naturalized." (Hinkle, 2005). The ti plant in eastern Polynesia appears to have sterile pollen while western ti plants appear to be fully fertile (Hinkle, 2005). The sterility of the ti plant in eastern Polynesia can be explained by the mediated vegetative propagation before European contact (Hinkle, 2005). It remains unclear whether the loss of fertility is due to continuous propagation or was a targeted selection. The ti plant provides extensive cultural utilization, which includes nutritional value, religious significance, and its use in clothing and costumes. Ti is part of the Agavaceae family and can grow up to 3m tall and the leaves range from 30-50 cm long and 10-15 cm wide (Brown, 1931). Culturally, the ti plant, called auti in Tahitian, is a spiritual and sacred plant (H. Murphy, pers.comm.).

This study was conducted on Mo'orea Island of the Society Islands in French Polynesia (Fig. 2). Mo'orea is a high volcanic island, the second largest in the archipelago.

Observations

Marae sites

The first objective of this study was to map out the varieties of ti located at marae sites and a paired site, as a control, in different climate zones: upland rain forest wet valleys, (Opunohu valley), drier valleys, (Amehiti valley) and coastal areas, (Umarea marae in Afare'aitu, Nu'upure marae in Ma'atea and Nu'urua marae in Ha'apiti) (Table 1). Each plot and paired site measured 40m by 20m. The control site measured 10m away from each marae site. A marae is a temple made of stone and in the case of the coastal marae, made also of coral. Marae were used for religious and ceremonial purposes. They are generally rectangular structures and could be a single level or more.

Contemporary sites

The next component of this project was to conduct a presence/absence distribution of ti by looking at the contemporary distribution of ti around modern occupied locations and establishments such as businesses and homes from the road. The ti varieties were categorized into one of two groups of either red ti or green ti. Chosen locations included Paopao, Afare'aitu, and Ha'apiti averaging a walk of 1km at each site. I was able to estimate within 15m of the road, the number of ti plants in view, and estimate the height of each ti plant.

Statistical analysis

For the distribution of wild ti at marae sites I would use an ANOVA test. For the presence/absence contemporary distribution of ti I used a chi squared test to compare site distribution of the different varieties of ti.

Cultural component

By talking with locals and reading previously written literature, I was able to learn the cultural significance and utilization of ti plants. I was also able to weave ti leaves to make part of a dance costume.

RESULTS

Observations

Marae sites

The observations at the 8 unrestored marae sites revealed zero number of ti plants.

The 8 control paired sites also revealed zero ti. While surveying for ti around marae I noticed ti has been planted along trails and at the restored marae only.

Contemporary sites

The observations from the roads of the contemporary distribution of ti showed a range in numbers of ti per site, which were associated with homes, churches, private roads, schools, and businesses (Table 2). The majority of the ti plants were lining the property, roads, driveways, and homes.

Statistical analysis

Ti distribution data was analyzed using Excel 2007 and JMP 8.0.

I did not run the ANOVA test since there was not any ti found at the marae sites. I used the chi squared test to analyze expected ti vs. observed ti.

The difference between the distribution among the green and red ti, not accounting for site differences is (x^2,n=621, df=6, x^2 =90.07, p< 0.0001). The plot shows more green ti is present than red ti at the contemporary sites. Total number of green ti plants was 63.93%. Total number of red ti plants was 36.07%.

Difference between sites within buildings compares the green and red varieties of ti within each building type between study sites. I chose to do the chi squared test on the building types that were observed in all study sites. The beach, cultural center, and restaurant were not tested because these locations were not at all three sites I walked. The church buildings p=0.50 presenting no statistical difference between sites. The homes were statistically different (x^2= 5.79, n=397, df=2, p=0.06,). Where ti was observed without a building showed a statistically different distribution (x^2 =9.23, n= 41, df=1, p= 0.0024).

Cultural component

By speaking with local Tahitians I was told of the cultural significance of the ti plant. The green ti continues to be utilized in a number of ways. Ti is a very spiritual plant and is used to make Tahitian sugar (S. Huna, pers. comm.). It is planted in the four corners of property and along paths so spirits will not follow (H. Murphy, pers. comm.). Protection and good luck are the underlying meaning of the green ti. It is planted along roads, trails, homes, and pathways so bad spirits will not follow people. The large green leaves are used to cook with and wrap foods in (Barrau, 1965). The leaves are also used in the earth oven. The underground rhizome can be eaten and used to make sugar. There are many uses medicinally. In cases of fever the leaf is placed upon the forehead. Other uses include treatment of earaches, abdominal pains, and a variety of other ailments (Whistler, 1992). A branch is used to treat a broken tibia (H.Murphy, pers.comm.). Ti continues to be used in the making of clothing and traditional dance costumes. I had the opportunity to make a traditional dance belt made from ti. The large green leaves were torn in to smaller pieces and weaved into a belt using the dried leaves of Pandanus. Ti is planted with crops such as taro and yam for spiritual growth (Hinkle, 2005). Ti is also used in fire walking ceremonies and priests use ti for spiritual cleansing (H.Murphy, pers.comm.).

