2020-2030

GUAM

FOREST ACTION PLAN

Contents

An observation deck overlooking Cetti Bay, Guam.

Source: Coca Coco, Shutterstock

About This Booklet

"Bridging Forestry Through Stewardship" is an abridged version of the 2020 Guam Forest Action Plan. This document was created by Keanno Fausto and John I. Borja, under the direction and guidance of Christine Fejeran (Guam Department of Agriculture Forestry and Soil Resources Division) and Dr. Romina King (University of Guam). The full version of the 2020 Guam Forest Action Plan is available online on the Guam Department of Agriculture's website.

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Source: Chriistine C. Fejeran

From the Island Forester

Christine
Camacho Fejeran

Forestry Division Chief
for the Forestry and Soil
Resources Division

As a natural resource manager, I have the honor of working with a team of exceptional individuals. Our forestry team is made up of dedicated professionals who take great pride in their work because they know that their efforts will benefit their families, friends, and community.

Over the years, I have described forestry in many ways, but I firmly believe that our Urban and Community forestry program is the gateway to all our other amazing initiatives. The value of an urban tree is truly incalculable, and oftentimes, the only tree a community member may be familiar with is that one tree in the parking lot, the road median, or in the nearby park. The conversation starts there, sparking discussions about what happened around that one tree and ultimately leading people into learning more about our Forest Stewardship program.

The Forest Stewardship program brings great work into your backyard. It provides landowners and community members with the opportunity to expand our green spaces across the islands, ranging from your backyard to our island's vast mountains and valleys.

We also have programs like Cooperative Forest Health Management, which encourages us to closely examine our management decisions, as well as the Cooperative Fire Protection Program, which engages all stakeholders in preventing, mitigating, responding to, and recovering from wildland fires. Wildland fires are human-caused on Guam – everyone has a role to play.

Our Forestry and Soil Resources Division has the privilege of doing good work, hard work, the people's work. Together, alongside our community members, we are working toward a greener Guam to honor our heritage, families, and future generation. As Rachel Carson once said in "Silent Spring": "In nature, nothing exists alone." We are stronger and better together.

> "Nature has introduced great variety into the landscape, but man has displayed a passion for simplifying it. Thus, he undoes the built-in checks and balances by which nature holds the species within bounds."
>
> – Rachel Carson, "Silent Spring"

Let us work together to ensure the necessary checks and balances are in place and let us take that necessary pause, a moment to consider: will this help us, heal us, connect us? After all, we protect our forest and soil resources for the overall wellness of our people, for food security, clean water, healthy fisheries, essential habitat, climate resilience, preservation, and perpetuation of cultural practices, and the invaluable joy found in living among our beautiful trees.

Join us and be part of the effort and good work taking place at your Guam Department of Agriculture, Forestry and Soil Resources Division. Biba Guahan!

The mission of the Forestry & Soil Resources Division (Guam Forestry) is to conserve, protect and enhance Guam's vegetative environment and sustain the natural resources which are depended on healthy forests.

The agency works with stakeholders to promote healthy productive forests in both rural and urban areas throughout the island in partnership with the USDA Forest Service and other key stakeholders

INTRODUCTION

The tropical forests on Guam are comprised of over 600 species of plants, with more than 100 species of trees. The unique biodiversity found within Guam's forests supports traditional practices such as agroforestry, collection of plant materials for medicines, harvesting of timber for seafaring, and wood carving practices. In addition to these significant cultural and intrinsic values, Guam's forests provide critical ecosystem services and habitats for native, endemic, and endangered species. Guam's forests have been impacted by typhoons, drought, wildfires, and invasions of introduced insects, plants and ungulate species. These impacts have greatly altered native communities, and now threaten biodiversity and watershed functions. Additionally, Guam is experiencing an increase in development and population associated with the expansion of the U.S. Marine Corps, Navy, Army and Air Force on the island. This assessment recommends strategies for protecting forests, restoring forest ecosystems, and reducing pollution to critical reef systems.

The Guam Forest Action Plan (GFAP) is a tool for Guam to identify the highest priorities for forest resource management and seek implementation of these strategies with local partners and with assistance from the United States Department of Agriculture, Forest Service (USFS).

The Forest Action Plan (FAP) is integral to the Forest Service's State and Private Forestry (S&PF) redesign and required as an amendment to the Cooperative Forestry Assistance Act (CFAA), as enacted in the 2008 and 2010 Farm Bills. Each State, Territory and Freely Associated State receiving funds from S&PF programs is required to complete a 10-year update in 2021 to receive funds under the CFAA.

Primary Components of the Forest Action Plan

State-wide Forest Resource Assessment

Provides an analysis of forest conditions and trends on the island and identifies and delineates priority rural and urban forest landscape areas.

State-wide Forest Resource Strategy

Provides long-term strategies for investing state, federal, and other resources to manage priority landscapes identified in the assessment, focusing federal investment to most effectively stimulate or leverage desired action and engage multiple partners; providing a description of resources necessary for Guam Forestry to address the state-wide strategy; and addressing the national priorities for SP&F.

