

Recollections of *Fadang* and *Fanihi*: The Taste and Smell of CHamoru Bygone Foods and the Challenge of Endangered Island Species

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Abstract

Pacific Islands have a high degree of biocultural diversity. On Guåhan (Guam), the CHamoru people's traditional knowledge, practices, and language developed in tandem with the island's biological diversity for over 3,500 years. Global processes such as colonization, globalization, and modernization put the island's biocultural diversity at risk. Two endemic species, the *fadang* and the *fanihi*, a cycad and a fruit bat, are threatened with extinction. Both *fadang* and *fanihi* are traditionally eaten as food. Open-ended interviews allowed participants to tell their stories of taste and smell, and their recollections preparing and sharing endemic dishes like the *titiyas fadang* and *kådu fanihi* with their elders. Endangered species conservation can play a role in preserving these practices alongside their emphasis on biodiversity protection. Recovery plans, inclusive of traditional practices, can protect this biocultural diversity. A council of traditional and scientific knowledge holders, grounded in the CHamoru value system, can guide its implementation.

A Story of Taste, Smell, and Sharing

For people growing up on a small Pacific island, the proximity of the ocean and the flora and fauna surrounding people's homes foster a connection to the land and sea. Stories of elders interweave a child's experiences with words of wisdom and knowledge, shaping a physical and spiritual relationship with the natural environment, honoring a holistic Indigenous worldview. One way of sharing this unique island culture is through the preparation and sharing of food. Children learn to husk coconuts and to fish at a young age. Communities share these foods of the land and the sea with their families, neighbors and at celebrations with the entire community.

Such is the experience of the CHamoru people of Guåhan (Guam), the most southern island of the Mariana Islands in the northwestern Pacific Ocean. One of the *manåmko'* (elders) in our neighborhood, Rosalind Pilar Paulino Dydasco, taught my children and I (Else Demeulenaere), how to grow and prepare certain traditional foods. CHamoru values surrounding food such as the practice of *chenchule'* (reciprocity) are paramount, and especially valued is *ka'lo yan fattoigue'*, bringing prepared food to

someone's house and staying over for a conversation (Aguon, 2020). During walks in the garden and along the limestone forest, my family learned about Indigenous plants and animals. We listened to stories about Rosalind's childhood and how her family used these plants and animals. Rosalind's story about the traditional preparation of *titiyas fadang*, tortillas made of the flour of the *fadang* seed (*Cycas micronesica*), stood out to me. Her family used the flour made from *fadang* to make CHamoru tortillas. The word "*titiyas*" (pronounced tee-TEE-juhs) was adapted from the way the CHamoru people pronounced "tortillas" introduced from Mexico during the missionary period in the 17th century (personal communication, J. Flores, October 27, 2020). These stories provide local context to global processes such as colonization, globalization, and modernization, which introduced new foods and increased the dependence on imported food, disrupting traditional food systems (Parrotta & Troster, 2012). The introduction of starches such as corn during the Spanish colonial era reduced the use of traditional starches (Tolentino, 2018). Rosalind's recollection of the atmosphere during the preparation of *titiyas fadang* painted a powerful story connecting endemic foods with traditional preparation methods. Her stories detailed the abundance of cycads in the forest nearby, the social interactions she had with family members during processing and preparation of the *titiyas fadang*, and the exquisite taste and divine smell of the *titiyas fadang*. Besides the *fadang*, the abundance of birds, fruit bats, and other native plants diminished in her lifetime.

After my children began attending school, I (Else Demeulenaere) started working as a biologist at the University of Guam. As an endangered species specialist, I worked with endangered plant and animal species in Micronesia for seven years. In 2011, Marler & Lawrence reported a high cycad mortality rate after the introduction of a scale insect pest in 2003. The cycad became threatened with extinction and was listed as threatened in 2015 under the Endangered Species Act (ESA) (U.S. Fish and Wildlife Service, 2015). I recalled my neighbor's story of the *titiyas fadang*. The once abundant population of *fadang* in the forest surrounding Rosalind's house plummeted alongside other cycad populations on the island and could not be harvested anymore. I realized that incorporating the restoration of traditional food and other cultural practices is a crucial part of endangered species conservation.

Other similar cultural food stories followed, such as the Mariana fruit bat or *fanihi* (*Pteropus mariannus*), which used to be prepared as a prized dish for the *fi'esta* (celebration of a patron saint of a parish) and *gupot* (celebration) table (Guampedia 2020). The preparing and sharing of food at a *fi'esta* or *gupot* occur in the spirit of *inafa'maolek*, which means "restoring harmony or order, cooperation, and interdependence" (Mendiola, 2020; Perez-Yeched, 2020). *Fanihi* populations declined and became threatened with extinction in the 1980s. Mostly elders, but also 40-50 year old people recollect the acquired taste of *fanihi* and the value and pride of sharing *fanihi* dishes at the *fi'esta* or *gupot* table. The *fadang* and *fanihi* and their use by the CHamoru people are examples of a rich biocultural diversity that was once present on the island of Guåhan.

Maffi (2005, p 602) defines biocultural diversity as "diversity of life in all its manifestations - biological, cultural, and linguistic - which are interrelated within a

complex social-ecological system". Many scholars have examined the link between high levels of biodiversity and Indigenous people (Loh & Harmon, 2005; Toledo, 2013; Parrotta et al., 2016). Biocultural diversity is especially high on islands because of their geographic isolation and the way Indigenous knowledge and culture practices are tied to their unique biodiversity, while adapting to changes in their environments (Loh & Harmon 2005; Tershy et al., 2015). The Mariana Islands are part of the Micronesia-Polynesia biodiversity hotspot. The region has high species endemism rates and biocultural diversity (Myers et al., 2000; Loh & Harmon, 2005). The Mariana Islands, Palau, and Yap are closer to the Indo-Pacific center of biodiversity around Indonesia and Eastern Asia (Mueller-Dombois & Fosberg, 1992) and consequently have a greater biodiversity than found on islands farther east from the Indo-Pacific center.

National endangered species conservation policies such as the Endangered Species Act focus on preserving the world's rapidly declining biodiversity, which threatens to bring devastating consequences to the earth's ecosystem functionality and stability (Isbell, 2010). The islands' biocultural diversity loss deserves more attention and protection in this conservation story, as it will benefit the islands' biodiversity and its people to prevent converging extinction crises between culture, language, and biodiversity (Maffi, 2005; Loh & Harmon, 2014), aspects of life that are very important to CHamoru people.

