

Ecological Imperialism in an Occupied Landscape: Tangantangan and the Tropical Forest

In 1947, the Boy Scouts of America formed the Guam Council and officially began the first post-war troop on the island. One of the spring projects of the Boy Scouts, along with other schoolchildren, was to collect seedpods from trees growing near Tai (south of Mangilao, northeast of Yona), Fort Santa Agueda (Fort Apugan), Talofoto, and Manenggon (in Yona) throughout the month of April.¹ These long, brown, flattened seedpods were from an introduced tree known locally as tangantangan (*Leucaena leucocephala*). On October 10, the American Naval Governor, Admiral Charles A. Pownall, officially proclaimed the day Arbor Day to raise awareness of forest conservation and encourage the planting of trees. That Friday schools held special activities, agricultural experts offered planting demonstrations, and the Department of Agriculture gave away a number of ornamental shrubs and trees to area schools. By the end of the day, island residents planted more than 2,600 trees and shrubs. A few days later, a light plane loaded with 2,200 pounds (~1,000 kg) of seeds took off from Agaña Airfield. Maneuvering the plane into a low altitude, the pilot and small crew prepared for the dispersal of perhaps as many as twenty million *L. leucocephala* seeds (~20,000 seeds/kg) near Mount Tenjo, just south of the capital of Agaña (Hagåtña) in the middle of the rainy season.²

The aerial seeding program was a stunning success, at least for the tangantangan. Prior to 1947, this American tree grew in some limited stands and coexisted alongside other tropical forest species. As long as it did not have to compete for light under a tree canopy, the tangantangan burst into growth, going from small saplings to mature stands of leafy blooming trees in a couple of years. On an island naturally prone to erosion due to the tropical climate and a topography made up of limestone plateaus in the north and volcanic upland in the south, by 1947 droughts and wildfire scorched mountainsides black and denuded hills were crumbling into ravines, reducing soil fertility and putting critical watersheds in danger of sediment pollution due to increased run-off.³ Military planners



Image 1: Guam (Political). Source: U.S. Central Intelligence Agency. 1991. In the Public Domain and also available through the Perry-Castañeda Library Map Collection, The University of Texas at Austin, at http://legacy.lib.utexas.edu/maps/australia/guam_pol91.jpg.

hoped this aerial dispersal of a fast-growing species would control erosion by filling in barren areas of the once forested landscape, much of which weeks of heavy American bombardment had blasted away in 1944 to prepare for the eventual land assault by United States Marines, ending two and half years of Japanese occupation of American soil.

Within a few years, scientists began to notice potential issues with this species proliferation. Working for the United States Geological Survey in the early 1950s, botanist Francis Raymond Fosberg arrived on Guam as a lead researcher on a military mapping project of the Pacific. He recorded surprisingly large stands of tangantangan across the island. Denuded areas from the war remained but tropical vegetation—much of it tangantangan—was

quickly filling in destroyed rural, strand, and roadside areas. By the end of the twentieth century, botanists declared tangantangan an invasive species, pushing out native trees, infiltrating gardens, jutting up through the ruins of homes and businesses destroyed in typhoons, and permanently altering the forest ecology. In effect, tangantangan proved to be a ruthless and ultimately unruly agent of empire.

This article explores the intersection of Spanish and American ecological imperialism, the American civilizing mission, and post-war recovery through a study of one species, tangantangan. The environmental and imperial lenses guiding this research illustrate the connections between disparate places, events, and historical actors to understand the global ecological implications of Western colonialism on a small scale. Exploring the ecological dimensions of imperialism can allow students and scholars of world history to see the interconnectedness of large global processes that cut across real and imagined boundaries and borders. Shifting between scales, from the global to the local, makes those processes more understandable to students who may struggle with the '30,000 foot view' of history. Ultimately, this work extends Alfred Crosby's work on ecological imperialism into the Pacific and beyond 1900 to ask, "simple questions, because the answers to complicated questions probably will be too complicated to test."⁴ In this case, what was Guam's tropical forest like before tangantangan? Who likely introduced it and why? How did it become invasive? How has it transformed from a botanical interloper to an accepted, even embraced, part of the tropical forest by the local population? Answering these questions will allow us to understand how imperial powers selected and used certain species as tools of empire to control the landscape for the benefit of the dominant power.

Through centuries of environmental sculpting, Guam became an *occupied landscape*, an area of natural and built environments modified and controlled by an external power through conquest or settlement for the benefit of the imperialists. People colonize and species are part of the imperialist toolkit. Empires not only bring administration but scientists and scholars work in their own ways, whether they realize it or not, to create imperialized environments. By examining the history of this one species on the island, we can see that process unfold. Considering the interdisciplinary nature of this research that relies on archaeological studies, archival material, botanical studies, explorer journals, naturalist logs, ecological data, and historical records this article is only a brief introduction to occupied landscapes. I also recognize agents of imperial powers created and maintained most of the sources, both primary and secondary, used in this study indicating yet another layer of occupation in the production of knowledge.⁵

By tracing Guam's changing tropical forest from a largely endemic (native to a particular area or region), Asian, and Pacific one to a far more pan-tropical biome, this study repositions the island as a significant place in global environmental history by highlighting continuities of ecological domination by successive empires as they sought to control the Pacific. The importance of understanding how empire affected, and continues to affect,

colonial environments is critical at both the local and global level. In October 2020, the United States began relocating 5,000 members of the III Marine Expeditionary Force currently stationed at Camp Courtney, Okinawa, Japan to the newly created Camp Blaz on Guam and world populations increasingly struggle to deal with the accretive effects of climate change, exacerbated by modern forms of imperial domination.⁶

Thanks to Alfred Crosby and his intellectual progeny, ecology is no longer an overlooked component of historical explorations of colonialism. His work on the Columbian Exchange, and ecological imperialism more broadly, fundamentally shifted the way scholars teach and understand the consequences of European imperialism around the world, including in those settler colonies themselves.⁷ The incorporation of ecology into studies of American imperialism and militarism is a more nascent field with recent works by Richard P. Tucker on tropical resource use and extraction, Paul Sutter on the Panama Canal and David Biggs' investigation of a militarized landscape in Vietnam.⁸ All of these authors are inspirations for this work in its focus on the militarized occupation of landscapes to maintain empire along with Donald Wright's study of Niimi that focused on a small area to explore local changes brought about by global systems.⁹

Invasive species, with tangantangan being only one example, are a long-standing problem across global ecosystems. Biologists define an invasive species as a non-native species introduced either naturally or through human activities that is likely to cause environmental, cultural, economic, or political harm or harm to human health. Not every introduced species is destined to become invasive. However, those species that have a rapid growth rate, spread easily, have a high number of offspring, and tolerate a broad range of climates can quickly become invasive in certain ecologies. The introduction of invasive species is not exclusive to the modern era but the increase in trade and transportation of goods along with the speed and ease of travel over very long distances make them more widespread.¹⁰

Insular, or island, environments are particularly prone to invasive species because their fragility is defined by their geography; they are relatively small and remote from large landmasses. Historically, oceans provided a barrier to large introductions of species from continents with migratory birds, ocean currents, vegetation rafts, or sporadic human settlement being the primary conduits of arrival. For botanical species, this meant fewer opportunities to cross-pollinate with similar plants and the establishment of specialized, endemic species that did not exist elsewhere in the world. Often these endemic species evolved without defense mechanisms to protect them from introduced predators or competitors so that later, more aggressive introduced species are able to exploit an ecological niche. This can lead to extinctions, extirpations (localized extinctions), and destabilized ecosystems.¹¹ Today, Guam is internationally recognized as a "quintessential example of a collapsing ecosystem" due to the disastrous effects of accidentally and purposefully introduced and invasive species for centuries but especially after the conclusion of World War II.¹² This destabilization points to the effects of globalization on islands that, despite their small size, became increasingly important as they facilitated connections between geographic locations.

The First Occupied Forest

If the term 'pristine' evokes ideas of purity or changelessness, there is no such thing as a pristine environment, even on a small island in the Western Pacific, more than 2,000 miles (~3,220 km) away from the closest continental landmasses of Asia and Australia, and more than 7,000 miles (~11,265 km) away from North America. For millennia, natural processes brought layer upon layer of new species to Guam, the southernmost island in the Mariana archipelago. This small island, shaped roughly like a peanut, four to nine miles (~6–15 km) across at its narrowest and widest points, and thirty miles (~48 km) long, was probably completely forested at least 5,000 years ago.¹³ The volcanic soils of the southern uplands are laterite, formed primarily from basalts that weathered extensively over long periods in the warm tropical climate. Laterite soil is rich in iron oxide, often appearing red, orange, grey, or purple in color and highly acidic. This densely packed clayey soil drains poorly, and supports fewer varieties of vegetation though it can support trees even if they are unable to reach their maximum height. While scientists may not know all of the precise species in this early forest, it is clear that tall, closed canopy trees likely dominated the northern areas with their thin basic soils made up of weathered coral.¹⁴ This would also eventually be the best agricultural land even though it is more prone to erosion if left bare due to the thinness of the soil. These differing soil types meant more densely forested areas in the north, with grasses and vines growing along with somewhat fewer trees in the south.

The ocean currents that flowed through the Malay Archipelago, around New Guinea, and then north getting caught up in the equatorial currents that move through Western Micronesia deposited the seeds of some of the first trees of the tropical forest noted in Table 1 (Appendix). These botanical migrants and evolving endemic species filled in the bare soils of the island millennia before human arrival around 4,300 years ago based on charcoal particles indicating ancient fire pits, creating a relatively diverse forest ecology considering the archipelago's geographical isolation. Human migrations brought rice (*Oryza sativa*), taro (*Colocasia esculenta*), yams (*Dioscorea* varieties), bananas (*Musa* varieties), and perhaps a variety of seedless breadfruit (*Artocarpus altilis*).¹⁵

While these early introductions were perhaps small in number, rice cultivation required clearing forested areas using fire. Agriculture significantly changed both the soil composition and the natural vegetation in the northern plateaus and along the southern coast. The original limestone forest did not return to the disturbed areas, abandoned after cultivation. Instead, secondary vegetation of Pacific island silver grass or sword grass (*Miscanthus floridulus*) and low shrubs dominated these areas. Evidence also indicates the extensive use of fire for non-agricultural land clearing such as searching for wild food sources, increasing natural production, or clearing paths that resulted in deforestation and the creation of large savannas of ferns (*Gleichenia linearis*) and grasses (*Lycopodium cernuum*) that spread across the interior uplands.



Image 2: *Artocarpus altilis*, 2010.
By Lauren Gutierrez, licensed under CC BY-ND 4.0 at <https://www.flickr.com/photos/guam-flora-fauna/8448221965>.