State & Private Forestry National Themes & Objectives

1 Conserve Working Forest Lands

- Identify and conserve high priority forest ecosystems and landscapes
- Actively and sustainably manage forests

2 Protect Forests from Harm

- Restore fire-adapted lands and reduce risk of wildlife impacts
- Identify, manage, and reduce threats to forest and ecosystem health

3 Protect and Enhance Public Benefits from Trees

- Protect and enhance water quality and quantity
- Improve air quality and conserve energy
- Assist communities in planning for and reducing wildfire risks
- Maintain and enhance the economic benefits and values of trees and forests
- Protect, conserve, and enhance wildlife and fish habitat
- Connect people to trees and forests, and engage them in environmental stewardship activities
- Manage and restore trees and forests to mitigate and adapt to global climate change

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The FAP provides a basis for subsequent annual grant proposals, as authorized under several CFAA programs. The redesign deemphasizes program-by-program planning and emphasizes program integration to meet island priorities, which are in turn tied to one or more broad national themes and objectives.

Source: Guam Department of Agriculture

Key Agencies & Stakeholders

Local and federal agencies and stakeholder representatives on the FAP Advisory Council contributed critical input to complete the plan. The Council consisted of the Forest Stewardship Program (FSP) board, Urban and Community Forestry (UCF) council, and the Cooperative Fire Protection (CFP) Program committee. The Council identified and prioritized major issues and threats to Guam forests and landscapes. This effort of issues and and threats guided the development of the assessment and strategies.

Guam Forestry and Soil Resources Division (Guam Forestry)

The mission of the Forestry & Soil Resources Division (Guam Forestry) is to conserve, protect and enhance Guam's vegetative environment and sustain the natural resources which are dependent on healthy forests. The agency works with stakeholders to promote healthy and productive forests in both rural and urban areas throughout the island in partnership with the USDA Forest Service and other key stakeholders.

USDA Forest Service, State and Private Forestry Program

The State and Private Forestry (S&PF) organization of the USDA Forest Service provides technical and financial assistance to landowners and resource managers through a variety of programs – Fire Management, Forest Health Program, Forest Legacy Program, Community Forests and Open Space Program, Forest Stewardship Program and Urban and Community Forestry Program. The Landscape Scale Restoration Program provides additional, competitive funding under the authorities of several of the previously mentioned programs.

In 2008, the U.S. Forest Service began implementing a "Redesigned" S&PF program. The intent of the redesign is to improve the ability to identify the greatest threats to forest sustainability and accomplish meaningful change in high priority areas. The 2008 Farm Bill codified the main components of Redesign into law by amending the Cooperative Forestry Assistance Act (CFAA). The three national themes (listed in the Purpose and Scope section) are now set in law as national priorities and a FAP is required and is central to S&PF program delivery.

Stakeholder Involvement

Guam Forestry formed the GFAP Advisory Council to participate in issue identification and provide feedback throughout the process. Because Guam is a small community, many of the stakeholders serve on multiple committees and represented those stakeholder groups in the GFAP process. Member organizations are listed in the following table.

Organization

CHAMORRO LAND TRUST	GUAM DEPARTMENT OF LAND MANAGEMENT	GUAM DEPARTMENT OF AGRICULTURE
GUAM BUREAU OF STATISTICS AND PLANS	GUAM WATERWORKS AUTHORITY	GUAM POWER AUTHORITY
GUAM DEPARTMENT OF PUBLIC WORKS	GUAM ENVIRONMENTAL PROTECTION AGENCY	GUAM FIRE DEPARTMENT
NORTHERN GUAM SOIL & WATER CONSERVATION DISTRICT	SOUTHERN GUAM SOIL & WATER CONSERVATION DISTRICT	COOPERATIVE EXTENSION & OUTREACH UOG, COOPERATIVE EXTENSION & OUTREACH
UOG, WATER & ENVIRONMENTAL RESOURCES INSTITUTE OF THE WESTERN PACIFIC (WERI)	OFFICE OF THE GOVERNOR, GUAM MILITARY BUILDUP	THE NATURE CONSERVANCY
NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)	USDA NATURAL RESOURCES CONSERVATION SERVICE	U.S. FISH AND WILDLIFE SERVICE

Forest Action Plan Advisory Council

CURRENT RESOURCES AND INVENTORY

Forest Conditions and Trends

While limited documentation of Guam's forest cover and composition exists prior to 1900, World War II represents a significant shift in forest conditions. Events that occurred during the war and immediately after seem to have set the stage for enduring forest cover conditions, which do not appear to have changed substantially since the early 1950s.

A comparison of forest cover types shows that in general, the forest and non-forest components have been relatively stable for much of the island. A significant observation is the change in the urban landscape, with increasing urbanized zones, additional roads, and impervious surfaces, especially in the north of the island. In the next five years, increased urban development is anticipated to be a significant disturbance to Guam's forest. The creation of Marine Corps Base Camp Blaz has removed or disturbed about 1,000 acres of forest, and the buildup is driving additional development that could impact forests outside the base footprint as well.

Detailed vegetation maps in the following pages were developed to provide the foundation for evaluating forest conditions and trends, water resources and water quality impacts. Approximately 49% of the area on Guam has tree cover, either recognized as forest types or as individual tree fragments; 19% is developed or mixed-use areas, 18% of the landscape is grassland, 9% of the area is open water, 3% consists of wetland vegetation, and 2% is identified as bare land.