This study aims to emphasize the important and unique connections the CHamoru people have with plants and animals and how global processes can cause parallel extinctions of plants, animals, and cultural practices. We pursued an interdisciplinary research approach to ensure Indigenous perspectives and traditions are part of the conservation discussion. A CHamoru epistemology forms the basis of this research. This ethnographic study used a qualitative mixed method approach, comprising participant observation and storytelling, open-ended interviews, and bibliographic research to answer three key questions: (a) are the traditional food practices and the stories of taste and smell tied to endangered species at risk of being lost?, (b) how is the CHamoru worldview and CHamoru value system tied to the way of knowing these endemic species?, and (c) can Traditional Ecological Knowledge (TEK) and Scientific Ecological Knowledge (SEK) unite in a co-production of knowledge to guide conservation efforts such as outlined in local and national endangered species regulations?

We can summarize the results as: (a) endangered species and their traditional use as food are at risk of being lost alongside the people's memories of taste, smell, sharing customs, storytelling, and transgenerational knowledge transmission, (b) the CHamoru worldview and value system is connected to the biodiversity of the Mariana Islands and (c) community, inclusive of activism-oriented groups, TEK holder' and scientists' involvement are necessary to protect endangered species, the CHamoru people's cultural food practices. A co-production of knowledge (TEK and SEK) can protect and conserve the *fadang* by outlining sustainable harvest practices in endangered species regulations. This study is part of a larger interdisciplinary case study on the protection of TEK of endemic and native plants using a mixed-method approach to identify governance structures and levels that can allow for the protection

and management of sacred places to the Indigenous people and for the continued perpetuation of TEK practices.

A Community Integrated Mixed-Method Ethnographic Approach

We employed a qualitative mixed-method approach to gather ethnographic data and perceptions about the CHamoru values and practices surrounding food and how they relate to plants, more specifically endangered endemic species, using the *fadang* and *fanihi* as an example (Creswell & Clark, 2011).

During sixteen in-person, open-ended interviews, the interviewer, Else Demeulenaere, asked about the use and preparation of *fadang*. The interviews were recorded and transcribed verbatim (Martin, 2004). After the initial in-person interviews, the interviewer asked the interviewees follow-up questions over the phone. The participants were able to edit the quotes (sent by email) cited in this manuscript. Participant observation (by Else Demeulenaere) was not intended to happen intentionally for this research but allowed me to listen to stories or have conversations with *manâmkô'* and TEK holders as a member of the community and as a biologist (Creswell & Clark, 2011). These stories were not recorded nor transcribed but provided the researcher a more holistic view on CHamoru values and cultural aspects surrounding food. Lastly, we gathered biological, ethnobotanical, archeological, and ethnographical information from historical documents and studies by ethnobotanists/biologists and archaeologists. This triangulation of methods increased the validity of the data (Østreg, 2010; Creswell & Clark, 2011; Jernigan, 2012). An age-cohort analysis of interviewees aided in the ethnohistorical reconstruction of social change and identified the effects of global processes on traditional endemic food practices (Yamin-Pasternak et al., 2014). Knowledge retention per age group was tabulated along with the reasons why certain knowledge concerning *fadang* and *fanihi* was retained or why it was lost.

We would like to elaborate on the use of storytelling as a valid method in qualitative research. Storytelling helps to understand the importance of different aspects of society because stories transmit lived experiences of values, culture, place, environment, and language (Turner and Turner, 2008; Bird et al., 2009; Kuhnlein et al., 2009; Smith, 2012). This research method focuses on a people- and place-specific context, emerging from an Indigenous epistemology grounded in its community (Smith, 2012; Tuck & McKenzie, 2015). Storytelling brings forward the different dimensions of an eating occasion centered around food. When the interviewer listened to participants, the stories addressed different settings, such as collecting plants in the jungle, preparing plant dishes in the kitchen, decorating the table during a *fi'esta* or a *gupot*, as well as who joined the quest for food, how the making of food was celebrated, shared, and valued. Similarly, cookbooks can track social and ideological change over time, and illustrate different settings (Gold, 2007), but storytelling will add that extra dimension of social interactions (for instance sharing and cultural teaching), to the table. Although taste and smell are sensory experiences in the moment, people have the ability to bring these memories back through storytelling. When participants

talked about food, the thought of these endemic foods made their mouths water; they sniffed the air which led them to the warm memories of preparing these foods with their elders.

The CHamoru Worldview, Core Values Surrounding Food, and Diet Changes

CHamoru epistemology forms the basis of this research. Ancient CHamoru people viewed humans and nature as interdependent, recognizing that all of nature has an essence or spirit (Phillips, 2019). Today the CHamoru people, the *taotao tano'* (or people of the land), still exhibit strong connections to the land and uphold this worldview. CHamoru values relating to food have unique names and are expressed in a specific way. *Inafa'maolek* is one concept that supports the idea that land and its produce belong to everyone (Cunningham, 1992). CHamoru people still practice the *inafa'maolek* spirit and they value *chenchule'* by the sharing of foods, visualizing, and providing a taste of the culture. Today's CHamoru society continues to share these values of generosity (*geftao*) and hospitality (*yo'ase'*). The CHamoru people are very generous and always invite people to attend a *gupot*, offering food and drinks. When people leave the party, the hosts offer *balutan* (bundle of packaged food) as CHamoru people prepare enough food for their guests so they can also take some food home with them.

When the first ancestors of the CHamoru people migrated to Guåhan 3,500 years ago, they brought food plants such as *lemai* (breadfruit or *Artocarpus atilis*), *gaddo'* (yam or *Dioscorea esculenta*), *sunì* (taro or *Colocasia esculenta*), *atmagosu* or bittermelon (*Momordica charantia*), *loofah* or *patola* (*Luffa acutangula*) and *fa'i* (rice or *Oryza sativa*) (Pollock, 1983; Cunningham, 1992; Dixon et al., 2012). The CHamoru people used native and endemic food plants present on the island such as *niyok* (*Cocos nucifera*), *dokduk* (*Artocarpus mariannensis*), *kafu* (*Pandanus tectorius*), and *pahong* (*Pandanus dubius*). The *Makana*, CHamoru healers, prepared herbal teas for healing and as a vitamin-rich supplement to their heavy starch-fish dominated diet (McMakin, 1978).