These ancient anthropogenic (caused by humans) changes to the landscape, and the forces of natural and anthropogenic erosion irrevocably reshaped the ecosystem within less than 2,000 years. In effect, the ancient settlers who became indigenous Chamorus were, to use Crosby’s metaphor, “shock troops—marines—seizing beachheads and clearing the way for the second wave.”¹⁶ Their canoes brought the first wave of ecological imperialism by occupying the landscape and modifying it through introduced species, changes to land use patterns, and establishing agriculture to ensure their survivability. Population estimates of 50,000 to 100,000 people living on Guam by the sixteenth century CE appear to be a testament to their success.¹⁷ Indeed, perhaps the most successful introduced species on the island during this ancient period of ecological imperialism was humanity itself.

The Origin of a Species

Leucaena is a type of legume native to tropical America with several varieties of subspecies though this article will only focus on *L. leucocephala*. Like most legumes, it extracts (or fixes) atmospheric nitrogen, one of the three fundamental nutrients for plant growth along with potassium and phosphorus. The nitrogen is concentrated in the leaves, which in turn become excellent animal feed and fertilizer. After the plant dies, the stored nitrogen goes back into the air and soil through decomposition, increasing soil fertility. It is also a good nurse tree, providing shade and additional nutrients for plantation crops such as coffee (*Coffea* varieties), cacao (*Theobroma cacao*), corn (*Zea mays*), cassava (*Manihot esculenta*), pepper (*Piperaceae* varieties), and teak (*Tectona grandis*).¹⁸

This short, shrub-like, fast growing tree that grows to a mature height of fifteen to thirty feet (4.5 to 9 m) in just a few years likely originated in present-day Mexico and



Image 3: *Leucaena leucocephala*, 2013. By Lauren Gutierrez, licensed under [CC BY-ND 4.0](https://creativecommons.org/licenses/by-nd/4.0/) at <https://www.flickr.com/photos/guam-flora-fauna/30690710782/in/photostream/>.

Central America, where it grows best in dry open areas as tall tree canopies block out the light needed for growth. Botanists note *L. leucocephala* has a high degree of invasive potential because of year-round flowering, self-fertility, and the number of seeds it produces in hundreds of long clustered pods; each containing up to twenty seeds. Animals, rodents, and birds spread the seeds, and the plants quickly grow from cuttings, cut stumps, and will even grow back if only moderately disturbed by low intensity fire or harvesting.¹⁹

Among the Mexica people of modern-day Mexico, there was a long tradition of using *Leucaena* as a human food source and medicine, though the variety of *L. esculenta* was preferred over *L. leucocephala* due to its larger seeds. *Leucaena* was known there as *oaxin* (Nahuatl) or *guaje* (Spanish), with the bundled seedpods and leaves sold at markets as recorded in *La Historia General de las Cosas de Nueva España* (commonly known as the Florentine Codex) and the *Relaciones Geográficas del Siglo XVI* (*Geographic Relations of the Sixteenth Century*).²⁰ In fact, *Leucaena* trees and their seeds were so important the original name of the capital city of Oaxaca was the Nahuatl word, *Huaxyacac*, referring to the indigenous name of the tree. While the Mexica did use *L. leucocephala* for *guaje* when the preferred variety was unavailable, they more often used it as fire wood, boundary markers, and as shade for young cacao trees.²¹

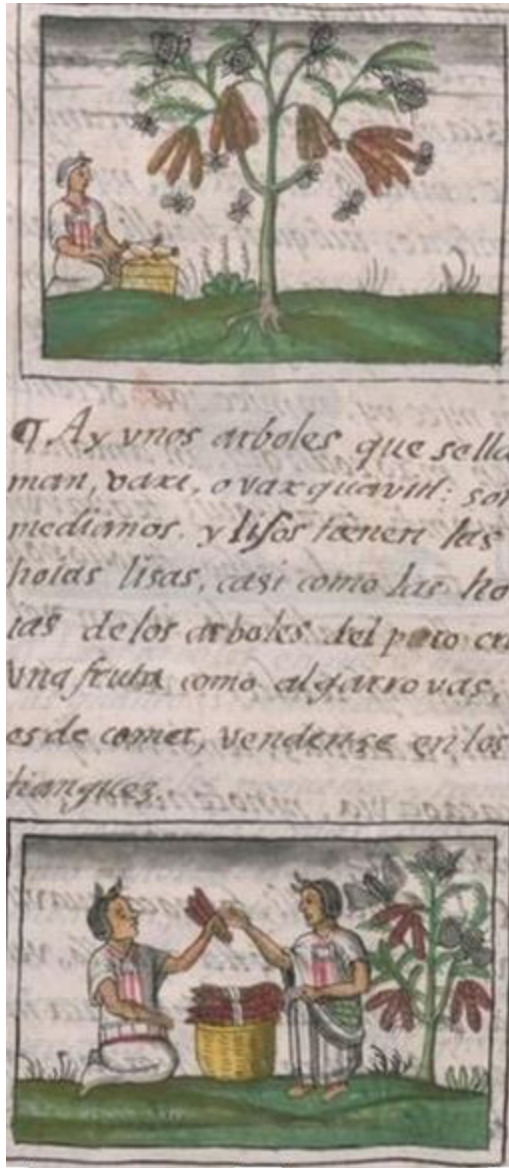


Image 4: Top, *Leucaena* tree with seed pods. Lower, *Leucaena* pods harvested and bundled for market. Uaxi. Source: Fray Bernardino de Sahagún, “Historia general de las cosas de nueva España (General History of the Things of New Spain—The Florentine Codex)” (Manuscript, 1577), 562, folio 124, Medicea Laurenziana Library, Florence. In the Public Domain courtesy of the World Digital Library, at <https://www.wdl.org/en/item/10096/view/3/562/>.

As Spain expanded its empire, finding suitable trees for shipbuilding became of paramount importance to the maintenance of state power. A large galleon could take as many as 2,000 trees for its construction.²² This led to the creation of “one of the earliest and largest bureaucracies dedicated to forest use regulation in the early modern world” and the extraction of large hardwood trees like oak, pine, beech, elm, walnut, mahogany, and teak in Spain and the occupied landscapes of the Americas and the Philippines.²³ However, *L. leucocephala* did not figure into this Spanish timber hunger related to a perceived scarcity because it was neither large nor a hardwood. Additionally, colonists of New Spain did not

consider *guaje* palatable, with the exception of its infrequent use as a substitute for garlic.²⁴ Thus, they largely ignored the tree, leaving the Mexica to continue traditional uses and management of the trees among the indigenous and mestizo populations. With the introduction of large animals to New Spain from Eurasia, *L. leucocephala* became widely regarded as a preferred fodder for cattle, goats, and other ruminants due to its palatability.²⁵

The Arrival of Tangantangan

Over millennia, Chamorus introduced forest species and reshaped the land for their own uses, but the arrival of Spanish ships brought a much more global collection of animals, plants, and diseases to the island. Long before venturing into the Pacific, Crosby noted that as Europeans sailed first to the Atlantic islands of the Canaries, Azores, and Madeira in the fifteenth century they carried on board their ships a “scaled-down, simplified version” of species common to the Mediterranean region, a “portmanteau biota.”²⁶ Where these species had success in introduction, Europeans created “incomplete and distorted” neo-Europes they were then able to exploit for comfort and profit. This process of ecological imperialism spread across the insular areas of the Americas beginning with Columbus’s second voyage to the Caribbean that included seventeen ships, 1,500 people, and hundreds of animals.²⁷ Ultimately, this event was the beginning of introducing hundreds of new species into the American biome from Mediterranean honeybees to citrus fruits originating from Asia, delectable sweetness following in the wake of imperial conquest.

Historians tracking the development of ecological neo-Europes often focus on the introduction of crops and animals that thrived in climates similar to that of continental Europe, like those of the more temperate plateaus and interior uplands of New Spain. However, many of those early Spanish introductions also did well in tropical environments. Eventually, sugarcane, rice, millet, horses, chickens, cattle and other species familiar to Europeans came to thrive first in the tropical islands of the Caribbean and then across the American continents by the end of the sixteenth century. As these new species came to occupy their own ecological niche, they adapted to the availability of resources in the new environment. One of these adaptations with far reaching consequences was the incorporation of *L. leucocephala* into the diet of the burgeoning cattle population in the absence of the centuries old pasturelands of Andalucía.²⁸

The spread of *L. leucocephala* from its American origin forms an ecological web, following the Spanish introduction of cattle to the Western hemisphere and later into the Marianas and Philippines in the Pacific. The cattle fed the colonizers and the bushy tree fed the cattle, making both tools of empire. The bovines, first introduced by Columbus in 1493 and in larger numbers by Hernán Cortés and Gregorio Villalobos in 1521 for breeding purposes, became known as Criollo cattle; a term used for animals and humans alike to denote Iberian origins and migration to the colonies. The animals’ meat, milk, leather, fat for grease, and muscle power proved crucial to colonial life in the Americas. Within fifty

years, *conquistadors* continued cattle introductions into Nueva Vizcaya (Chihuahua) and Jesuits brought them into the Sierra Madre Occidental with their establishment of a mission to the Tarahumara in 1627.²⁹ These areas along with those of modern day New Mexico and Texas, which also became sites of cattle introduction, were all semi-arid scrublands with limited vegetation. The cattle proved to be adept browsers, eating plants other animals would not eat including prickly pear (*Opuntia* varieties), creosote bush (*Larrea tridentate*), and mesquite (*Prosopis* varieties). *L. leucocephala*, with its tender highly digestible leaves that were rich in protein must have been a treat.

Magellan may have sailed across the Pacific in 1521, claiming the Mariana Islands for Spain, but contact with European or American species was limited and inconsistent with little to no species introductions until the establishment of the Manila Galleon trade route in 1565. Arturo Giráldez points out these ships, “originated the first planetary economy, the intercontinental market from which emerges the globalized world.”³⁰ During the 250 years of that shipping line that transported Spanish silver and other American and European goods from Acapulco to Manila (*Galeón de Acapulco*) to exchange for a long list of Asian trade goods, Guam became the only stop along the route for resupply of fresh food.³¹ In effect, the Manila Galleon made the Pacific a Spanish Lake with Guam crucial to its success. Following the pattern of previous exploratory voyages, the route to the Philippines tracked through the Marianas but the return voyage (*Galeón de Manila* or *Nao de China*) went farther north, bypassing the archipelago. That is not to say no ships traveled from the Philippines to Guam, however. Regular resupply ships made the short but often treacherous two-week voyage from Manila to deliver essentials and official communications from the Real Audiencia of Manila, which governed the Spanish East Indies.³²

When Miguel López de Legazpi arrived on Guam in 1565, on his way to establish the first Spanish settlement in the Philippines, a chronicle of his voyage noted, “Not one sign of any cattle, wild or tame, was found in the whole island.”³³ Between 1565 and 1668, European arrivals were sporadic and usually temporary, consisting of shipwreck survivors, deserters from resupplying ships, and the occasional priest. Imperial occupation of the landscape began in earnest with the establishment of a Jesuit mission and garrison in 1668, with a governorship soon after as ordered by the Captaincy General of the Philippines, governed from Mexico City by the Viceroyalty of New Spain underscoring Guam’s importance. By that time, the viceroyalty knew quite a bit about the landscape, resources, and people on the island from traveler accounts, using this knowledge production as a tool of empire.