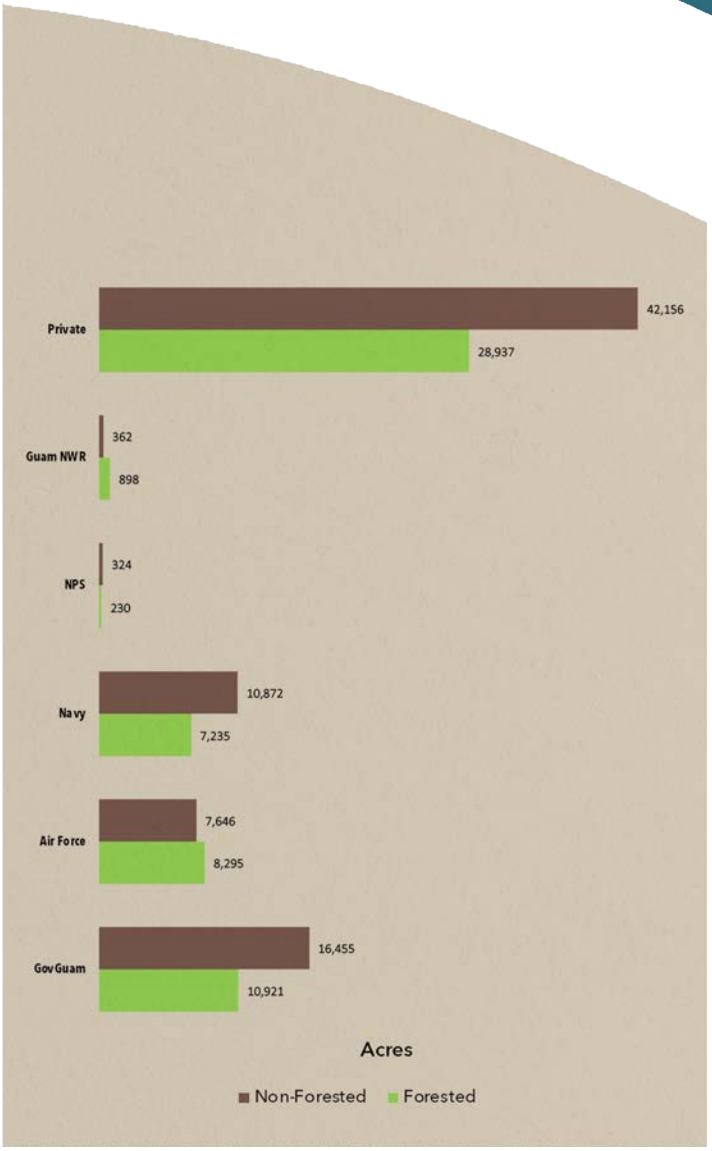
Source: Christine C. Fejeran

Land Ownership & Management

Land ownership on Guam is split between private (53%, 71,093 acres) and public management entities (47%, 63,238 acres). In the public sector, lands managed by the Department of Defense (Air Force and Navy lands) incorporate 34,048 acres, or ~25% of Guam. Approximately 1,814 acres are associated with National Park Service (NPS) and the National Wildlife Refuge (NWR), though the Park also manages marine reserve areas offshore of Agat and Piti/Asan watersheds. Approximately 20% of Guam Island is under local management, Government of Guam (GovGuam), 27,376 acres.

The current forest cover conditions were evaluated and attributed to land ownership. Overall, all ownerships reflect the approximate distribution of forest cover found on Guam (56,520 acres, or 42% island-wide). GovGuam, National Park Service, and Private Lands all have approximately 40-42% forest cover, reflecting the island-scale average. The DoD lands combined have 46% tree cover under their management, with Navy lands slightly below the island average (40%) and Air Force much higher than the island average (52% cover). The National Wildlife Refuge lands, while relatively small in a land-area comparison, are mostly forested with 71% tree cover.

At watershed scales, GovGuam has a management presence in all 19 major watersheds, with over one-half of the land ownership in five watersheds in western Guam. The DoD has interest in 11 of the 19 watersheds; private ownership is the majority landowner in all but 5 watersheds.



The distribution of forest non-forested acres under each major ownership on Guam.

2014

GENERAL VEGETATION MAP OF GUAM

Map was created by Romina King on 04 August 2020. Datasets used were the Pacific Islands Vegetation Map (PIVM) for Guam 2014, created by the USFS in conjunction with NOAA CCAP. Watershed basins and rivers datasets were downloaded from htttp://hydroguam.net.