When the Spanish colonized Guåhan, the CHamoru diet changed. After the Spaniards burned the CHamoru people's *proas* (large ocean-going sailing canoes) (Amesbury et al. 2008), a 20-year long war ensued between the CHamoru and Spanish from 1671 to 1691. The Spanish colonizers instituted a policy of *reducción* to diminish resistance amongst the CHamoru people, by forcibly resettling the people into new villages around the Catholic Church (Rogers, 1995; Kuper, 2014). After the destruction of the *proas*, traditional pelagic fishing practices and food trade among the islands almost ended. The Spanish also brought domesticated farm animals such as pigs in the 1600s, which increased the CHamoru consumption of meat (Wiles et al., 1996). Colonization by the Spanish brought other foods to the Mariana Islands as well, such as *papaya* (*Carica papaya*), *kamuti* (*Ipomea batatas*), *alageta* (*Persea americana*), and *laguana* (*Annona muricata*). The CHamoru people incorporated these plants into their diets.

The most influential food relating to the *fadang* story is the introduction of corn or *mai'es* (*Zea mays*). This starch is also used to prepare *titiyas* and does not require pre-processing, such as is the case for *fadang*. Although the CHamoru people used *mai'es* for *titiyas*, they kept making *titiyas fadang*. The *lâncho* or ranch system was created by CHamoru people after the *reducción*. This practice involved part-time residence away from the village centers and close to the jungle where CHamoru people could still maintain their farms, growing food crops, raising farm animals, and practicing their rituals while being protected by the view of the *hâlomtâno'* or jungle, away from the Spanish priests and soldiers (Bevacqua, 2019). Although the Spaniards prohibited the traditional healers *makâna* and *kakâhna* from practicing, the traditional healing culture and use of herbs for overall health was sustained by *suruhânas* and *suruhânus*, a new name given by the Spanish (Lizama, 2014; Salas, 2018). In the 1770s, the Spanish introduced more meat into the CHamoru diet by bringing deer to Guåhan (Safford, 1905). Deer together with the introduced pigs had devastating effects on Guåhan's native and endemic flora (Morton & Perry 1999). Ungulates (hoofed animals such as deer and pig) had never been present on Guåhan (Wiles et al., 1996).

While the Spanish introduced meat, new starches, and tropical fruits, the CHamoru diet changed more drastically after WWII. Processed mass-manufactured industrialized foods with high concentrations of refined hyperprocessed carbohydrate and fat such as Spam®, corned beef, sausages, as well as sugar-loaded drinks became popular (Leon Guerrero et al., 2008). Traditional knowledge holders said the use of *fadang* for *titiyas* lessened substantially after the war. When housing and infrastructure development increased on the island towards the end of the twentieth century, the ungulate pressure on the vegetation increased. Because the pigs could not find sufficient food in the jungle, they started destroying local crops in people's yards, further harming native and endemic plants and foods. A good example to illustrate the effect of ungulate damage is the preparing of a traditional dish called *gollai hâgun suni*, which is a dish made of the leaves of *suni* (taro) cooked in coconut milk. People used to grow *suni*, turmeric, lime, hot peppers, and coconut in their backyard to prepare *gollai hâgun suni*. Nowadays people mostly replace the *suni* with imported frozen spinach and canned coconut milk because it is easier to use, but also because pigs dig up the roots of the *suni*. Despite these cultural changes, people still use locally sourced lime, turmeric, and hot peppers in this dish. The dish is still found at every *fi'esta* or *gupot*. Yam used to be very popular to make *boñelos dagu* (donuts) but yam is another crop favored by the wild pigs. When I, (Else Demeulenaere) the interviewer and neighbor of Roselind, started a garden in southern Guåhan 15 years ago the vines of the yam Rosalind gave me covered my kids' bamboo teepee. Several housing developments sprang up in the neighborhood in anticipation of the military build-up and have substantially increased the pressure from the pigs. Among the breadfruit trees available on the island, the endemic *dokduk* is not used as much compared to the introduced *lemai*.

Niyok is still used in many traditional dishes, but the accidental introduction of the rhinoceros beetle (*Oryctes rhinoceros*) damaged or killed many coconut trees (Moore et al., 2015). The *yo'amte* (term used for today's traditional healers) still

preserve the dualistic function of preparing medicine and making *ãmot tininu*, a wellness tea used for body cleansing and to improve overall health (personal communication, *yo'ãmte* Mama Chai and S. Aguon, 2019). Lizama (2014) notes that people in Guåhan still value Indigenous healing, which is inclusive of the dualistic function of herbs to sustain an overall healthy lifestyle and provide nutrition. As many CHamoru people have pride in consuming traditional cultural foods with locally sourced ingredients, it is important to find ways to protect these plants.

Threatened with Extinction: The Practices and Stories of Taste and Smell

Pacific Island communities pass traditional knowledge on from generation to generation, embedded in the language, as the CHamoru language is spoken during food acquisition, preparation, and during eating occasions (Forsyth, 2012; Lee, 2014; Lizama, 2014). Island cultures modified traditional practices over time, which today may differ among island cultures, communities, and even families. Traditional relationships between generations are important in passing on this knowledge. Tangible and intangible aspects of traditional knowledge and value systems make these traditional relationships very strong and special (Lee, 2014). A shift from subsistence living to a cash-based economy disrupted many of these traditional ways. The Federated States of Micronesia for instance is experiencing a loss of knowledge retention (Lee et al., 2001). The current study about *fadang* and *fanihi* aims to illustrate the importance of traditional knowledge and value systems and how they can link to plant conservation. Participants shared the importance of passing on the knowledge of harvesting and cycad processing practices, and the ways CHamoru people share this food and use it as medicine.