One thing the Spanish knew based on their earlier colonization of the Americas: In order to enjoy a similar lifestyle in the Pacific as they did in New Spain, colonizers had to reshape the island, bringing plants and animals along with Spanish officials, soldiers, and laborers from New Spain and the Philippines. In this long project of ecological imperialism, introduced species came from both the east and the west, with the majority arriving from the Americas after the 1660s. Some of the earliest introductions included maize (perhaps

as early as 1602) and cacao, arriving along with the stone *metate* and cylindrical stone *mano* (mortar and pestle) used to grind the corn in preparation of flat round cakes known as *titiyas* on Guam.³⁴ The exact date of tangantangan introduction is unknown, but it must have been concurrent with or soon after livestock introductions between 1668 and the 1720s. Corroborating this date range, the Spanish went on to introduce tangantangan to the Philippines, known there as *ipil-ipil*, within a few decades based on descriptions given in *Flora de Filipinas (Plants of the Philippines)* published in 1837.³⁵ Sources related to the establishment of the garrison, accounts of Commodore George Anson, and the work of twentieth century tropical plant specialists suggest this fifty-year period is the most likely time of introduction.

Writing in 1690, Fray Gaspar de San Augustin, a chronicler of earlier Spanish voyages to the Philippines surmised about Guam, "If at present they have pigs and cows, they have been acquired from the ships passing by there and coming from New Spain."³⁶ Perhaps it is unusual to think of cattle as transpacific travelers but ships frequently carried live animals on board to supplement the dried or salted fish, salted or brined meat, and hard biscuits that were customary maritime provisions with those of high rank or elite passengers eating better than the rest of the crew. This was usually smaller livestock that did not compete too much for space such as chickens, pigs, goats, and sheep.³⁷ However, the 20 hogs, 500 chickens in cages stacked on the deck, and large quantities of fresh fruits and vegetables brought on board a galleon in 1699, did take up a significant amount of space before it was reduced during the first few weeks of the voyage.³⁸ Since the ships transferring silver between Acapulco and Manila were not usually overburdened with trade goods, galleons making their way westward had more room for other larger animals to travel as cargo, like cattle. Crews received additional pay if they could keep the animals alive and in relatively good health to their destination.³⁹ Some of these were destined for Guam to supply the burgeoning colony there.

As part of the initial *socorro* (relief supplies), the *San Diego* off-loaded new species including rams, sheep, a bull and cow, and three parrots along with its human passengers in 1668.⁴⁰ Plants, seeds, and more animals including cattle, pigs, goats, and chickens arrived on subsequent galleons as part of regular *socorro* distributions, which also included wine, flour, soap, cloth and clothing, tools, metal sheeting, and iron.⁴¹ Indeed, cattle had occupied the island and grazed freely by 1684, as disdainful letters written by Jesuits accused the governor, Damián de Esplana, of dereliction of duty and spending too much time, "building pigpens, fattening hogs, and hunting cattle."⁴² For the first few decades, these regular arrivals of animals and seeds were critically important to the daily maintenance of the settlement. After 1680, the government annually expanded the amount of plantation land under cultivation by Chamorus in efforts to increase production of food crops for use by the Spanish administrators, missionaries, and soldiers, leading to less reliance on *socorro*.⁴³ Other utilitarian goods arrived on the resupply ships from Manila along with an early introduction of Philippine water buffalo known as carabao (*Bubalus bubalis*). Chamorus

used the large, sturdy carabao for pulling carts, plowing rice paddies, and they may have been a food source for the indigenous people, but the Spanish preferred beef, particularly from the Criollo cattle well-established in the Americas by the seventeenth century. Both ruminants were perfectly suited to eat tangantangan in addition to savanna grasses, the tender ends of banana leaves, and the glossy broad leaves of the breadfruit tree.

Cattle, and their forage, may have arrived early on in Spanish colonization but it took a few decades for large herds to roam the Marianas. Though it probably arrived on the Manila Galleons, tangantangan may not have been a purposeful introduction at first. Ethnobotanists suggest it may have been an, “involuntary passenger, perhaps contained in the sand used for ballast.”⁴⁴ Other Portuguese, English, Flemish, or Dutch ships that stopped at Guam after departing from areas of the Caribbean, Yucatan peninsula, Gulf of Mexico coast, and the Tehuantepec isthmus may have also carried it in their ballast sand, as this form of species introduction has occurred with other species, notably European searocket (*Cakile maritima*).⁴⁵ It could have also arrived as left over fodder, provided to the animals for their two-month voyage across the Pacific, seeded itself, and eventually became naturalized.

The cattle population did very well and within a few decades, the Spanish governor made nearby Tinian into an island-sized larder for livestock overflow. Commodore George Anson of the British Royal Navy discovered this when he arrived in the Marianas in August 1742 aboard HMS *Centurion*. In 1740, Anson set out from Britain leading a squadron of eight ships ordered to attack Spanish imperial possessions in the Americas and capture ships of the Manila Galleon line as part of the War of Jenkin’s Ear. By the time he crossed the Pacific, he had only one ship and a crew sickened with scurvy. He and over 120 members of the crew disembarked at Tinian for two months to convalesce and repair their squadron flagship. They did not visit Guam since Britain and Spain were at war. With an active garrison, they faced arrest or worse if captured.



Image 5: Carabao, 2012. Photograph by the author, used with permission.

In his account of those months, Anson remarked the island had, “the air of a magnificent plantation where large lawns and stately woods had been laid out together with great skill.”⁴⁶ He noted the abundance of cattle, estimating perhaps as many as 10,000, with large numbers of pigs and chickens as well that roamed freely, thriving on the abundant vegetation. Anson did not say whether those thousands of cattle slowly chewed leafy mouthfuls of tangantangan and he only saw Tinian but clearly, this ecological occupation was transforming not only Guam with waves of animal and plant species introductions by governors, priests, and generals, but the other Mariana islands as well.

Another concurrent source indicated tangantangan was doing well on Guam at this time. The limestone soils were the perfect growing medium and tangantangan thickets were substantial enough by the mid-eighteenth century to provide abundant wood fuel and animal fodder. Illustrating its abundance, Chamorus may have used large piles of felled tangantangan along with other tree species to comply with the long-standing decree that signal fires should light the cliffs and beaches for approaching galleons every night beginning in the last week of May through June.⁴⁷ Tangantangan fires may have guided the galleon *Nuestra Señora de Covadonga* around the reef that encircles much of Guam to safe anchorage in June 1743. It was then that the Portuguese captain and fourteen-year veteran of the line, Geronimo de Monteiro, learned of Anson’s presence in the Pacific and the *Centurion’s* departure to Macau in October 1742. Eventually the *Centurion* would capture the *Covadonga* and its more than thirty-four metric tonnes of silver at Cape Espiritu Santo in June 1743, in one of the most well-known maritime battles of the eighteenth century.

Due to more liberal trade policies that ended governmental control of transpacific exchanges and growing political instability in New Spain, the last galleon sailed from Acapulco to Manila in 1815, during the Mexican War of Independence. Somewhat ironically, the official name of the ship was *San Fernando* with the alias of *Magellan*. The end of the Manila Galleon trade also meant a shift in the arrival of plants and animals from the Americas. European and American vessels carrying merchants, explorers, pirates, and whalers stopped at Guam over the course of the nineteenth century but not as regularly, nor with the purposeful intention of introducing species to occupy the landscape. From 1815 to the end of the Spanish empire in 1898, the most regular arrivals were from Manila, bringing some limited garden plant introductions. Instead of creating a neo-Europe, Spanish occupation of the landscape ultimately created a hybrid of the Mediterranean littoral, tropical Americas, and the indigenous forest. In essence, Guam became an ecological microcosm of the Spanish empire. After the United States embarked on its own imperial venture on Guam with the conclusion of the Spanish-American War, the flow of species came largely from this new empire, along with Hawaii, Manila, and Japan.⁴⁸

Ultimately, it is difficult to trace the exact introduction of tangantangan because it was not highly regarded by the Spanish colonizers of New Spain. They did not use it to build ships or grace their dinner tables; it was an indigenous American food source and fodder

for livestock, thus discounted as not important enough to record. In Carl Linnaeus' taxonomic identification of it in 1753, he referred to the tree as "*Mimosa glauca*," referencing other literature published as early as 1678. George Bentham proposed a new taxonomical name, "*Leucaena glauca*," in 1842, which botanists recognized until the identification work of Dutch botanist, Hendrik de Wit, renamed it "*Leucaena leucocephala*" in 1961.⁴⁹

The culinary traditions of eating *guaje* did not transfer to the Chamorus, meaning tangantangan did not appear as an important cultural species in interactions with the population. Chronicles of colonization, shipping manifests, and otherwise profoundly thorough expeditions of knowledge production are silent about the tree. For instance, Charles Gaudichaud-Beaupré, the botanist who sailed with Louis Claude de Freycinet spent two months collecting information for a French scientific expedition in 1819, but he did not mention tangantangan.⁵⁰ Taddaeus Haenke collected the first botanical specimens on Guam as part of a brief stop by the Malaspina Expedition, February 12–24, 1792.⁵¹ Due to the haste in departing because of dangerous winds, Haenke's work was incomplete. Governor Francisco Olive y García may have included it in his report on useful trees in the 1880s but his references to taxonomy were vague and three of the most prominent twentieth century botanists who studied Guam's vegetation disagreed on the identification. Olive also recorded most of the 607 carabaos and 1,607 head of cattle were living on Guam, which had fallen into a state of poverty and neglect after the end of the galleon trade. During a drought in 1885, "it became necessary to cut the tree tops for cattle fodder" though he did not identify the trees.⁵² Could these be the illusive tangantangan? It may not have dominated the forests by the end of the eighteenth century, but tangantangan was there, growing in thick bunches in the limestone soil, with Chamorus using it as boundary markers, feeding animals, and occupying the landscape.⁵³

Cataloging Empire

Lieutenant Colonel Juan Marina was governor when a small American fleet led by Captain Henry Glass sailed into Apra Harbor aboard the USS *Charleston* early on the morning of June 20, 1898, escorting three troop transports—*City of Peking*, *Australia*, and *City of Sydney*—from Pearl Harbor to the Philippines, and ordered to capture Guam along the way.⁵⁴ News of the outbreak of war between the United States and Spain had not yet reached the island. By this point, Guam was in marked decline and impoverished for more than half a century through imperial ambivalence. By the next day, Glass had accepted the formal surrender of the island and recorded, "no guns remain in the islands except four small cast-iron guns of obsolete pattern . . . formerly used for saluting, but now condemned as unsafe even for that purpose."⁵⁵ The bloodless American capture was complete and Glass sailed on for Manila two days later taking the Spanish officials as prisoners of war, 21,000 bananas, 10,000 coconuts, and 50 razorback piglets with them.⁵⁶ The Spanish-American War

marked the end of Spain's empire and, along with the resolution of the Hawaii annexation debate that same year, the beginning of the United States' formal commitment to projecting its imperial power in the Pacific.