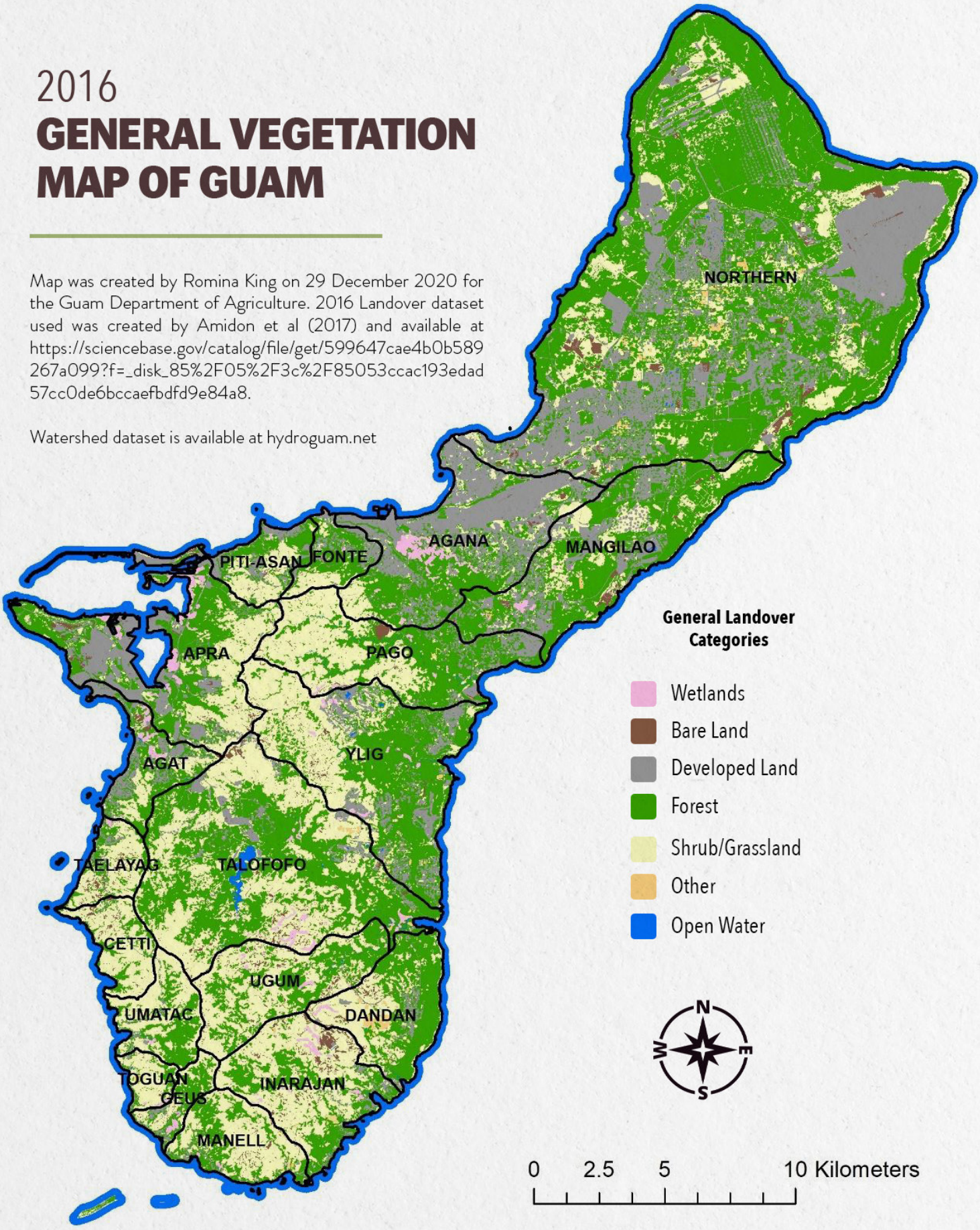
PIVM dataset is available at https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3821659.zip

2016

GENERAL VEGETATION MAP OF GUAM

Map was created by Romina King on 29 December 2020 for the Guam Department of Agriculture. 2016 Landover dataset used was created by Amidon et al (2017) and available at https://sciencebase.gov/catalog/file/get/599647cae4b0b589267a099?f=_disk_85%2F05%2F3c%2F85053ccac193edad57cc0de6bccaefbdfd9e84a8.