Ethnobotany and history books about the Mariana Islands list the use of *fadang* for food (McMakin, 1978; Safford, 1905; Pobutsky et al., 1991; Cunningham, 1992) and medicine. A topical medicine is made from the *fadang* to treat skin fungus and ringworms (Pobutsky et al., 1991; Borenstein et al., 2007). "The *fadang* used to be very common. Viewing the limestone forest from the ocean along northwest Guåhan, one out of every four trees was *fadang*" (L. Cunningham, October 29, 2020: personal communication with F. Cruz). "The CHamoru people used the *fadang* pre-contact time" (personal communication, M. Ramirez, March 15, 2019) (McMakin, 1978; Pollock, 1986; Safford, 1905; Dixon et al., 2010; Bayman et al. 2012). Archaeologists found pollen of *fadang* in earthen ovens (Horrocks, 2016). "The cycad microfossil remains were from earth ovens. Pollen rather than phytoliths was found, so not necessarily food remains but ambient windblown particles" (personal communication, B. Dixon, 2020). "Along with breadfruit, taro, and yam, *fadang* was a common staple likely before the introduction of corn" (personal communication, J. Tuquero, January 23, 2019; October 29, 2020).

Gathering and Processing the Fadang Seeds

CHamoru people gathered the *fadang* seeds in the forest. In CHamoru culture, family members collected and processed food together. The men would typically collect the *fadang* seeds and split them, while women processed them. The CHamoru people knew the *fadang* seeds contained toxins (cyanide). Different ways of leaching the seeds are documented to ensure the toxins were washed out and the seeds were safe to use by the CHamoru people. The first leaching technique occurred in the rivers and might be the oldest technique. Figure 1 accompanies the first story told by Hope Cristobal.

There are a lot of cycads at Mount Alutom, at Famha' and Manenggon. After gathering mature seeds, our elders used the embedded basalt boulders at riverbanks to prepare the seeds by pounding them with a *manu* or hard grinding stone on a *lusong* (mortar) to crack them open. The cracked seeds are gathered and placed in a gunny sack secured to a tree root or rock and left in the rushing river to wash for a few weeks--until my aunts determine there are no more toxins in them. The leached cracked seeds were then spread out and dried a bit on a mat and placed in the sun. The dried seeds are then ground up usually in a manual cast-iron grinder (*molino*) that is attached to a solid table. The product is a fine starchy flour that is stored in an airtight container and placed in the icebox. (personal communication, H. Cristobal, October 27, 2020).



Figure 1: The *lusong* (mortar) imprints are still visible in the basalt boulders at the riverbanks of Mount Alutom (photos provided by Maria Cristobal).

The Mayor of Agat told me that he collected *fadang* 'nuts' in the Fena area when he was a boy. He transported the *fadang* nuts in gunny sacks loaded on a carabao. He sold the *fadang* nuts to people in Sumay. Sumay was the second largest village in Guam before WWII. His customers processed the *fadang* nuts into flour to make *titiyas*. A man from Piti reported that he chopped up *fadang* nuts and then put them in a gunny sack. Next, he tied the gunny sack into a freshwater stream for two weeks. This leached the poison out of the *fadang* nuts.

Recollections of *Fadang* and *Fanihi*

Then the nuts could be processed into flour (personal communication, L. Cunningham, January 16, 2020; October 29, 2020).

A second leaching technique, called “the soaking and rinsing technique” is practiced at home. People who still make the flour today mostly use this technique. “The women soak the seeds, process, and cook them. Because it was a lot of work, extended family members all worked together” (personal communication, R. Dydasco, December 1, 2018; October 26, 2020). The different stories below contain different nuances and recollections of this leaching technique.

Artist Judy Flores describes the process and depicts the preparation of the *titiyas fadang* in Figure 2. The *fadang flour* was mixed with water or coconut milk to make *titiyas*. Typically, people cooked the *titiyas* on a heated *kommat* (cast-iron pan) over an open fire (Flores, 2020).

The *fadang* trees were very abundant. Only adults would harvest the seeds because we tried to avoid children being exposed to the toxin in the seed and to the pollen of the male cones. We husked the seeds in the jungle. Then we cut them up in chips and soaked them. The water was changed every day for two to three weeks. We sun-dried them and put them in containers. We stored the seeds in these containers until we were planning to prepare the *titiyas*. Mostly they were stored and only used when a storm passed by and food was scarcer (personal communication, J. Quinata, August 16, 2020; October 26, 2020).

When the seeds were ripe, we harvested a big tub full of them. Processing cycad seeds is time consuming. The brown seeds have a hard shell [seed coat] and are very difficult to open. We cut the seeds in half and take the soft part [the starchy cotyledons] out. Then, we soaked the seeds in water and put them outside under the porch. My mother changed the water in the morning and in the evening for a few weeks. The water needed to be changed until the water was clear. This process helped to get rid of the poison in the seeds. Then we dried the seeds. My aunts would come and help to grind the seeds. We use a handheld grinder fixed on the table to manually grind the seeds into flour. Then we put the flour in containers for later use to make *titiyas* (personal communication, R. Dydasco, December 1, 2018; October 26, 2020).

As a young teenager I helped collect the seeds from the wild. Four to six people go into the bush and collect, and might represent three or four different families, usually the siblings. Everybody is related. We collect them a few times a year. I do not know what the trigger is when the elders say, ‘Let’s go’. We brought the seeds home. I helped, cleaning the seed, splitting the kernels, changing the water. We cleansed the water every day for at least a week, probably more than that. I do not remember rushing it. They most likely soaked them longer, as long as you change the water all the time. They do not shorten the process. Some of it is stored as split kernels, some of it is ground up and stored temporarily that

way. Usually that is used for *titiyas*. People usually do not let the grounded material sit around long (personal communication, F. Cruz, February 8, 2019; October 27, 2020).



Figure 2: The woman is demonstrating the making of *titiyas*. When corn was scarce, they processed the cycad, called *fadang*. In the foreground (left-right) is the ripe seed which grows in clusters at the base of the fronds of the female cycad tree. Next is the round, flat meat (the starchy cotyledons, or embryonic leaves) released from its hard case. These are cut in half to form half-circles, or crescents. These are soaked in barrels or pots of water which are changed daily for two weeks. The discarded water emits a strong, sour smell. After two weeks the toxin is gone, and they dry the crescents in the sun until bone dry for storage. The plate in the middle has the dried crescent ready to grind on the *metate* (ground stone). She mixes the ground *fadang* flour with water, kneads it into a ball, then presses it flat onto a waxy banana leaf. From there it is baked on the flat, cast iron pan (called *kommat*) over an open fire. This drawing from the 1970s is part of a series depicting traditional practices demonstrated at Lanchon Antigo, a cultural village prior to GefPa'go (Drawing and description provided by Judy Flores, 2020).