Taking up Alfred Mahan's admonition to extend United States naval presence into the Pacific and expand coaling stations in "looking outward" towards imperialism, President McKinley placed Guam under the control of the Department of the Navy, making the entire island a naval station, which governed with what essentially amounted to martial law and concomitant environmental domination until 1941.⁵⁷ Rather than an extractive economy centered on a commercial crop like sugar in Hawaii, the southernmost Mariana Island had an ideal strategic location for ships traveling to Hawaii and the Philippines as a station for resupply and repair. Guam would also soon be the landing site of the trans-Pacific cable. That, along with the speed of maritime travel brought about by the completion of the Panama Canal further signified Guam's important role in America's global affairs.

After more than a year of political confusion and temporary administrators, Captain Richard P. Leary became the first Naval Governor in 1899. He set about installing direct military rule and the American civilizing mission through a series of twenty-one far-reaching proclamations including requiring each family to have a certain number of livestock. Lieutenant William E. Safford arrived aboard the USS *Brutus* August 13, 1899 to become the Lieutenant Governor, handling the day-to-day governing and addressing the grievances of Chamorus. Safford's contribution that has a far more lasting legacy is his work chronicling his year on the island and collecting material for the United States National Museum (now the Arts and Industries building of the Smithsonian Institution in Washington, D.C.). Safford noted the lack of sufficient species collections taken by earlier naturalists and numerous species still needed identification. He collected some samples of botanical species and dried them with the help of his Chamoru assistants. Safford, his secretary, José de Torres, a younger assistant, Vicente Franquez, with occasional assistance from his housekeeper, Susana Perez, and another young man, Benigno Acosta prepared the specimens for transfer to the museum. Based on the indigenous names he recorded at the time, later botanists Raymond Fosberg and Benjamin Stone would identify many of those as endemic to Guam.

After resigning from the Navy in 1902, Safford went to work first at the Smithsonian and then in the division of Tropical Botany at the United States Department of Agriculture. He proved to be a pioneer in developing the field of ethnobotany as a tireless observer of natural history with largely sympathetic reflections on Chamoru culture, though sometimes with a streak of paternalism, producing knowledge used by scholars to this day. Among Chamorus, Safford's work continues to have a revered status with local historians like Jillette Leon-Guerrero, founder of Guamology, Inc., who republished his voluminous works on Guam in print and electronic form for use by teachers, scholars, and the public.

Safford went on to publish several works on Guam's ecology and culture. His *The Useful Plants of the Island of Guam*, as Frank Quimby notes, was, "the most comprehensive

history, ethnography and botanical account of the Marianas available in the 20th century.⁵⁸ Indeed, in a letter to the *Washington Post* after Safford's death, his wife, Clare Safford, stated, "botanists and agriculturalists refer to [it] as the Bible of Pacific Flora."⁵⁹ Whether he realized it or not, his intensive effort to catalog and quantify what the United States had acquired with its new territory became an early tool of the American empire. His publications assisted the Navy and later the Department of the Interior in building and maintaining empire, whether it was later water and sanitation systems, public health, attempts to expand copra production (dried coconut meat; the only export during Safford's tenure), or infrastructure development for the naval base and villages.

In a larger sense, imperialists often used the production of knowledge on acquired territories to prove their supposed superiority. By collecting information on local knowledge, skills, and traditions and then discounting it as simplistic, inefficient, or unsuitable for a 'civilized' population provided a convenient justification for imposing outside systems of control and a civilizing mission to reshape the colonial landscape right along with the culture. In some cases, empires provided the means for scientists and naturalists to explore and encounter new knowledge such as that on valuable resources or commodities and then used that knowledge to benefit the empire. As an example from the previous section, Spanish fears of a timber famine led explorers and naturalists to be preoccupied with timber resources in their voyage accounts, providing valuable information for imperial decisions about where to occupy for timber extraction. In the late nineteenth and early twentieth centuries, we see a similar focus on coconut palms due to the development of the lucrative copra industry in the Indian Ocean and Pacific colonies held by the empires of Britain, Germany, and the United States.⁶⁰

Turning to Safford's work in this hunt for tangantangan provides evidence to counter a common misconception that the United States military introduced the tree in 1947.⁶¹ Rather, it already existed on the island perhaps for more than two centuries if we track it to the beginning of the Spanish colony and the introduction of cattle. Safford recorded its existence among a number of other bushes along the inner strand area but he did not list it as a principal tree. Abandoned clearings in the northern limestone soils, often overgrown "with common tropical weeds, thickets formed by hedge plants, plants once cultivated which have continued to grow, or indigenous species which usually grow on the edge of the forest or in open places" contained far more tangantangan.⁶² Among these different types of plants, Safford indicated it was one of the primary hedge plants that formed large thickets and he recognized its distribution across other occupied biomes such as that of the British West Indies where it was known as lead tree. By that time, the tree had spread throughout India, tropical Asia, Africa, and somewhat in the Mediterranean region through occasional plantings.

Safford noted the advancement of these hedge plants was due to fallowing lands that usually grew tobacco, sweet potatoes, and maize. Soon the scrubby bushes arrived along with the tangantangan including, "cassia, indigo, sappan wood [*Biancaea sappan*]," physic

nut (*Jatropha curcas*), and limeberry (*Triphasia trifolia*), and other leguminous plants.⁶³ The legumes, like tangantangan, improved the soil, critical to agriculture since Chamorus did not use any additional fertilizers. Safford did not indicate the use of tangantangan as a nurse tree for cacao at the time he was on Guam. Instead, he said Chamorus used banana plants to protect the delicate trees from the wind and sun, with the added bonus of producing fruit themselves.⁶⁴ However, Chamorus did use tangantangan trees as enclosures for their gardens since stakes of it took root so readily.⁶⁵ He also listed tangantangan as a weed widely distributed across the island and present in the field behind the overgrown Government House in Agaña (Hagåtña).⁶⁶

About a month after Safford's arrival, Captain Benjamin Havner sailing with a cargo of California wine on the schooner *Bessie E. Stevens*, saw that cattle thrived on the island during his three-month stay.⁶⁷ Safford noted that most cattle on Guam were kept tethered by 1900 to keep them out of unfenced gardens and cornfields, with only a "few herds" of cattle and carabao grazing in the interior of the island. In his discussion of forage plants Safford noted Chamorus usually gathered forage for the tethered cattle, carabao, horses, and pigs. Among the forage plants gathered, he lists "leguminous shrubs" which could include tangantangan along with moringa (*Moringa oleifera*), mungo bean (*Vigna mungo*), peanuts (*Arachis hypogaea*), creeping tick-trefoil (*Meibomia triflora*), camachile (*Pithecellobium dulce*), Bermuda grass (*Cynodon dactylon*), and several other grasses, and they particularly enjoyed breadfruit leaves. While noting the animals did eat tangantangan, it was "reputed to be injurious" to them, basing this statement on an account of Lyster Hoxie Dewey, an assistant botanist at the United States Department of Agriculture. Dewey was working on the island of New Providence in the Bahamas where he, "was shown horses, without manes or tails, which had lost them, it was declared, as the effect of eating this plant."⁶⁸ As previously noted, the loss of hair would not occur in cattle because, as ruminants, they have the ability to digest the mimosine toxin. With increasing numbers of Americans arriving on the island, the livestock populations began to dramatically decline. Chickens, pigs, and cattle all declined to the point that Safford feared it was, "only a question of time when all the cattle will be killed off" on September 24, 1899.⁶⁹

In addition to cataloging the plants of Guam, Safford intended to continue the process of ecological imperialism by making introductions of his own. He brought seeds and plants with him from Honolulu and ordered more from Japan and San Francisco soon after his arrival with plans to establish a nursery of "useful plants" and ornamentals that would thrive in the tropical climate including "chirimoyas [sic; (*Annona cherimola*)], alligator pears [avocados (*Persea Americana*)], mangosteens [(*Garcinia mangostana*)], durians [(*Durio* varieties)]" and "Polynesian chestnuts [(*Inocarpus fagifer*)]."⁷⁰ Many of these were recent discoveries of American botanist, David Fairchild, who introduced more than 200,000 plant species to the United States during his years managing the Office of Seed and Plant Introduction at the United States Department of Agriculture beginning in the 1890s.⁷¹ Many

of these plants made their way to Guam, brought by American military personnel, their dependents, and administrators. The Meyer lemon, found growing in China by Fairchild's agricultural explorer, Frank Nicholas Meyer, was introduced to Guam directly by the United States Department of Agriculture.⁷² The population of Guam was small at the turn of the twentieth century, with the 1901 census listing 9,676 people.⁷³ These introductions and others, intended to contribute variety to the local diet would prove crucial to feeding island residents along with increased imports as the population dramatically grew over the course of American occupation, reaching 27,985 residents (total, including military personnel 58,754) by June 1950.⁷⁴

Throughout Safford's investigation of Guam's plant life, several things are clear. Spanish occupation of the landscape for over two centuries transformed the forest ecology and the cultivated crops in gardens and plantations. Almost all Chamoru families practiced subsistence agriculture and raised their own livestock; even those who lived in the villages had ranches (*lãnchos*) carved out of the forest. Ancient introductions of rice, coconut palms, breadfruit, taro, and bananas existed alongside thriving coffee bushes, rows of maize, cacao trees, and garden plants from Afro-Eurasia and the Americas.⁷⁵ More introductions, particularly those suited to American tastes or uses flowed in within weeks of occupation that would continue unabated until Japanese occupation in December 1941. Importantly, Safford did not indicate tangantangan was taking over entire areas, though he did mention it as a weed, perhaps hinting at its future invasive potential. Similarly, E.H. Bryan's 1937 study on the plants of Guam characterized tangantangan as "Penetrating into the native



Image 6: Agaña (Hagåtña) with coconut palms and limestone forest in the distance. Aerial of Agaña City, Guam, 1923. Source: In the Public Domain courtesy of the Naval History & Heritage Command, L40-11.09.09.

forest, as along roads and edges of clearings,” referring to it as “invading the forest” but he did declare it a “good feed for cattle.”⁷⁶

Guam was not the only occupied landscape in the Pacific, with the Philippines and Samoa undergoing their own transformations. It was also part of a much larger process of ecological transformation that many agronomists and botanists saw as a positive development brought on by extensive industrialized transportation networks and Western economic dominance of the modern era. Bringing foods and plants from the world to enliven American markets was part of it but so too were the Americans who traveled the world collecting, cataloging, and introducing plants they saw as useful in this ecological civilizing mission.