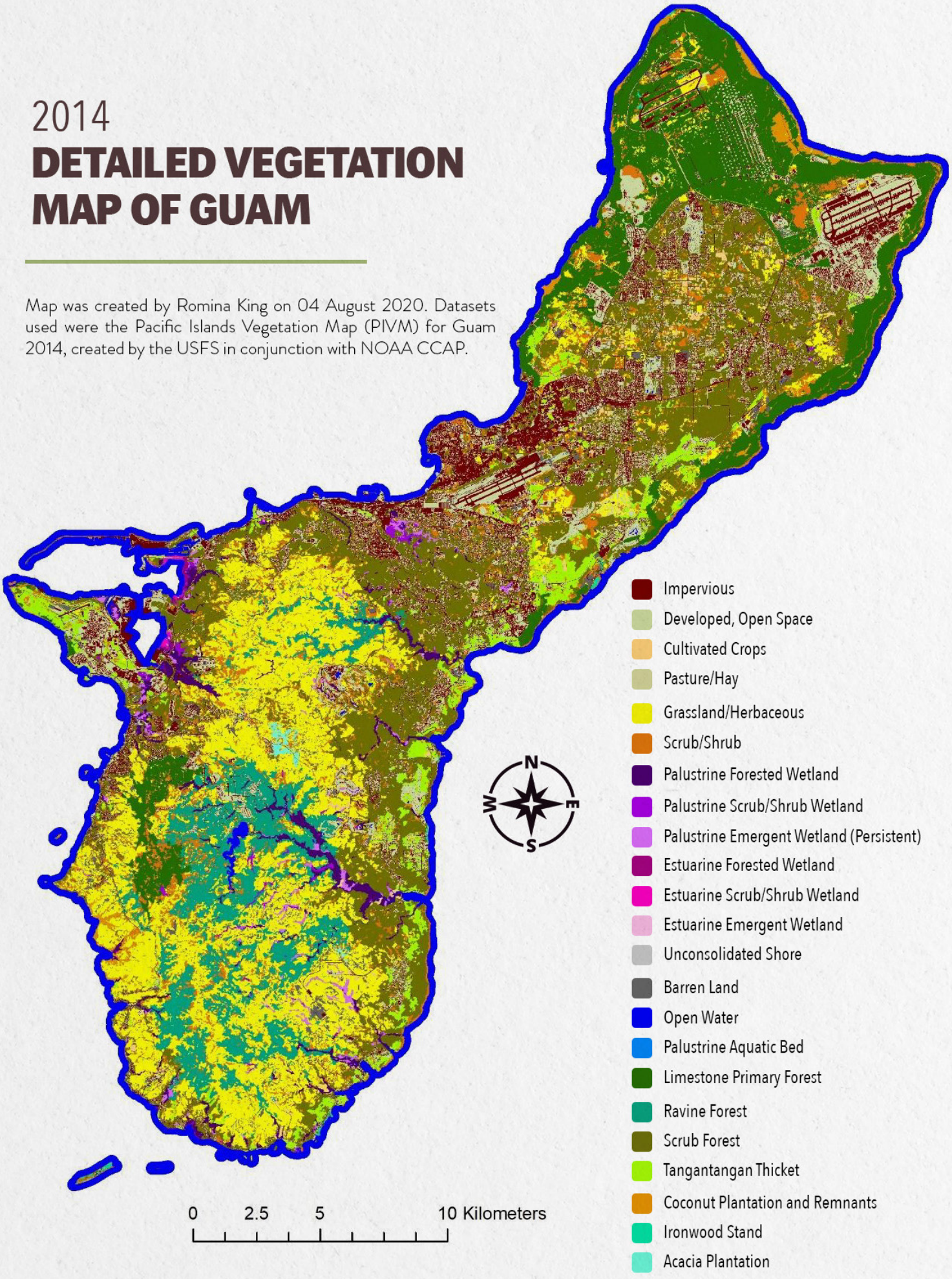
Watershed dataset is available at hydroguam.net



2014

DETAILED VEGETATION MAP OF GUAM

Map was created by Romina King on 04 August 2020. Datasets used were the Pacific Islands Vegetation Map (PIVM) for Guam 2014, created by the USFS in conjunction with NOAA CCAP.