The Cooking, Sharing, Flavor and Smell of Titiyas Fadang

What struck me, (Else Demeulenaere), the most as the neighbor of Roselind and when interacting with traditional knowledge holders, are the stories about the *titiyas fadang* and the description of the taste and smell. CHamoru people prepare *titiyas harina* (made of flour and additionally sweetened), *titiyas mai'es* (made of corn), *titiyas lemmai* (made of breadfruit), and *titiyas fadang* (Flores, 2020). Nowadays *titiyas mânia* are very popular and are made from young coconut. These types of *titiyas* are shared at a *fi'esta* or a *gupot*. People described the texture, flavor, and smell of *titiyas fadang*. Some people really loved the taste of *titiyas fadang*, describing them as the best *titiyas*, while others did not like them, but would still eat them out of respect, and then eventually acquire a taste for them. Larry Cunningham (personal communication, January 16, 2020; October 29, 2020) told me that the father of one of his friends liked the *titiyas* if they prepared the flour when it was still brown (not processed as long) because he thought it was more flavorful. CHamoru families oftentimes prepare food together and share meals. The Chamoru people also share food through the act of giving. *Chenchule'* (reciprocity), is the core of a support and exchange system that traditionally exists between families, but also extends to neighbors and friends. *Ka'lo yan fattoigue'* is referred to the making a lot of food and wanting to share it (Aguon, 2020). When you share food, a great opportunity arises to stay over for a conversation. *Titiyas fadang* would typically not be shared at the *fi'esta* or *gupot* table because it was time consuming to make them and rather rare to have them available. Two participants said *titiyas fadang* would be shared in the back kitchen during a *fi'esta* or a *gupot* and offered to the cooks.

The *titiyas fadang* are so good because they are chewy and not soft. They are not sweet but surely have their own specific taste. When my mom would make *titiyas*, her sisters and sister-in-law would come and help make them. I could smell it in my room when my mother prepared the *titiyas* on the cast-iron skillet. I loved the smell. The smell of *titiyas fadang* is very soothing. We ate them with *fish kelguan* or just by itself. Being together with my family to eat them was a feast. I loved it! (personal communication, R. Dydasco, December 1, 2018; October 26, 2020).

I grew up with the taste of *titiyas fadang* or flat unleavened bread or tortilla made of *fadang*. We ate the food that was served on the table and were not allowed to refuse "i grasian Yu'os" (God's grace). We understood the hardship and hard work it takes to prepare our foods. The process of collecting and preparing the *titiyas fadang* is time consuming. The *titiyas* and the *pilota* [dumplings] in *kãdu* [soup] is a delicacy. The sharing of this food at the family table was considered very special. The *titiyas fadang* had a unique taste and texture. Our family consisted of extended family members who lived together or nearby. We shared food and other necessities. Our elders would make a big pot of *kadu* and

share it with everybody. We all ate the same foods (personal communication, H. Cristobal, October 27, 2020).

I like the *titiyas fadang*, but the only thing about the *titiyas fadang* it is only good when it is fresh. When you let it go old, by tomorrow, it would be hard, almost like leather, a little bit pliable. At that point, it is recycled and thrown into a soup to soften it up, boil it, usually in the soup. In my family it ended up with coconut milk in the soup, most likely with chicken or fresh beef (personal communication, F. Cruz, February 2, 2019; October 27, 2020).

Participants who were young at the time they ate the *titiyas fadang* remembered the smell of processing the seeds. Some had mixed feelings about the taste of *titiyas fadang* and did not like the taste or smell. "The *titiyas fadang* tasted sour and fermented. I like the corn ones better. When I was growing up, it was a famine food, but people had learned to like it. I remember our neighbors processing *fadang*, how it smelled as they changed the water. When they poured out the water this horrible smell would come out" (personal communication, J. Flores, May 25, 2019; October 27, 2020). Other younger people shared similar sentiments. But the youngest participant who ate *titiyas fadang* thought they were delicious. "*Titiyas fadang* had a very distinct taste. They taste better than the Spanish introduced corn and flour *titiyas*" (personal communication, J. Tuquero, January 23, 2019; October 29, 2020).

The Hunting, Cooking, Sharing, Flavor and Smell of Fanihi

While I was interviewing and during conversations about *fadang* and other plant species, participants would bring up the *fanihi* (fruit bat). Participants mentioned that the *fanihi* eats the seed coat (sarcotesta) of the *fadang* seeds (Figure 3). They would also share similar stories about the use of the *fanihi* as a traditional food and emphasized the taste and smell (Figure 3). Many people said they ate *fanihi* as a child and liked it. "Before the introduction of guns people would catch them with a net while they were sleeping in a tree. At night you would see a blanket of black bats, huge colonies starting to go out for the night" (personal communication, L. Cunningham, January 16, 2020; October 29, 2020). "My recollection is that in general, men would hunt for *fanihi* and the women would prepare it" (personal communication, D. Lujan, January 28, 2020; November 12, 2020). The *fanihi* would be shared at a *fi'esta*. "*Fanihi* was a specialty at *fi'estas*. People always tried to have as much variety as they could on the table. Fruit bat soup was a delicacy. The taste was very distinct. It was really a man's food. It smells like skunk" (personal communication, J. Flores, May 25, 2019; October 27, 2020). After it was becoming endangered in the 1980s people stopped eating *fanihi* in Guåhan and *fanihi* were not seen at the *fi'esta* table anymore.

We used to have fruit bats in our backyard. They would come to the *dokduk* tree in the season. Fruit bats were part of our diet. It was seasonal, but still regular. During those times of the year there was *dokduk*, my father did not have to go

Recollections of Fadang and Fanihi

far to get fruit bat. Just go out of the backdoor and shoot it. Where I grew up there was jungle. There was nobody in the vicinity for a mile (personal communication, F. Cruz, February 8, 2019; October 27, 2020).

Fanihi smells really good, especially when it is cooked in coconut milk. It would be a sweet smell. The taste is ok, but I only like the wing. It is soupy. I would break it up and suck the wing. When I was young there were a lot of *fanihi*, so we could share them at the *fi'esta* table (personal communication, R. Dydasco, December 1, 2018; October 26, 2020).

I like the *fanihi*. It became an acquired taste. As a child we would only eat the wings, because when we saw the bat in the pot it looked like a rat. Later as I got older, I started to appreciate everything, even the fur, intestines, and the head. I enjoyed the taste of it. We cooked it in three different ways. We prepared *fanihi* as a regular stew, with water and onions. *Fanihi* was also cooked with coconut milk, as a soup. Lastly, we ate *fanihi* in coconut milk soup with corn added (personal communication, J. Tuquero, January 23, 2019; October 29, 2020).