The Forest of Survival and Deathscape

It is not hyperbole to state the ecological transformation of Guam in the twentieth century had everything to do with American reoccupation of the island and its landscape in 1944. Japanese forces attacked Guam within hours of bombing Pearl Harbor, on December 8, 1941 (December 7 on the mainland due to the International Date Line). Mitsubishi planes took off from Saipan in the Northern Marianas, bombing Guam’s prominent villages of Agaña (Hagåtña), Piti, and Sumay along with the Naval Station for two days to prepare for the invasion forces *en route* from the Bonin Islands. The Governor of Guam, Captain George J. McMillin, understood his small force of 271 Navy personnel, 153 Marines, and 80 Chamorus of the Insular Guard would not be able to resist a full-scale Japanese invasion (including 5,500 soldiers and a special naval landing force of 400).⁷⁷ No reinforcements were coming. After less than an hour of fighting and twenty-one deaths, McMillin knew surrendering was the only option. Guam became the first American territory occupied by the Japanese on December 10, 1941 and part of its “absolute national defense sphere.”⁷⁸

All surviving United States military personnel and civilians, about 500 people, spent the rest of the war in prison of war camps in Zentsuji, Japan with only half surviving to the end of the war.⁷⁹ The occupation was brutal for the more than 22,000 island residents many of whom scattered from the bombed-out villages to live at their ranches. They experienced hunger, internment, forced marches, forced labor, beatings, rape, and executions by the *Keibitai*, the Japanese security force that killed at least 1,170 people. It also began another occupation of the landscape as the *Minseibu*, the Japanese naval civilian administration, gathered thousands of people into forced labor crews who used machetes, picks, shovels, and axes to clear large areas of tropical forest for airfields, roads, bridges, and the expansion of rice cultivation. As part of the Greater East Asian Co-prosperity Sphere, Guam was to be self-sufficient in agricultural production in addition to supplying food to 30,000 troops defending Japan’s periphery. The *Kaikontai*, a militarized unit specializing in agriculture, arrived with mechanized farm equipment including twenty tractors, plows, and cultivators to increase production.⁸⁰

To survive Chamorus turned to the forest, not only to have a roof over their heads, but for food and protection. Women and girls fled into the dense undergrowth to escape rape by *Keibitai* on patrol. Wild pigs, deer, and chickens provided valuable protein sources in the form of meat and eggs. The forest also hid carefully planted crops of yams, taro, fruits, and vegetables so they could avoid Japanese confiscation. Growing rice in the forest was difficult but corn easily grew in small stands, resulting in a shift in cereal production that continued after the war. Then, as now, it was the place of the taotaomona—ancient ancestral spirits that are “prevalent in desolate places, remote beach areas, the limestone forest, the ‘boonies,’ graveyards, karst caves with water in them, and deserted houses.” They may be good or evil but many protect against moral infringement. Specifically, they inhabit the banyan trees and people must ask permission before entering the forest. For this reason, banyan trees are still considered sacred to the point that, “Farmers and developers strip the land to the bare earth yet leave the banyan trees intact.”⁸¹ In his memoir of the war and occupation that began when he was thirteen years old, Ben Blaz recounted feeling the protection of the taotaomona in providing food and safety for his family. The forest was no longer a place of fear with “menacing and frightening” branches but a “sanctuary,” a “refuge,” and a place where he felt connected to his ancestors.⁸²

The forest as provider extended to the trees themselves. Coconut palms provided *tuba*, sweet coconut sap that Chamorus could drink immediately or ferment into an alcohol; a practice introduced by Filipino arrivals during the Spanish occupation. Chamorus also made the sap into vinegar for cooking and washing. Pressing coconut meat produced oil for use in lamps and cooking. It was also an excellent food source for both people and animals, especially chickens and pigs. Coconut trunks and fronds became the supports, walls, and thatched roofs of new houses built during the occupation and repaired the bombing damage to older homes.

Blaz also recounted how tangantangan, “held in low regard,” “the bane of anyone who ever tried to clear a piece of land,” provided as well. His family used the fresh leaves as “an exceptional animal feed” and mulched the dried leaves with their rich nitrogen as a fertilizer. The improvement of the soil just from the presence of tangantangan meant in recently cleared areas, “almost anything could grow in the soil that was left behind.” He noted the “unmatched fragrance,” similar to mesquite, and the long, slow-burning flames tangantangan produced when used as firewood. In the garden, smaller branches became climbing poles for yams and beans and the trunks of larger trees made “good foundations for houses or posts for fencing” when felled. He may have also provided the first documentation of its human consumption on Guam, not in the form of roasting the seeds as in Mexico but grinding and mixing them with water and filtering it for a coffee substitute.⁸³

These wartime experiences of a young boy hint at the accretive reality of occupied landscapes and ecological imperialism. Each successive occupation overlaid the previous one, but did not fully replace it. The Chamoru occupation, characterized in this case by

traditional land use patterns, the use of forest products, agrarian practices, and conceptions of the sacred forest existed alongside the legacies created by Spanish occupation with its plant and animal introductions. Those new species transformed large areas of the forest into pastures and reshaped gardens, changing the diet, culinary traditions, and culture of Chamorus as they negotiated the process of adopting or rejecting the new arrivals. Added to these two occupations were almost fifty years of the first American landscape occupation, bringing more plant and unintended pest introductions but a significantly smaller number of new animal species. The tropical forest may have been beautiful to Safford with all of its variety, but like many progressively minded Americans engaged in the civilizing mission abroad he hunted for plants with a missionary's zeal that were useful in creating ecological transformations to benefit indigenous people. The fourth occupation of the landscape, by the Japanese, proved the usefulness of tangantangan beyond livestock fodder, cleared more areas of the forest, brought mechanized farm equipment, and ironically, contributed to the demise of rice production and its replacement with corn. The fifth occupation began with the destruction of the landscape by American bombs and continued through a process of military-directed recovery.

The strategic value of the Mariana Islands took precedence among the Central Pacific military planners. Occupying the Marianas put the Japanese home islands within range of the newly developed Boeing B-29 Superfortress. The invasion began in June 1944 on Saipan, a settler colony of the Japanese empire for twenty-five years and the most heavily defended, as the first target. The Japanese defenders of Saipan proved difficult to defeat, setting back the timeline for the invasion of Guam by more than a month to July 21. In preparation for the eventual ground assault to begin on the four beaches between Asan Point and Adelup Point, American planes and ships bombed the defenses of General Takashima Takeshi's 18,000–20,000 army and navy personnel during that delay, at first sporadically beginning on June 16, then intensively beginning July 8. Indeed, those 13 days were “the longest prolonged air and naval shelling of any of the landings” in the Central Pacific.⁸⁴ Rear Admiral C. Turner Joy used the firepower and bombs of his four heavy cruisers, twelve destroyers, and two escort carriers to target coastal defenses, anti-aircraft positions, airfields, and the high ground of inland areas where planners assumed defensive fortifications existed. Secondary sites were areas of troop concentrations, communication lines, warehouses, and command positions but these were more difficult to target with any precision. Aerial photographs of Japanese defenses taken in April and May were of limited use because the thick forest cover obscured large areas, but planners hoped, “that American firepower and Marine bravery would overcome their lack of knowledge.”⁸⁵

During the bombardment, the Navy expended, “836 rounds of sixteen-inch, 5,422 rounds of fourteen-inch, 3,862 rounds of eight-inch, 2,430 rounds of six-inch, and 16,214 rounds of five-inch shells.”⁸⁶ By the day of invasion, planes had flown 3,332 sorties and dropped 1,245 tons (~1,129 metric tonnes) of bombs, mostly along the western side of the

island. On the day of the invasion alone, naval pilots dropped an additional 405 tons (~367 metric tonnes) of bombs in 967 sorties. Thus, well before soldiers and marines stepped on the beach, this bombardment killed perhaps half of the Japanese defenders and destroyed most of the buildings (eighty percent) in Agaña (Hagåtña), along with the villages of Asan, Agat, Sumay, Piti, areas near Orote peninsula, and four miles of landscape in any direction.⁸⁷ A lack of intelligence reports on the locations of Japanese fortifications, and a more general lack of knowledge about Guam prior to the war, resulted in much of the civilian infrastructure, forests, and crops in these areas becoming collateral damage.

The deforestation caused by bombardment remained in a relatively confined area. However, once the land invasion began on July 21, commanded by Marine Major General Roy Geiger of the III Amphibious Corps and carried out by the combined 59,400 men of the 3rd Marine Division, 1st Provisional Marine Brigade, and the Army's 77th Infantry Division as support, much of the island's forest became a casualty of war. Bulldozers cleared land to build emplacements for weapons during the invasion and cut roads from the beaches up into the hills.⁸⁸ The 682 armored pieces landed on Guam including a large number of tanks and halftracks, troop movements across the interior uplands and the northern limestone forest, flamethrowers used to clear Japanese troops from caves, and battles occurring in the thick underbrush of the forest denuded the landscape.⁸⁹ Writing about August 6 and 7, Pascual Artero could hear the "continuous drumming" of supporting fire from the ships along the reef line as "huge stones rolled down, giant trees were cut in two, losing branches and leaves, until not a leaf was left."⁹⁰

The fighting in the limestone forest in particular was "not typical" of most island-hopping operations in the Pacific because it was a "slow, cautious advance" in part due to sporadic opposition but also because of the difficult hilly and often thickly overgrown terrain. Accounts of those operations refer to constant communication problems, getting lost in "very dense growth," unable to see where they were going, and being reduced to using compasses for navigation amidst "towering trees up to a hundred feet tall."⁹¹ Tank destroyers led the way when possible, cutting paths along with bulldozers, breaking down areas around clearings that appeared likely sites for ambush, blasting away Japanese foxholes dug between the roots of ironwood trees, and engaging in tank battles with the remaining Japanese forces.

During operations further to the south, a three-man unit came upon the Manenggon concentration camp that the Japanese hastily created by bulldozing the forest and erecting guard towers. The camp held perhaps as many as 18,000 people, who had to construct their own dwellings out of tangantangan branches with coconut-thatched roofs.⁹² Once military units started to make contact with Chamorus heading to the American lines the local people assisted as guides, interpreters, and volunteered as armed patrols to search for Japanese soldiers hiding in the forest. That work went on sporadically for years with Sargent Yokoi Shoichi being the last to surrender in 1972.



Image 7: Guam Invasion. Source: Marine tanks and infantry advance cautiously along a Guam road, July–August 1944. In the Public Domain courtesy of the National Archives and Records Administration, USMC 91166.



Image 8: Guam Invasion, 1944. Source: 155mm guns of “A” Batty, 7th 155mm Battalion, 3rd Phib Corps Artillery, being set up 500 yards in from beach white two, in the Southern landing area, Guam, July 1944. In the Public Domain courtesy of the National Archives and Records Administration, USMC 93106.

Ultimately, the Battle of Guam resulted in the deaths of more than 18,000 Japanese, 1,250 interned on the island as prisoners of war, 1,783 American service members killed, another 6,010 wounded, and an unknown number of Chamoru casualties. Guam became the second most costly Marine Corps operation of the war; only nearby Saipan resulted in more Marine Corps casualties (11,727). The landscape destruction from the war was uneven with most concentrated towards the west and north, with only pockets of destruction in the south. Ben Blaz visited areas in the south with untouched villages and coconut palms lining the dusty road.⁹³ Those sites of war however, exploded and crushed trees, artillery craters blasted into the limestone rock and coral reef, smoldering flattened grasslands, and the churned red soil of the south were a deathscape, a space reflective of the tragic loss of human life. Mourning the landscape, Pascual Artero noted, “So green is vegetation and so pretty a sight had Guam always been, now it was all burned. It had neither a tree nor a coconut with leaves. All now was burned or destroyed by bullets and bombs.”⁹⁴

Naval Visions of Forestry

For the remaining year of the war in the Pacific, Guam became a forward operations base for the Central Pacific Command, with 200,000 more military personnel rotating through the island by the end 1944. Military infrastructure rehabilitation and expansion of the Naval Station began even before the Battle of Guam concluded and by mid-1945, engineering and construction crews made more than \$170 million worth of improvements. The Engineering



Image 9: Guam Invasion, July–August 1944. Source: Women washing clothes in a creek near Agaña, Guam on 12 August 1944. In the Public Domain courtesy of the National Archives and Records Administration, 80-G-248080.