2016

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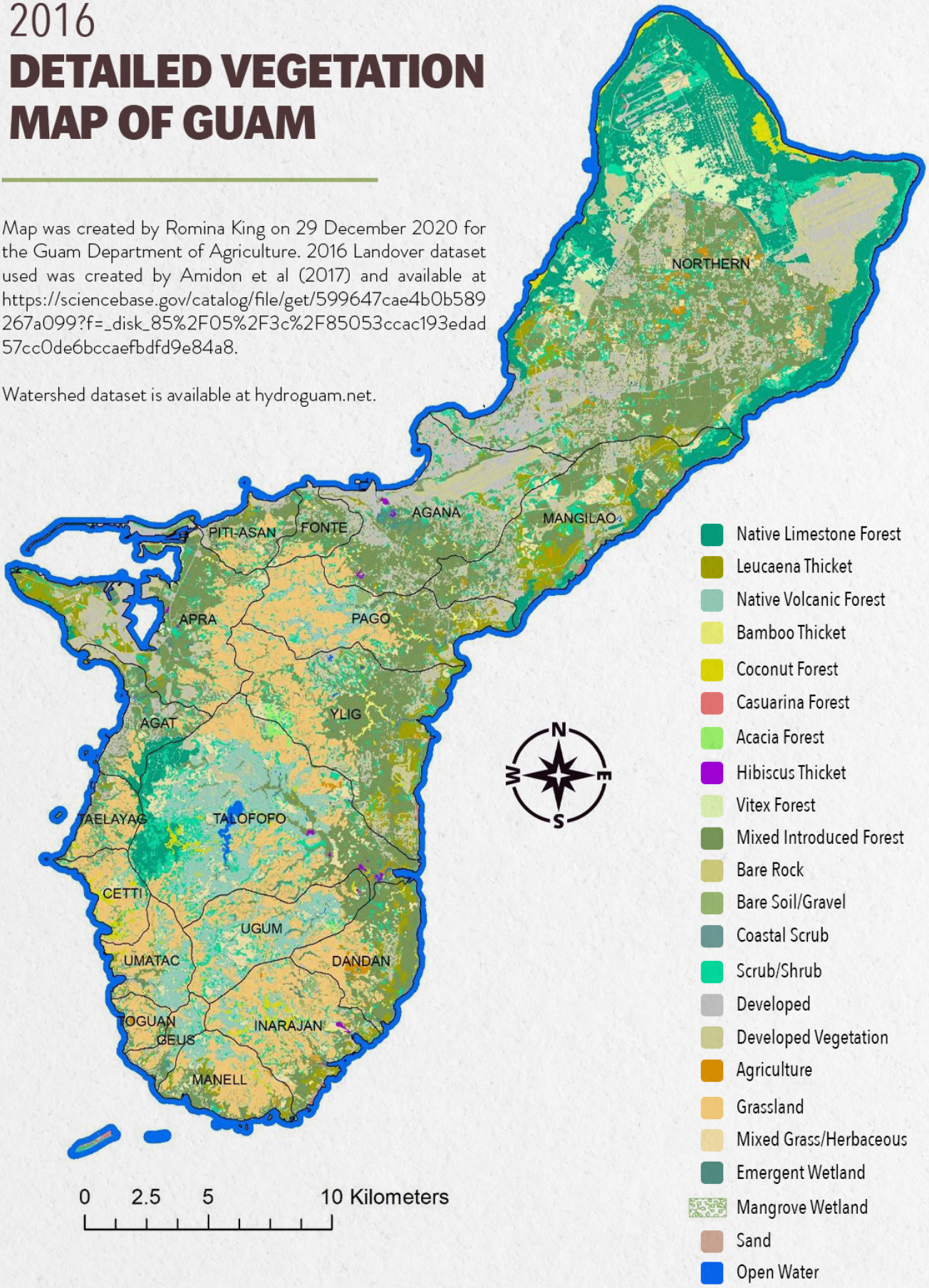
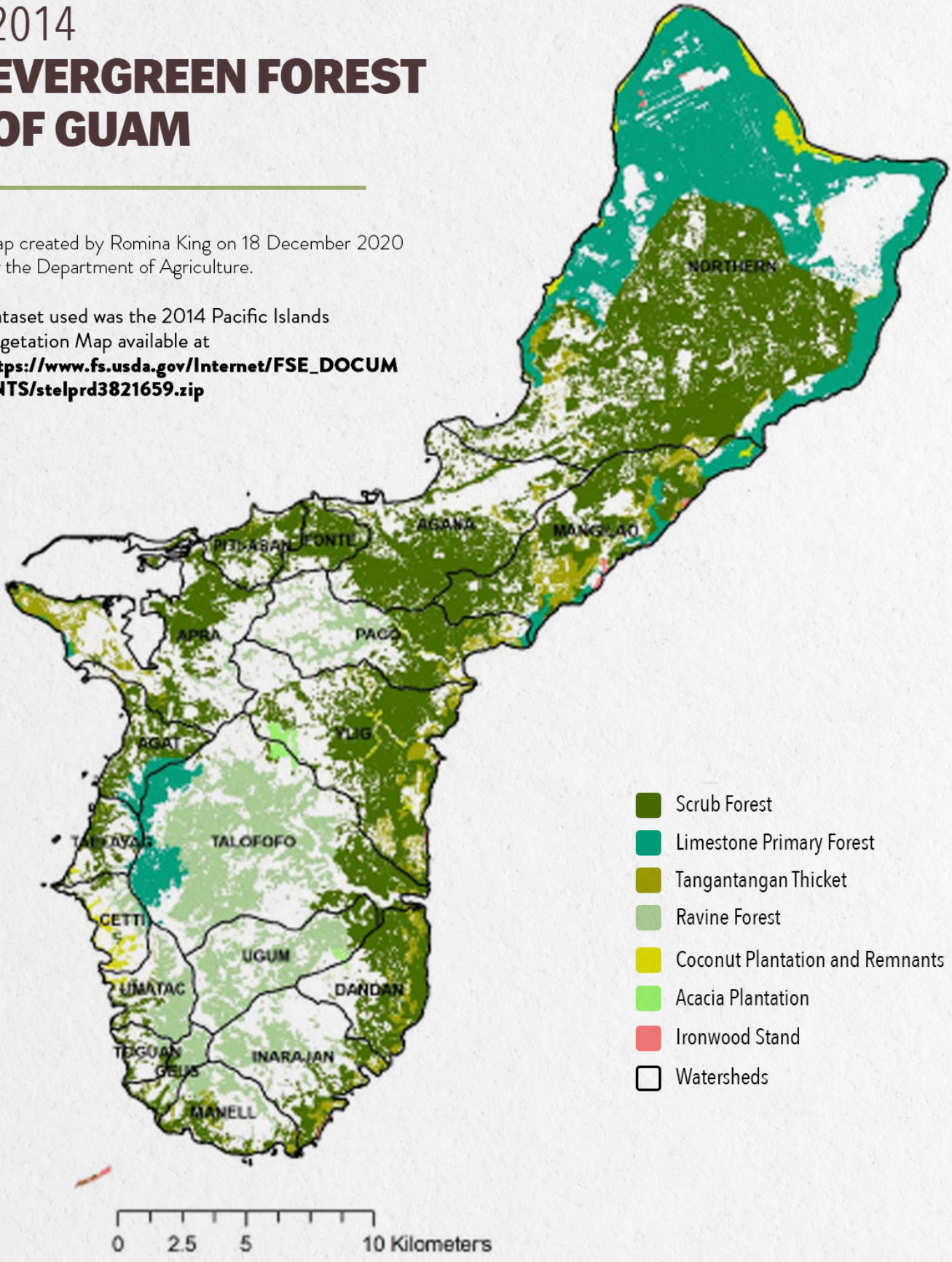


2014

EVERGREEN FOREST OF GUAM

Map created by Romina King on 18 December 2020 for the Department of Agriculture.