When I visit Palau and smell cooked *fanihi*, it brings back memories of the days with my grandpa and grandma. They all passed on. Even when I am in the jungle and the fruit bats show up (I know that sounds weird) my mouth waters. My mouth is watering right now talking about it" (personal communication, D. Lujan, January 28, 2020; November 12, 2020).

I recently had the special opportunity to enjoy the taste of *fanihi* in Palau. It was what I remember it to be. I did not see an abundance of *fanihi* at our dinner table; if we did, it is usually my mom who would enjoy it. We, kids, basically just had a taste or two. It never looked appetizing as the animal was cooked whole and you can imagine the creature's teeth showing in the pot. It is usually cooked in coconut milk and the sauce is quite delicious. Mom would place a small piece of flesh on our plate with our rice and the coconut milk sauce. It tasted like "corned beef" to me. I liked it. My mom usually ate the head part as well as the skin and wings (personal communication, H. Cristobal, October 27, 2020).

Fanihi is delicious, especially with taro. When you smell it while they cook it, it does not matter how it looks, but you cannot help being attracted to it. Everything is eaten, including the fur and wings. There is not much taste on the wings. When you go to a *fi'esta* it is usually gone by the time you get there. When you had fruit bat at a party you were the king (personal communication, L. Cunningham, January 16, 2020; October 29, 2018).

At the old *fi'esta*, you have your normal food, and then you have your special food, that is kind of in the back kitchen. Obviously, it is always *fanihi* or turtle. You have your main plate, main spread up front on the table. But then someone

would say “Hey in the back kitchen we have *fanihi* there”. It was highly prized (personal communication, D. Lujan, January 28, 2020; November 12, 2020).

The *fanihi* has flown
My story is known
Catch it!
And you can make yourself
A furry pet or a delicious meal

(poem by L. Cunningham)



Figure 3: The picture on the left shows a *fanihi* eating a *fadang* seed (Merlin Tuttle). The picture on the top right is *ká'du fanihi* with coconut milk. The picture on right below is a *fanihi* dish in Palau (picture provided by Hope Cristobal).

The Mariana Islands' Native Breadfruit Story

We would like to tell one more story of taste. *Dokduk* is an endemic breadfruit and one of the favored foods for the *fanihi* (Wiles, 2005). The tree is currently still abundant, but recruitment has slowed down substantially because wild pigs and deer eat the fruits (Wiles, 2005). Insect pests also plague the trees. People used to eat the fruit and seeds, but the non-native seedless breadfruit *lemai* is preferred nowadays.

Few people still eat the seeds of the *dokduk*, called *hutu*. The collection and preparation of the fruit and seed was also shared with family members. "It would be the same with breadfruit season. My aunts would come and help. They would dry the breadfruit in the outside oven, put them in big cans and make flour with it" (personal communication, R. Dydasco, December 1, 2018; October 26, 2020). The reason we tell this last story is because this endemic species is not threatened with extinction yet. When conservationists, scientists, and traditional knowledge holders work together this species can be saved and thrive in Guåhan's forest and around people's gardens.

The seeds of the *dokduk* would take long to boil. They taste like chestnuts. We would bake the *dokduk* fruit. That is so good. It is sweeter than the *lemai*. People would mostly use the seeds. The seeds would be more for your own consumption, not to bring to the *fi'esta*. But we often would cook more and then bring it to people (personal communication, R. Dydasco, December 1, 2018; October 26, 2020).

We use both the *dokduk* fruit and the *hutu* (the seed). We would collect 50 pounds of *hutu*. We usually carried sacks. It is difficult to find ripe intact *dokduk* fruit because they are very delicate. We pick mature fruit. We collect ripe ones, but it is really hard to find ripe ones that are intact. They are very delicate. Where I grew up, there were a lot of trees in our vicinity. There were certain trees my father pointed out. Those were the trees we would collect the fruit from. We do not collect the fruit from just any tree. There are preferred ones. The *hutu*, we just boil. The *dokduk* fruit itself, primarily we boiled it, sometimes we had it with coconut milk. We boil the riper ones. The older ones we would hold until they start to soften. That is when they are really sweet. That one is really sweet. It is sweeter than *lemai*. The fruit is almost liquidy. We would eat the really ripe one fresh. When we get the ripe one, we pick it off the tree and eat the flesh fresh. We shared the *dokduk* and *hutu* on *fi'estas*, but it was seasonal (personal communication, F. Cruz, February 8, 2019; October 27, 2020).

I eat *hutu* (cooked *dokduk* seeds) occasionally. With or without salt, you boil them for like twenty minutes or roast them for about 20 to 30 minutes. You can find fallen fruits at places where there are no deer or pigs. At those places you can see recruitment of *dokduk*, but where there are high populations of deer and pigs there is little recruitment (personal communication, J. Tuquero, January 23, 2019; October 29, 2020).

A Reflection on the Uncertain Etiology of Lytico-Bodig: How did Fadang and Fanihi get Involved?

In the 1950s a disease known locally as Lytico-bodig (amyotrophic lateral sclerosis-parkinsonism-dementia or ALS-PDC) was prevalent in Guåhan, especially in the village of Umatac (Steele, 2005; Weiner, 2005; Keck, 2011). Researchers proposed

competing hypotheses in search for the cause of the disease. Several hypotheses were linked to the consumption of *fadang* and *fanihi* (Keck, 2011). As of today, the etiology of Guåhan's ALS-PDC is still uncertain. This study does not aim to analyze this topic, as many have done so (Monson et al., 2003, Keck, 2011). I rely mostly on the work of Verena Keck (2011) who used an anthropological approach to look at the causes of the disease. I used her work as a guide to the literature and to summarize the "search for a cause" as she states in her title. Although I did not gather information from participants in relation to the disease, some people mentioned Lytico-bodig.