Battalions and Construction Battalions (Seabees) worked to build and maintain 360 miles of roads around the island and across the interior. They also repaired and lengthened two airstrips the Japanese had forced Chamorus to build, creating a “Road to Tokyo” for Allied planes.⁹⁵ By the beginning of the following year, B-29 Superfortresses took off from the newly established Andersen Air Force Base (AFB) for bombing runs to the Japanese home islands and Fleet Admiral Chester W. Nimitz moved his Pacific Fleet Headquarters from Pearl Harbor to the newly constructed buildings in Agana Heights. More than forty years after American occupation, Guam was on its way to becoming the “Gibraltar of the Pacific.”⁹⁶

In his inaugural address on May 30, 1946, the last Naval Governor of Guam, Rear Admiral Charles A. Pownall, spoke of having a “new Guam to build” with no place for the “tragic insecurity and inadequacy” of its pre-war military status. It was time, he said, to “make Guam a better place in which to live, to enjoy life, and to work.” Reflecting a sense of national paternalism, he gave assurances that the United States government “always” improved the “happiness and well-being of the people they govern, whether abroad or at home.” Pownall laid out the new civilizing mission of the military imbued with a quest for modernization for a post-war Guam. Hinting at the need for socio-economic uplift he stated, “the Guamanian People do possess latent capabilities to accomplish infinitely more than they are now doing in labor, trades, skills, agriculture, business, and the professions.” He confirmed the purpose of the naval government was to, “reactivate the hands and minds of those who aspire to a more useful and fruitful life; not by breaking down, destroying, or interfering with Guamanian freedom, institutions, and traditions, which are good and beautiful, but through the furtherance thereof.” The island itself held its own “latent possibilities” that rebuilding would bring forward.⁹⁷

Despite Pownall’s rhetoric, reconstruction and rebuilding moved at a much slower pace for Chamorus than it did for the Navy, many of whom still lived in rudimentary temporary housing or Quonset huts until 1947 while waiting for home construction in Agana Heights, Tamuning, and outer villages. Military rebuilding took precedence and a powerful typhoon on September 2, 1946 destroyed hundreds of newly completed military and private structures. The Hopkins Committee Report to the Secretary of the Navy, James V. Forrestal, in March 1947 recommended several items related to rehabilitation. These included implementing civilian rebuilding at a faster pace to quell “uncertainty and insecurity,” determining permanent land needs of the military before acquiring any more land, and a long-range forestry program. In the north, some standing timber remained but there was no inventory of species to know what remained. At the time of the report, construction crews were clearing out those trees as they built Andersen AFB, trees that the report recommended to use as lumber for civilian reconstruction efforts. The report also noted that grasslands flourished in southern areas that may have once been forests and was “heavily eroded from overgrazing and repeated burning” resulting in soil erosion and leaching of nutrients by

heavy rainfall. The Hopkins Committee noted a permanent forestry program conducted by a technical forester could tackle both of these issues and pursue reforestation of the south. It recommended a, “competent forester familiar with tropical conditions” to determine the “maximum effective use” of these lands. The goal of the forestry program would be three-fold. Combined with pasture development an efficient forestry program intent on revegetation through planting grasses and forest trees could increase revenue, check erosion, and prevent excessive loss of water through runoff after heavy rains, a concern with base planners questioning the adequacy of fresh water as the base grew permanently larger.⁹⁸

Indeed, there were a number of professional foresters among military ranks. Early in the war, foresters received a deferment from military service but some with university degrees were involved in aerial map interpretation, a critical component of operational intelligence. Corps of Engineers and Seabees ran forestry operations, like the 799th Engineer Forestry Company that served supplying lumber for military operations in Kiska and Attu in 1942, then France and Germany in 1944, and the Philippines in 1945. Other units ran logging and milling operations in the Pacific, such as the Marine Engineers of the 4th Base Depot in the Solomon Islands that worked with botanists to send herbarium specimens and wood samples to the Arnold Arboretum in 1943, eventually identifying a new species. By the end of the war, the military had a separate forestry division responsible for forest resources, lumber, wood fuel, pulp, and paper. Most of these positions replaced the men and women in uniform with civilians so that by 1983, the only active forestry unit in the Army was the 457th Engineer Detachment from Hurley, Wisconsin.⁹⁹

Civilian botanists working in agriculture, agronomy, economic botany, food production and processing, and horticulture also proved crucial for the war effort and post-war development studies. Some, like E.D. Merrill who did much of his research in the Philippines, encouraged military personnel sent to the tropics to collect specimens in their spare time for the Smithsonian Institution and the University of Michigan. About one-third of those who collected specimens were among the ninety-three trained botanists in the ranks, with about fifteen percent being foresters. The rest were not professionals but received information on pressing and drying samples by mail, and got to work. Of the forty-one service members who sent in plant collections, seventy percent were from the Pacific, with the largest number of collectors sending specimens from Guam.¹⁰⁰

F. Raymond Fosberg, perhaps “the most travelled botanist in history” was one of these civilian plant experts working in government service.¹⁰¹ When the United States entered World War II, Fosberg served as part of the United States Foreign Economic Administration until the end of the war (1941–1945). He visited Guam a number of times, first as part of a team asked to conduct a four-month economic survey of Micronesia by the United States Commercial Company, an agent of the Navy Department in 1946. This expedition influenced the rest of his career, placing him at the center of tropical island ecosystem studies. His longest stint was at the United States Geological Survey (1951–1965), during which he

founded and edited the *Atoll Research Bulletin*.¹⁰² In the 1950s, he would again work on the island with his long time professional partner Marie-Helene Sacht as part of the Pacific Vegetation Project, supported by the United States Geological Survey and the United States Office of Naval Research. He continued to publish works on Guam flora well into the 1960s and 1970s but his first trip after the war profoundly influenced his belief in documenting and managing delicate island ecosystems.¹⁰³ Eventually he became Special Advisor in Tropical Botany to the National Museum of Natural History, Smithsonian Institution, and then the Curator of Botany until his retirement in 1978. Even after gaining Emeritus status, he continued to publish regularly until his death in 1993.

Fosberg's importance in shaping botany and ecological studies cannot be overstated. Over the course of his career, he made more than 56,000 scientific collections of plants, published more than 600 books and articles, published 463 new plant names, and 40 plants bear his name. Like Safford, he was a tireless investigator of global ecological webs, particularly those having to do with tropical plants in insular environments. At a time when the focus of the United States was on the post-war economic boom and the bi-polar power relationship of the Cold War that relegated any concerns about the environmental costs of military buildup in the Pacific to a tertiary level, if that, Fosberg was deeply concerned by the destruction of nature.¹⁰⁴

Fosberg's research trip to Micronesia in 1946 was "to investigate all matters in which plants or vegetation bear any relation to the native life or economy, or to the economy of the United States." He was only able to spend six short days on Guam doing the fieldwork of observing natural vegetation, plant cultivation, weeds, and the effects of human activity on natural vegetation. Frustrated by the lack of time and lack of flexibility in the schedule, Fosberg indicated gaining only a "certain degree" of knowledge about the island vegetation, not a complete picture.¹⁰⁵ The Hopkins Committee report, completed just five months later, echoed many of Fosberg's recommendations. Overall, he concluded a host of botanists, tropical foresters, agronomists, anthropologists, and ethnobotanists needed to conduct more research and inventory on plants, timber, mycology, plant diseases, algae, complete fieldwork on complex plant groups that were not well understood, the preservation of natural areas for scientific reserves and watersheds, and the conservation of soil and timber resources as long term projects. For short-term projects potentially managed by the United States Commercial Company Fosberg recommended the rehabilitation of the agricultural experiment station on Guam, a timber survey of the limestone forest, weed control to eradicate serious pests introduced by the war, the introduction of new pasture plants and fruits, and intensive investigations of potential economic plants. Notably, he cautioned plant introductions must be done, "thoughtfully, with full attention given to the consequences of each introduction" because a "careless hit-or-miss" introduction of some grasses and legumes "will result in much wasted effort" and the introduction of plants that, "while benefitting the stock raiser, may be serious pests to others."¹⁰⁶

Erosion and the water supply were prominent concerns in Fosberg's mind as well as those of the Naval Government. Specifically, local administrators discussed the possibility of converting the savanna around Talofoto into a forest to create a more effective watershed there. Fires, often human in origin and sometimes deliberately set in "injudicious clearing," kept these areas as grasslands. Fosberg's recommendation as the least expensive way to forest the area was by fencing it off, setting up patrols, providing education, and "severe punishment" for setting fires to eliminate most of them. Without fires, the natural vegetation succession would occur with ironwood and tangantangan being the "first invaders." While neither are good watershed trees, he posited other species would come in and develop a normal vegetation pattern. It would take some time for these leached out soils to support dense cover, however. In any case, he noted it would be an enlightening large-scale experiment in vegetation control. In fact, some ironwood trees already grew in the grassland areas, which some locals thought the Japanese might have planted, but Fosberg disagreed, indicating Safford observed ironwood as a normal part of the savanna flora. The Japanese likely did not have time in their short tenure on the island to plant ironwood trees. Instead, the wind probably carried their small winged seeds from ironwood stands along the coast, depositing them in the grasslands. The restrictions on normal activities during the Japanese occupation likely reduced the number of fires and allowed the seedlings to grow.¹⁰⁷

In addition to the extensive erosion in the south related to land clearing and expanding cultivation, especially during the Japanese period, erosion was also occurring in the limestone areas due to the use of heavy machinery in intensive cultivation. Reminiscent of Hugh Hammond Bennett's pioneering soil conservation practices during the Dust Bowl, Fosberg recommended to stop mechanized farming on areas of rolling or sloping land and practice contour farming to reduce erosion. He warned that without such "standard soil conservation practices as contour farming" the thin layer of top soil sitting on top of the limestone will "disappear very rapidly by sheet erosion." Additionally, planting strips of forest to break up large open areas would check wind erosion. Perhaps even worse than erosion, according to Fosberg, was the loss of nutrients leaching out of soils in wet areas that over time made them increasingly sterile. His recommendation was to mulch these areas, using litter (dead plant material) to cover the soil rather than burning it or using leguminous cover crops as green manure, both of which would provide vital nitrogen for growth.¹⁰⁸