Table 2. Total number of ti plants found at building type

	locations						
	beach	church	home	school	none	restaurant	cultural center
green ti	6	50	271	17	39	12	2
red ti	1	76	126	0	2	2	17

DISCUSSION

This study demonstrates that ti is not currently located at marae sites, contradicting previously written studies. The contemporary distribution of ti presented a higher number of green ti plants over the red ti varieties associated with occupied sites.

Previously written literature states that the red ti is ornamental so I expected to see more red ti than green. This leads me to believe that the green ti is more prevalent because green ti continues to be utilized in more ways than red ti. After speaking with the locals, ti continues to be considered a spiritual and sacred plant.

The absence of ti at archaeological marae sites prompts further questions as to what factors contributed to such results, though historically ti was planted and found at marae sites. Some environmental reasons could include lack of soil, nutrient depleted soil, leaf litter competition, and invasive species. The overgrowth of hibiscus and mape create a canopy cover which blocks out necessary sunlight for ti growth (West, 1996). Wild pigs were also noted to have uprooted the rhizome of the ti for food. Humans may have also uprooted the ti for food, though it was taboo for people to cut down ti plants associated with the marae (H.Murphy, pers.comm.). Ti was not planted inside the marae because the gods of the marae did not need protection. It was the people outside the marae that needed protection from the gods, so ti was located around the marae (S. Huna, pers.comm.). Since the marae are not utilized anymore and ti is sterile in Eastern Polynesia, there is no one to maintain or plant ti. Ti appears to have become naturalized from cultivated populations which are clearly reliant on human propagation of vegetative clones. Agricultural maintenance is required for their ongoing survival (Prebble, 2008). After European contact, the ti could have been pulled out by the missionaries. The salty conditions of the coastal marae are not conducive for ti growth.

Ti is no longer located at the marae, which may be the result of the marae no longer being of use. Ti is distributed at contemporary, occupied locations including homes and businesses. Since ti is a sterile plant, humans are the direct influence of ti distribution. After speaking with the locals, ti continues to be considered a sacred plant. The green ti is more prevalent as an ornamental which contradicts previous studies that state red ti is more prevalent amongst ornamentals. This leads me to believe that the green ti is more abundant because green ti continues to be utilized in more ways than red ti. With many uses, it is understandable why the Polynesians chose to bring ti from western to eastern Polynesia. The cultivation and utilization of ti in communities is important to the culture on Mo'orea. The interactions with this sacred, culturally relevant plant in relation to the distribution and environment help to understand the utilization of land on Mo'orea, which could also be applied to all of Polynesia where ti grows.

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LITERATURE CITED

Barrau, Jacques, Witnesses of the past: notes on some food plants of Oceania, Ethnology, 4:3 (1965:July) p282-294.

Brown, Forest. 1931. Flora of Southeastern Polynesia. Bishop Museum Press, Honolulu.

Fosberg, F.R.,1963. Man's Place in the Island Ecosystem, The Ecosystem Concept, Bishop Museum Press, p2-6.

Hillebrand, William F. 1888. Flora of the Hawaiian Islands: A description of their Phanerogams and Vascular Cryptogams. Carl Winter University Bookseller, London.

Hinkle, Anya. 2005. Population structure and reproductive biology of the ti plant (Cordyline fruticosa) with implications for Polynesian history. PhD dissertation. University of California, Berkeley.

Kirch, Patrick. 2000. On the road of the winds : an archaeological history of the Pacific islands before European contact. University of California Press, Berkeley, California.

Lepofsky D. Kirch, P.V. Lertzman,KP. 1996. Stratigraphic and paloebotanical evidence for prehistoric human-induced environmental disturbance on Mo'orea, French Polynesia. Pacific Science 50: 253-273.

Merrill, Elmer D. 1945. Plant life of the Pacific world, The Macmillian Company, New York.

Petard, Paul. 1960. Quelques plantes utiles de la polynesie Francaise Pteridophytes et Monocotyledontes. Societe des Oceanistes, Paris.

Vitousek, Peter M. 2002. Oceanic islands as model systems for ecological studies. Journal of Biogeography, 29: 573-582.

Whistler, W. Arthur. 1992. Polynesian Herbal Medicine. National Tropical Botanical Gardens, Hawaii.

West, Carole.1996 Assessment of the weed control programme on Raoul Island, Kermac Group, Science and Research Series, 98: 5-96.