The first hypothesis is the "genetic hypothesis", suggesting the disease is heritable. Two other hypotheses suggested neurotoxins found in *fadang* and *fanihi* are causing Guåhan's ALS-PDC. The second hypothesis is the "*fadang* hypothesis", which suggests that the flour produced from the cycads seeds contains the toxic beta-N-methylamino-L-alanine (BMAA), which causes the disease. This hypothesis was first posed by Whiting in the mid-1950s (1963) and later studied by other scientists. The third hypothesis suggests that people ingested BMAA when eating fruit bats who bioaccumulate the toxin in their tissues (Cox & Sacks, 2002). Later, a fourth hypothesis suggested the BMAA comes from cyanobacteria living in the roots of the cycad trees (Cox et al., 2003). Lastly, the "aluminum toxicity hypothesis" suggests that low calcium and magnesium concentration in the soil and water lead to a higher accumulation of aluminum in the brain (Yanagihara et al., 1984).

The CHamoru people have passed on the processing techniques of the cycad through generations, with the primary focus of removing the toxins through leaching. TEK holders who processed the fruits and ate the *titiyas fadang* emphasized the need to follow the protocols strictly to wash out the toxins. Most participants did not worry about the disease. TEK holders said it was one of their main staples and that they knew how to process the seeds. These few statements align with the sentiment Keck (2011) gathered from the CHamoru people. The significance of traditional food and traditional ways of knowing how to leach the toxins conflicted with the *fadang* and *fanihi* hypotheses. Both TEK and SEK offered explanations and ways of relieving patients. In her concluding chapter Keck calls for a new agenda of Indigenous research, grounded in decolonization methodologies (Smith 2012), where Indigenous people themselves initiate the need for research and Indigenous participation. Although Lytico-Bodig is disappearing, new cases of parkinsonism, dementia and ALS arise and are clinically different from Lytico-Bodig. CHamoru people continue to be asked to partake in ALS research.

Weaving Together Different Ways of Knowing and Protecting: Science, Traditional Food Knowledge, and Activism

The search for synergy between traditional and scientific ecological knowledge to advise natural resources practices, planning, education, and protection has found a legitimate place among academic Indigenous and non-Indigenous scholars (Kimmerer, 2015; Hoagland, 2017). To develop local sustainable conservation and policy strategies, TEK needs to be preserved in the island's culture and Indigenous

language (Maffi, 2005; Pretty et al. 2008, Hong et al., 2013). Activists also have an important voice in preserving ecosystems, species, and traditional knowledge, especially in the context of Guåhan. We first provide a short description of how SEK contributes to the recovery of *fadang* and *fanihi*. Secondly, we illustrate how activism is an important force for preserving a species. Lastly, we look how these ways of knowing and protecting can be woven together to advance biocultural heritage.

Cycas micronesica is endemic to Micronesia (Figure 4). Cycads are the only native naked seed plant (gymnosperm) in Guåhan. Gymnosperms dominate temperate and boreal biomes in the form of conifers. Cycads are part of a group of plants that were once abundant during the times dinosaurs lived on the Earth. They are now much restricted in numbers, found solely in tropical and subtropical regions, and many cycads face extinction in the wild. Resembling palms in overall appearance because of their large, divided leaves and stout trunks, cycads are an attractive horticulture plant. Many also are of cultural and religious significance, all contributing to their threatened status. The *fadang* used to be one of the most dominant tree species in Guåhan's limestone forest (Donnegan et al., 2004). Over the past seven years the health of the cycad populations plummeted because of an invasive scale insect. Infestations with the scale *Aulacaspis yasumatsui* have caused a lot of damage to adult trees (Moore et al., 2006; Marler & Lawrence, 2012). Similarly, the scale affects seedling recruitment, contributing to the further decline of *fadang*. The U.S. Fish and Wildlife Service listed the *fadang* as threatened under the ESA in 2015 (Department of Interior, 2015). *Cycas micronesica* occurs on the Micronesian islands of Guåhan, Luta (Rota), Yap, and Palau in limestone forests, beach habitats, and riparian areas. The scale is only found on the islands of Guåhan and Luta. Researchers at the University of Guam follow population trends, developed conservation horticultural practices, and study pollination biology of the cycads. This scientific knowledge is important to battle insect pests and increase seed propagation success.



Figure 4: *Cycas micronesia* or *fadang* (male cone on the left, female cone on the top right, ripe seeds on the bottom right).

Pteropus mariannus or Mariana fruit bat is endemic to the Mariana Islands. The *fanihi*'s diet comprises many native fruits and the sacrotesta (seed coat) of the *fadang* seeds (Wiles, 1987). The *fanihi* is also threatened with extinction and has been listed since 1984 as endangered in Guåhan (U.S. Fish and Wildlife Service, 1984), and as threatened in 2005 throughout its range in the Mariana Islands (U.S. Fish and Wildlife Service, 2005). The *fanihi* has been included in the Convention on International Trade in Endangered Species (CITES) list since 1990 as "threatened with extinction". Researchers are monitoring the fruit bat populations in Guåhan and Luta and studying their behavior.

In 2016, a social movement led by Prutehi Litekyan re-connected the CHamoru youth with the *fanihi*, as the construction of a firing range to accommodate the translocation of Marines from Okinawa to Guåhan is threatening the habitat of the *fanihi* at Litekyan and Tailålo, sacred places to the CHamoru people. During protests artists depicted the *fanihi*, illustrating the deep connection the *fanihi* has with its environment and its people (Figure 5). Memes on social media called for action to protect the *fanihi* (Figure 5). The strict regulations put forward by the ESA relating to Indigenous food stand in a sad contrast to the destruction of *fanihi* and *fadang* habitats,

Recollections of Fadang and Fanihi

which has long-lasting effects for the island's ecosystem and the cultural practices tied to these species.

The *fanihi* in the Mariana Islands are known to display inter-island migration which may be highly influenced by typhoons, illegal hunting, and wildlife fires. As biologists continue to monitor the Mariana Islands' population, we should all do our part and plant native trees, spay and neuter our pets, discourage invasive species, and refrain from illegal burning (personal communication, J. Quitugua, May 21, 2018; November 18, 2020).

The military will uproot thousands of cycads to construct the firing range. While the ESA is the mechanism in place to protect biological diversity, it fails to prevent this large habitat destruction. The ESA regulations also miss the chance to connect natural and cultural heritage, while incorporating sustainable biocultural protection.

These stories are a call for action to incorporate these different ways of knowing (science, traditional food knowledge, activism) in endangered species regulations such as the ESA. Mildenstein (2016), a fruit bat biologist, recommends research on the impacts of hunting in Oceania because fruit bats are a culturally important food. To avoid unregulated hunting, recovery plans under the ESA should include clear guidelines concerning hunting practices, management, and outreach to facilitate biocultural diversity protection.