Fosberg referred to limestone forests as "one of the most extensive and important vegetation types in Micronesia" that included species commonly found in the strip of land next to the sandy beach and subject to constant salt spray along with dozens more "true rainforest or jungle" tree and bushy understory species. In areas left undisturbed for long periods, these forests are usually the site of some of the most important timber resources in the Pacific, especially Pacific teak used for high quality flooring and furniture. Japanese logging during occupation made the timber scarce in accessible places so that the remaining resources needed good management and safeguarding from destructive lumbering

practices. Destruction from the American reoccupation, however, was profound and the post-war land clearing created disturbances that allowed weeds to grow in “great luxuriance” along with “large areas” filled in with tangantangan specifically.¹⁰⁹

In fact, tangantangan had a special entry in the report’s section on weeds with Fosberg noting it was generally regarded as a serious pest, as it “takes complete possession of an area and is very hard to get rid of” but is considered good forage and used extensively on Guam for this purpose. He went on to state it is “one of the most aggressive and dominant of all weeds,” having a “wide tolerance of varying environmental conditions and an extreme tendency to form solid stands, crowding out all competition.”¹¹⁰ The first book warning about the ecological destruction caused by non-native invasive species, Charles S. Elton’s, *The Ecology of Invasions by Animals and Plants* would not be published until 1958 but Fosberg’s description of tangantangan’s weedy qualities seemed to offer an early warning about a potentially invasive species.¹¹¹

The Ecological Experiment

Given Fosberg’s warnings about tangantangan, it is unclear why the Naval Government would choose this particular legume but perhaps to a forester more familiar with temperate plants rather than tropical ones or an applied botanist looking for a solution to multiple ecological problems, tangantangan seemed a tool of empire that could solve them all. Donald Maxwell Matthews, an American forester working in the Philippines in 1914, touted it expressly as a reforestation tree.¹¹² It could help prevent erosion if planted in large numbers and it grew fast. Its nitrogen fixing properties could improve the leached soil in those eroded areas and in areas following after intensive cultivation. It could provide a good source of firewood and feed for cattle, which the Naval Government also began importing through the United States Commercial Company to boost the numbers killed during the war.¹¹³ There was proof tangantangan already grew well on the island and there were already abundant seeds.

In the United States, crop dusters experimented with aerial seed dispersal by the late 1920s, with some limited success in the western states. Critically, aerial reforestation had occurred before in another occupied landscape. As part of emergency conservation work done on forest reserves in Hawaii during the Great Depression, 500 men worked for the Civilian Conservation Corps (CCC) clearing trails, building fences, shooting pest animals, and planting trees. Over two years the CCC men collected eleven tons of *L. leucocephala* seed, known on Hawaii as *haole koa* with an unknown date of introduction. The United States Army Air Corps broadcast these seeds across the dry lowlands in 1933 to restore the watershed.¹¹⁴

Reforestation of the south, an area dominated by sword grass since early human settlement, became an experimental project of the Naval Government’s Department of

Agriculture by December 1946 with increasing focus by March 1947. Prime motivations for undertaking the project included erosion control, creating an efficient watershed that would be useful in times of drought, ameliorating temperatures, and making the landscape more comfortable to increase farming and food production. Consultation with the United States Commercial Company led to the project's inclusion in their recommendations for the Pacific islands.¹¹⁵ Development of the landscape project began under the direction of Commander J.T. Stewart, Jr. as Department Head with implementation occurring during the tenure of Harold E. Schwartz, civilian Department Head who replaced him in the summer. In February 1947, the Hopkins Committee visited the Department of Agriculture with Knowles Ryerson from the University of California Berkeley as their agricultural specialist.¹¹⁶ Regarding the southern grassland, the report indicated the land could become better grazing and forestlands "if given adequate attention and study."¹¹⁷ By March, Stewart's report indicated tangantangan as the species selected for propagation with an additional motivation of producing firewood and fence posts.¹¹⁸

To reduce costs, the Department of Agriculture enlisted the help of island schools, children, and the local Boy Scouts for seed collection with repositories at the schools. This was not unusual as getting local children involved in outdoor clean up, landscape beautification projects, and agricultural education stretched back to the pre-war era.¹¹⁹ Seed collection took place over the month of March as the trees were in season with time allowances for cleaning and germination tests (eighty-two percent under nursery conditions) to occur before eventual distribution during the rainy season that began sometime between August and September.¹²⁰ The children had to collect at least one ton of seed to justify the use of a light plane to broadcast the seed over the sword grass landscape with documentation of the dispersal locations made by a rough sketch.¹²¹

While waiting for the rains to soak the soil, the Department of Agriculture and the Department of Education developed a plan to use the experiment as an educational opportunity in economic botany. The memo sent from the Department of Agriculture to island schools and the Boy Scouts establishing the partnership explained that tangantangan had proven to be "well adapted" to savanna reclamation. Its unusually long root system that allowed it to survive droughts and grow even on barren exposed limestone indicated, ". . . in the struggle for the survival of the fittest, it generally comes out to be the victor and eventually has the entire area under its control."¹²² It is interesting to consider if this phrasing referred to Darwin's original theories on natural selection, even though there was little natural about aerial seed dispersal across an occupied landscape. Alternatively, perhaps it was more of a reflection of the Social Darwinist conception of 'survival of the fittest' so often used as a justification for imperialism reapplied here in this project of *unnatural* selection and *ecological* imperialism. In any case, considering the long-term plan for the southern grasslands was the conversion to forest and then to farmland, that root system could be a potential problem

in terms of regrowth after clearing. However, the volcanic soils had quite a different composition, leading to an increased risk of unintended consequences for this project.

Meanwhile, running counter to Fosberg's recommendation against mechanized farming to help slow soil erosion, the United States Commercial Company and the Department of Agriculture Extension Service continued to rent out small tractors and Caterpillar D8 bulldozers. For a nominal fee per acre, farmers used them in clearing land in the south and parts of the limestone forest for agriculture though many continued to use single animal plows to cultivate smaller plots after clearing.¹²³ Mechanized land clearing continued to exacerbate the conditions for erosion and disturbed the ecology, making these areas increasingly susceptible to tangantangan infiltration. The Extension Service also established a nursery that propagated a number of fruit, nut, forest, and windbreak trees along with a few ornamental species for the "restocking of the denuded areas and the landscaping of the island."¹²⁴ Several types of economic plants including sugar cane (*Saccharum* varieties), papaya (*Carica papaya*) seedlings, Chinese betel palms, and lowland varieties of taro arrived from Hawaii along with ciruela (*Spondias purpurea*) from the Philippines, and "boie seed" from Yap (possibly betel palm, called *buw* in Yapese).¹²⁵

The 1947 rainy season arrived with heavier than normal rains and a hog cholera epidemic that killed hundreds of swine kept the Department of Agriculture busy with eradication efforts. After a slight delay due to weather, the light plane carrying more than a ton of tangantangan seeds successfully completed dispersal in a designated experimental area on and around Mount Tenjo. Overlooking Apra Harbor, Mount Tenjo was the site of World War I era defensive fortifications of Camp Barnett and the highest point taken in the 1944 recapture. The report of the drop indicated more aerial dispersals would occur in the future, if tangantangan was successful in occupying the grassland.¹²⁶ The soil in the first experimental area contained volcanic and mixed soil types. Tangantangan will grow in those mediums—it will grow almost anywhere—but it did not do as well as it would have in limestone soils. Sword grass continued to dominate the area but the tree spread quickly over other parts of Guam in the next decade.

On subsequent research trips from 1951 to 1954, Ray Fosberg recorded changes to the forest since his truncated trip in 1946. In the dry months, fires still destroyed the ironwood trees dotting the savanna. There was very little undisturbed forest. What stood in its place were areas of secondary growth, comprised of irregular stands of trees with dense, spiny, tangled undergrowth, patches of weeds, clearings with spotty vegetation, "thickets of fast-growing, soft-wooded, weedy trees and scattered bare skeletons of dead forest giants." The tangantangan in particular, "had increased enormously since the war" covering some beach ridges in "pure stands," spreading across the lower central part of the island, and dominating the entire beachfront of Agaña (Hagåtña) until the high salt-water waves accompanying a typhoon in December 1953 killed most of it.¹²⁷ The southern volcanic areas

were largely free of it except along roadsides where crushed coral formed the roadbed, dangerously affecting visibility on the sides and around curves. It became such a problem that one of the first actions of Governor Bill Daniels was to clear tangantangan in Agaña (Hagåtña) as part of his 1961 cleanup campaign.¹²⁸

In the limestone forest, tangantangan was one of the most prominent tree species in many areas. It formed dense, impenetrable thickets of fifteen to twenty foot (5 to 6 m) tall trees scattered between coconut palms with smaller seedlings covering the ground. The branches were rarely more than two inches (5 cm) in diameter making them perfect for firewood. Bushy leaves formed a thick canopy and each tree grew so close to its neighbor that it was difficult to walk between the trees with any comfort. Usually, these thickets were pure tangantangan because no other plants could establish themselves except for thorny limeberry trees around the edges. Insects might attack the seedpods and giant African snails, introduced by the Japanese, could kill young branches by rasping off the green bark but Fosberg did not see these as a significant threat. In his assessment, tangantangan “may persist indefinitely so far as present observations show.”¹²⁹

By the mid-twentieth century, Guam’s ecology was a reflection of the Anthropocene and the “wild ecological oscillations” that arrive along with introduced species.¹³⁰ Natural processes built the forest, but change was ever-present as new species washed ashore to make the island their home. Ancient settlers then too made Guam their home, clearing the land, introducing new forest foods and crops, and occupying the landscape. These processes continued during the Spanish occupation that shifted the patterns of introduction, bringing tangantangan and so many other introductions from the Americas and Afro-Eurasia. As the Spanish Galleons ultimately became the conduit linking the world in a global pattern of trade, so too did they take part in this global transformation through ecological imperialism. The Spanish administration may have ended in 1898 but their legacies continued long after the empire crumbled. Guam’s landscape had become an ecological microcosm of empire. The brief Japanese occupation of the land bifurcated the American occupation. The first period characterized by a paternalistic civilizing mission of inventorying this stepping-stone of empire, a dizzying number of species introductions, and land clearing for profit and self-sufficiency. The second period being more characterized by a particularly American vision of modernization with mechanized land clearing and small scale farming, the end of self-sufficiency, massive base construction, and the unintended consequences of ecological experimentation. In all this change, as empires come and go, Chamorus remain, exercising their own agency and navigating their own way through the landscape.

Today, there are no commercial crops produced on Guam for export. Island residents still produce small amounts of corn, fruits, and vegetables that make their way to farmer’s markets and small village grocery stores but rice, meat, and other foods are all imported from Japan, Korea, Australia, and the mainland. The capital of Hagåtña, historically home to most

of the island population until World War II, currently has a little more than 1,000 residents. Most of the 168,700 people now live in other villages built up after 1945. The American military presence, comprised of Navy, Marines, Air Force, and Coast Guard has spread throughout the northern part of the island, along the western coast, and south past the Ordnance Annex (formerly Naval Magazine) in the south central uplands. During periods of heavy rains, sediment flows into Fena Lake Reservoir and Ugum River leading to ongoing water quality issues for southern Guam. Forestry workers and local volunteers are planting trees to stabilize the soil and preserve natural habitats with some limited success. Grasslands remain in the south and wildfires continue to burn with perhaps eighty percent set by poachers to attract deer to new plant growth.¹³¹ Tangantangan is evident in most other places.