Dataset used was the 2014 Pacific Islands Vegetation Map available at **https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3821659.zip**



2016

EVERGREEN FOREST OF GUAM

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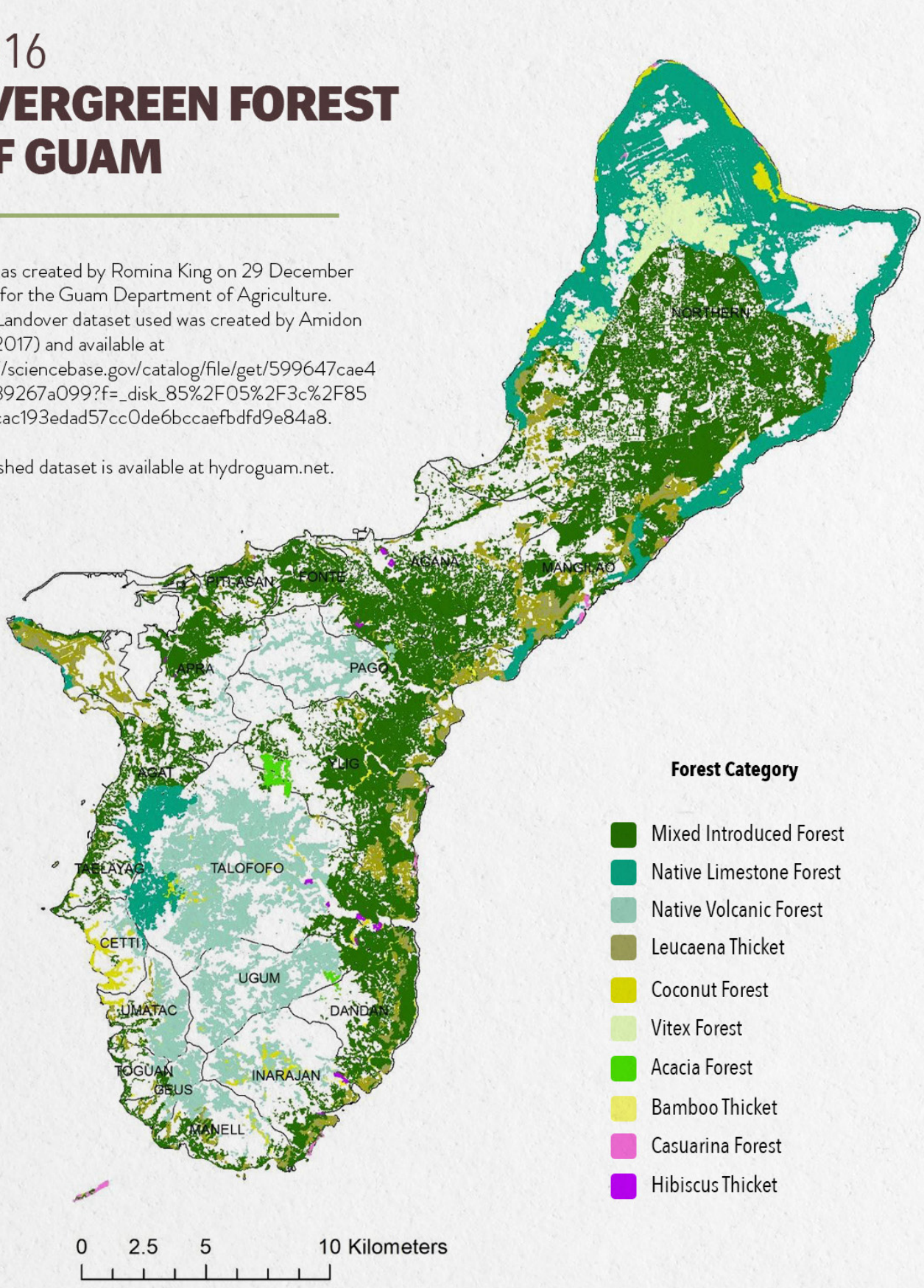
Watershed dataset is available at hydroguam.net.



Non-Forest Communities

Assessing Non-Forest Community Types on Guam is critical in evaluating threats to forested acres, urban areas, and water quality. Non-Forest Communities include several Savanna Communities, Tall Grass communities, and Mixed Grass communities. The nonforest communities exhibit the highest fire prone risk to forests and communities and are the major source of sediment to waterways and the reef system. Other Cover Types were classified as Bare Ground, Developed Areas and miscellaneous other types.

Savanna Communities with Trees: Savanna lands with mid- to tall structure grasses and scattered tree species. *Pandanus tectorius, Casuarina equisetifolia*, and *Cerbera odollam* may be present.

Savanna with Shrub Component: Savanna with scattered, generally short-stature native shrubs. The most abundant shrub is *Scaevola taccada*, with the endemic *Phyllanthus mariannensis*, *Timonius nitidus* and *Myrtella bennigseniana*; *Wikstroemia elliptica* and *Geniostoma rupestre* may also be found in this association. This complex is notable as the habitat for the endangered savanna species, *Phyllanthus saffordii* and *Hedyotis megalantha*. In some locations, the endangered shrub Eugenia bryanii may be present.

Savanna with Low Grass: Mostly open savanna types as described above with little tree cover. Mid- to low-grass structures dominate. *Dimeria chloridiformis* is a short statured (< 0.5 m) endemic soft low-growing bunch grass covered with silvery hairs. *Dimeria* grows in scattered clumps and is often mixed with other species complex occurs within low-grass savanna areas which are often associated with rare and listed savanna species making the management and protection of these areas essential for the recovery of rare and listed species.