Figure 5: Artwork Kaitlin Ngeremokt (left, top right), meme Prutehi Litekyan (bottom, right).

Most participants would like to eat *fanihi* again once the populations are restored. Protection of limestone habitats, snake suppression, and restoration of limestone

forests are important to recover the species and make sustainable harvest possible, led by scientists. The goal of several natural resources managers is to allow for sustainable *fanihi* harvest once the populations are not threatened anymore. When people would be allowed to propagate *fadang*, grow them and take care of them, they can also harvest seeds and use some to augment recovery efforts (personal communication, R. Quitugua, 2019). Therefore, it is important that these regulations are incorporated in the endangered species recovery plans. A council of traditional knowledge holders and scientists can guide the development of the rules and regulation, and advise on implementation.

It is nice to see the fruit bats in the wild, but the real goal, for most Indigenous people, is to have the fruit bats back so we can allow for sustainable harvest, like we did in the past. This has always been my personal goal (personal communication, D. Lujan, January 28, 2020; November 12, 2020).

The cultural harvesting of fruit bat may only occur after the recovery of fruit bat populations on Guåhan. It is imperative to maintain habitat (not one that is piecemeal rather continuous) for a fruit bat refuge. A system with established rules and regulations must be in place and effectively enforced. An acceptable harvest will be one away from a fruit bat colony. The harvest should be restricted to only traditional methods. The harvesting must perpetuate methods of our ancestors to truly identify this as “CHamoru” culture while maintaining conservation practices as our ancestors did during their time (personal communication, J. Quitugua, May 21, 2018; November 18, 2020).

Conclusions

The answer to the guiding question for our study, “Are the traditional practices tied to endangered species at risk of being lost?” is affirmative. The age-cohort analysis showed that only people above the age of 45 had eaten *fadang* or *fanihi* and remembered the taste. The *manåmko’* (55 years and older) also remembered the practice of gathering, hunting, processing, preparing, and sharing of these foods. The participants in this cohort added other dimensions to the stories about the species’ existence. First, the description of the taste and smell and the joy in their voices when talking about this experience was extraordinary. Secondly, the *manåmko’* talked with excitement about the way they prepared the *fadang* with family members and guests and shared the *titiyas* in small circles, while the *fanihi* was a prime dish at *fi’estas*. People between the age of 45 and 55 years remembered the taste or smell of *fanihi* or *titiyas*, but their sentiment towards them was rather mixed. Many of them recalled the gathering, hunting, and processing practices. This age group stopped eating *fanihi* and *titiyas* at a young age. This cohort only recalls sharing *fanihi* in a smaller family setting or in the back kitchen at a *fi’esta*, as these foods were becoming rarer. It was noticeable that the younger people, between the age of 25 and 45, who never prepared these foods nor ate them, nevertheless knew about the use and had

a basic knowledge about the *fadang* seed processing technique, illustrating their fascination with the process and their desire to taste it. The *manâmkô'* emphasized how family members gathered to process seasonal foods such as breadfruit and food that can be stored for later use such as *fadang*. Food security was a necessity after WWII. Nowadays, although people still share endemic or native foods at their home and during a *fi'esta* or a *gupot*, their inclusion in local diets is slowly disappearing because the use of traditional seasonally stored food is disappearing as modernization and globalizations make imported food items convenient, plentiful and available year-round. Today's society is also threatened with food insecurity, increasing reliance on imported goods. Younger people recognize the urgency of food security and are engaged in growing their own food, learning local food recipes tied to the culture and local practices, illustrating the re-discovery of endemic and native foods, making their *manâmkô'* proud. They value local customs of gathering, processing, and preparing endemic and native foods. People's desire to maintain these practices and knowledge is strong. Endemic foods have the potential to significantly contribute to food security and conservation on Pacific Islands.

It is important to recognize that Pacific Islands in the twenty-first century have the challenging task to balance two contrasting world views concerning preservation of the land, its species, land sovereignty, and the perpetuation of TEK practices. While TEK knowledge is a holistic way of knowing and interacting with the natural world, SEK maintains a reductionistic and analytical viewpoint based on scientific facts (Kimmerer, 2015; Snively & Williams, 2016). Activism has a central role in protecting cultural practices and the natural environment. Interdisciplinary research has advanced conservation and biological diversity research by including linguistic, cultural, human rights, and policy components (ØStreng, 2010). Scientific-led conservation can coincide with sustainable harvesting practices when incorporated in recovery plans. A council, guided by a co-production of knowledge of SEK, TEK, and activists can outline these harvesting practices and their implementation. The CHamoru value system can assist with outreach and sustainability by emphasizing the importance of sharing and knowledge transmission. These stories advocate for protecting and restoring TEK and making them part of the endangered species recovery.

We want to emphasize there is more at stake when dealing with endangered species than the species itself. The stories of the *fadang* and *fanihi's* taste, smell, the sharing of the dishes prepared by the CHamoru people, and the knowledge transmission on how to prepare the dishes are a different way of knowing the Mariana Islands environment. The stories capture the CHamoru culture which connects with the islands' unique flora and fauna. Telling these stories of food and recording recollections of taste and smell are part of CHamoru food heritage. The stories bring forward the sense of the environment as a different sense of loss, as compelling as the loss of a species in an ecosystem. Elders who hold these memories, fear this way of knowing a species will not be passed on to their children and grandchildren. Because the species are rapidly declining, the CHamoru people can no longer enjoy this sense of place, uniquely tied to the Mariana Islands. Therefore, it is important to

acknowledge that once we protect the native and endemic fauna and flora of the Mariana Islands, stories can assist in preserving the knowledge on how to procure, process (and leach out the toxins), and prepare these foods safe for consumption.

Acknowledgements

I (Else Demeulenaere) dedicate this paper to my neighbor Rosalind Paulino Dydasco and thank her for sharing her stories, food, and wisdom with our family. Si yu'os ma'àse' to all participants for sharing your stories of taste, smell, and practice. It is my hope that part of the *fanihi* and *fadang's* taste and smell is preserved in words and that we can find ways to preserve Guåhan's biocultural diversity. Thank you to Dr. Kevin Jernigan for your guidance during this research.

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