Barbeque the Chamoru Way

Tangantangan is a species with a dual identity. Perhaps the local relationship with tangantangan is a reflection of the contested and negotiated local relationship with the American military presence. When the tree infiltrates lawns and gardens or grows along the roadside in an impenetrable mass, it seems an almost futile pursuit to eradicate it. It encroaches, invades, and occupies. In those times it is understandable to wish it never arrived or at least, that tens of millions of seeds were not broadcast by air. On the other hand, it is an important species for increasing soil nutrients and a valuable livestock forage when carefully managed.

It is both invasive and cultivated globally. For instance, cattle ranchers in Australia are creating commercial *L. leucocephala* pastures and see the tree as the key to sustainable high yield grass fed cattle populations. It grows in over 150 countries with dozens of local common names. In Mexico, people often refer to it as *guaje* though it has two dozen other names as well. In the United States, it is the lead tree, hedge acacia, white popinac, or wild tamarind. In the Philippines, it is *ipil-ipil*. In Hawaii, it is *haole koa* or “foreign koa.” In Vietnam, it is *bo chet*. In the Western Cape of South Africa it is *reuse wattel*, and in China, *yin he huan*. Spend any time in a warm temperate or tropical forest setting and it is probably a familiar tree.

Today, many Chamorus consider tangantangan the best wood to use for barbeque, a very popular form of cooking for religious fiestas, community gatherings, beach parties, and family events. It sets local barbeque apart, tasting similar to mesquite but less bitter, and proves to be an attractive draw for visitors to the Wednesday Night Market at Chamorro Village, a collection of shops and eateries that feature local goods and fare. For those who are slow smoking meats like beef brisket, pork ribs, or pork shoulder over several hours, the selection of the right type of tangantangan is as important as the cut of meat, seasonings, and the cooking temperature.¹³² Grilling chicken wings, pork belly, or trendier tomahawk steaks usually calls for a mixture of charcoal and tangantangan to keep an even temperature and a marinade of soy sauce, white vinegar, brown sugar, onion, garlic, and *donne'* chili peppers (*Capsicum chinense*, originally from western South America). Ubiquitous on



Image 10: Tangantangan inhabiting abandoned urban areas on Guam. Source: “Tangantangan invasion,” 2013. Photo by J. D. Hager, used with permission.

Guam, the small peppers known locally as boonie pepper are similar to Thai bird’s eye chili (*Capsicum annuum*). Fina’denne’ sauce made with soy sauce, vinegar, onions, garlic, and donne’ peppers usually accompanies barbequed meats with sides of Chamorro red rice made with achote powder, grilled vegetables, and salads. Tangantangan is part of the landscape now and Chamorus are putting it to use.

Educators spend a good deal of time in world history classrooms teaching about connections, exchanges, empires, and their consequences. As empires continued their tack across the waters of the Pacific, species introductions became tools of imperial expansion and control. Examining the role of a single plant or animal can make these larger processes more accessible to students. Tracking the spread of familiar species like cattle, or even less familiar plants like tangantangan can illustrate the role ecological imperialism plays in students’ individual lives, bringing it down to an identifiable and more understandable level. Changes in cuisine resulting from imperial expansion, introduced species, new cooking technologies, and new tastes are also an effective way to discuss global environmental history. When students can see how occupied landscapes of empire shape their individual meals, that historical context can give a new flavor to even the most familiar meal.

Appendix

Table 1: Tree Species Arriving Through Natural Processes and Endemic Tree Species

Asia-Pacific Species (Common and taxonomic names)	Endemic to Guam and/or Marianas Species (Chamoru and taxonomic names)
betel palms (<i>Areca catechu</i>)	dugdug (<i>Artocarpus mariannensis</i>)
coconut palms (<i>Cocos nucifera</i>)	mapunyao (<i>Aglaia mariannensis</i>)
Caroline ivory nut palms (<i>Metroxylon amicarum</i>)	fadan (<i>Cycas micronesica</i>)
fish poison trees (<i>Barringtonia asiatica</i> ; <i>B. speciosa</i>)	agatelang (<i>Eugenia palumbis</i>)
rhea (<i>Boehmeria tenacissima</i>)	ufa halom tano (<i>Heritiera</i>
torchwood (<i>Bikkia tetrandra</i>)	<i>longipetiolata</i>)
mangroves (<i>Bruguiera gymnorrhiza</i> ; <i>Rhizophora apiculata</i> ; <i>Xylocarpus granatum</i>)	langiti (<i>Ochrosia mariannensis</i>)
rattan (<i>Calamus</i> sp.)	aplokating (<i>psychotria mariana</i>)
Alexandrian laurel (<i>Calophyllum inophyllum</i>)	hayun lâgu (<i>Serianthes nelsonii</i>)
ironwood (<i>Casuarina equisetifolia</i>)	tabernae (<i>Tabernaemontana rotensis</i>)
plumeria (<i>Cerbea dilatata</i>)	strand tangantangan (<i>Leucaena</i>
soap orange (<i>Citrus aurantium saponacea</i> ; <i>C. macroptera</i>)	<i>insularum</i> var. <i>guamensis</i> ;
cloxylon (<i>Claoxylon marianum</i>)	<i>Schleinitzia fosbergii</i>)
sea trumpet (<i>Cordia subcordata</i>)	
sago cycad (<i>Cycas circinalis</i>)	
blue marble trees (<i>Elaeocarpus joga</i>)	
beach cherry (<i>Eugenia reinwardtiana</i>)	
banyan (<i>Ficus prolixa</i>)	
screw pines (<i>Freycinetia reineckeii</i> ; <i>Pandanus dubius</i> ; <i>P. kafu</i> ; <i>P. fragrans</i> ; <i>P. tectorius</i>)	
zebra wood (<i>Guettarda speciosa</i>)	
lantern trees (<i>Hernandia nyphaeifolia</i> ; <i>H. peltata</i> ; <i>H. Sonora</i>)	
pacific teak (<i>Intsia bijuga</i>)	
mammea (<i>Mannea odorata</i> ; <i>Ochrocarpus obovalis</i>)	
twin apple (<i>Neisosperma oppositifolia</i>)	
false elder (<i>Premna guadichaudii</i> ; <i>P. obtusifolia</i>)	
pacific rosewood (<i>Thespesia populnea</i>)	
velvet leaf (<i>Tournefortia argentea</i>)	
faia (<i>Tristiropsis obtusangula</i>)	

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Sincere thanks go out to Guest Editor, Brian Holstrom, for the invitation to contribute to this issue of *World History Connected*. His work and patience along with the tireless efforts of Marc Jason Gilbert, the journal’s Editor, and other editorial staff members continue to make the journal an invaluable resource for world historians. I also thank Dr. Omaira Brunal-Perry and Dorathina Herrero at the Micronesian Area Research Center, University of Guam, for assisting me with archival sources in the time of Covid-19. Finally, thanks to the anonymous reviewers of the manuscript and the History Department Faculty Writing Workshop at Texas A&M University—Commerce whose encouragement, comments, and suggestions helped make this article possible.

NOTES

¹ The history of place names on Guam is a complicated matter. Spanish imperialists modified many indigenous place names and used Spanish names for new areas, particularly military installations and government buildings. The indigenous people became Chamorros, a Spanish term derived from *Chamorri* or *Chamoli*, the ancient name for ‘chief,’ perhaps in reference to those generally regarded as the highest-ranking elites. After the United States acquired the island, place names went through a corresponding Americanization and Chamorros became Guamanians. In the last decades of the twentieth century, indigenous rights activists reclaimed their heritage in part by using pre-Spanish original names so that Agaña became Hagåtña but the modern neighboring village of Agana Heights remained the same. The debate between the use of Chamorro and Chamoru became a fierce political battle throughout the 1990s. In this article, I have endeavored to use the naming conventions of each historical period with the current designate in parentheses in efforts to balance staying true to the archival sources while also recognizing the legitimacy of indigenous naming rights. I use Chamoru to recognize indigenous identity on its own self-defined terms rather than an identity imposed upon it. William Edwin Safford, “The Chamorro Language of Guam,” *American Anthropologist* 5, no. 2 (1903): 291; Robert F. Rogers, *Destiny’s Landfall: A History of Guam* (Honolulu: University of Hawaii Press, 1995), 6; Gina Taitano, “Chamorro vs. Chamoru,” in *Guampedia* (Guampedia, Inc., 2009), accessed March 24, 2021, <https://www.guampedia.com/chamorro-vs-chamoru/>.

² M. H. Anderson, “Naval Government of Guam Monthly Report 31 October 1947” (Naval Government of Guam, 1947), 22, Micronesian Area Research Center.

³ Russell Apple, *Guam: Two Invasions and Three Military Occupations* (Mangilao, Guam: Micronesian Area Research Center, University of Guam, 1980), 74; Joshua I. Tracey, Jr. et al., “General Geology of Guam,” U.S. Geological Survey Professional Paper, A Study of the Stratigraphy, Structure, and Tertiary Geologic History of the Southern Most Island of the Mariana Arc (Washington, D.C.: Government Printing Office, 1964), A10.

⁴ Alfred W. Crosby, *Ecological Imperialism: The Biological Expansion of Europe 900–1900* (Cambridge: Cambridge University Press, 1986), 6.

⁵ Part of this recognition includes the use of the indigenous word, tangantangan, as the primary signifier for the species in this article, rather than the taxonomic designate *Leucaena leucocephala*. All too often, European naturalists and biologists collecting species in colonized areas gave plants and animals taxonomic names that had no reference to the pre-existing indigenous name, which were at best irrelevant and at worst offensive to the indigenous people. In the biological sciences, there is a recent focus on restoring indigenous names to the taxonomic record. Similarly, this work recognizes the importance of maintaining the name tangantangan that has meaning within Chamoru culture. Len Norman Gillman and Shane Donald Wright, “Restoring Indigenous Names in Taxonomy,” *Communications Biology* 3, no. 1 (2020): 1–3, accessed March 12, 2021, <https://www.nature.com/articles/s42003-020-01344-y>.

⁶ “Marine Corps Activates Camp Blaz in Guam,” United States Marine Corps Flagship, accessed December 19, 2020, <https://www.marines.mil/News/News-Display/Article/2367980/marine-corps-activates-camp-blaz-in-guam/>; Leon Sealey-Huggins, “‘1.5°C to Stay Alive’: Climate Change, Imperialism and Justice for the Caribbean,” *Third World Quarterly* 38, no. 11 (November 2017): 2444–63; J. R. McNeill and Peter Engelke, *The Great Acceleration: An Environmental History of the Anthropocene Since 1945* (Cambridge: Belknap Press, 2016).

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