Eroded Savanna: Low grass structures and bare soils are interspersed with "clusters" of other savanna types. Expansion of native vegetation from clusters to bare soil areas will require focused soil improvement treatments. Areas of unusually high species diversity can be found in these "clusters" and offer good sources for propagating and direct expansion of native vegetation into neighboring types. Endangered savanna plant species are often found at the edges of eroded areas; *Phyllanthus saffordii* particularly seems to colonize the areas immediately adjacent to badland scars.

Tall Grass: This community type is dominated by tall grasses, especially the native *Miscanthus floridulus*, a 2-3m tall, flammable coarse cane-like grass called neti or swordgrass. Also, in moist communities, this type also contains *Phragmites* marshes; these types are generally monospecific dense patches of *Phragmites karka*, a 2-5m tall grass growing densely in moist depressions (seeps, springs) and along shallow waterways in open areas.

Mixed Grass: Mixed grass communities are dominated by low to medium stature (generally <1m tall) grasses such as the introduced *Pennisetum spp*., *Paspalum spp*., and *Dichanthium bladhii*. *Pennisetum* generally grows admixed with other grasses, sedges and shrubs, while *Dichanthium bladhii* forms extensive, dense, almost monospecific stands on upper slopes. Some fern and herb species (e.g., *Stachytarpheta jamaicensis*, *Hyptis capitata*) also occur within the grass community. *Dimeria* grasslands are also included in this type. *Dimeria* grows in scattered clumps and is often mixed with other species such as the native *Lycopodium cernuum*, *Miscanthus*, and invasive *Pennisetum spp*. *Dimeria* favors level to gently rolling terrain and often occurs with other grasses on slopes. *Dimeria* meadows generally occur on more level ground where erosion is not as high and where there may be some relief from fire; in areas with frequent wildfires, *Dimeria* meadows seem to be replaced by *Dichanthium*.

Other Forest Types

Cover types that did not focus on vegetation profiles are included in the 2016 General Vegetation Map of Guam (Figure 6 and Table 4). These types included bare ground, developed lands, open water, etc. Significant types are described below:

Bare Ground: Areas designated as Badlands were used to characterize exposed soils on the landscape. These are typified by mostly bare soil, with exposed C-horizon, saprolite or hard bedrock and very little vegetation. Some areas have early successional vegetation, principally *Gleichenia* and *Lycopodium cernuum*. Vegetation occurring on erosion scars of red soils differs somewhat from those on grey soils. This classification was also used to identify signatures of exposed soils between trees, grasses, and other classifications.

Development: Areas of development were estimated to be 18.72% of total land area.

Other Types: Open water and other designations with low confidence were consolidated. Few instances were lumped into this category.

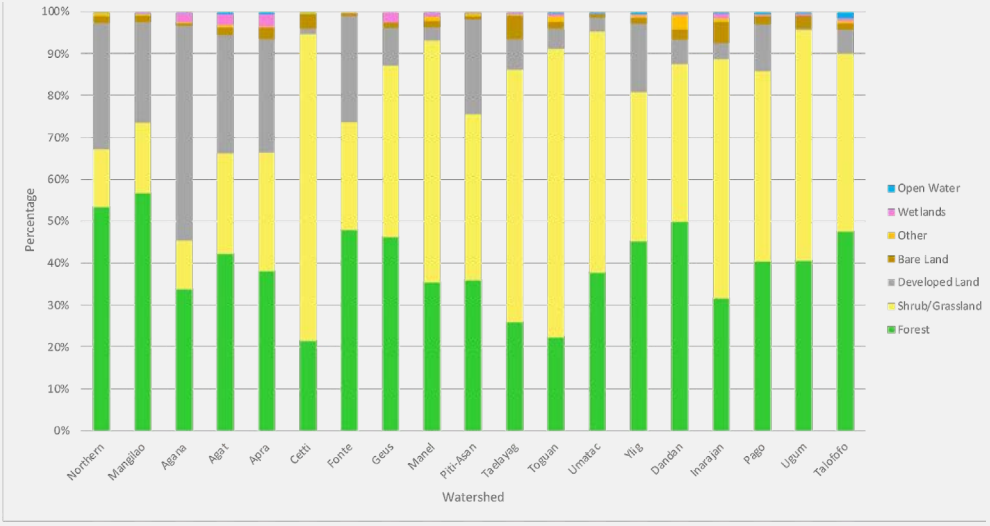
Characterization of Vegetation According to Watershed

The major watersheds of Guam were divided into three groups: western, eastern, and northern regions to capture the major changes in soils and topography. The western and eastern watersheds are mostly relegated to southern Guam. Further discussion on the delineation of watersheds and watershed groups is described in the Watersheds on Guam section. Using 2016 General Landcover geospatial dataset of Amidon et al. (2017), areas of each category were calculated for each watershed and graphed as percentages of total area of the watershed.

Most developed areas fall in the Northern Region (Northern, Agana, and Mangilao) and least amount of development occurs in the western and eastern watersheds. Non-forested cover is mostly found within the western and eastern watersheds of southern Guam; on average, these watersheds have 45% of the land area in non-forested cover.

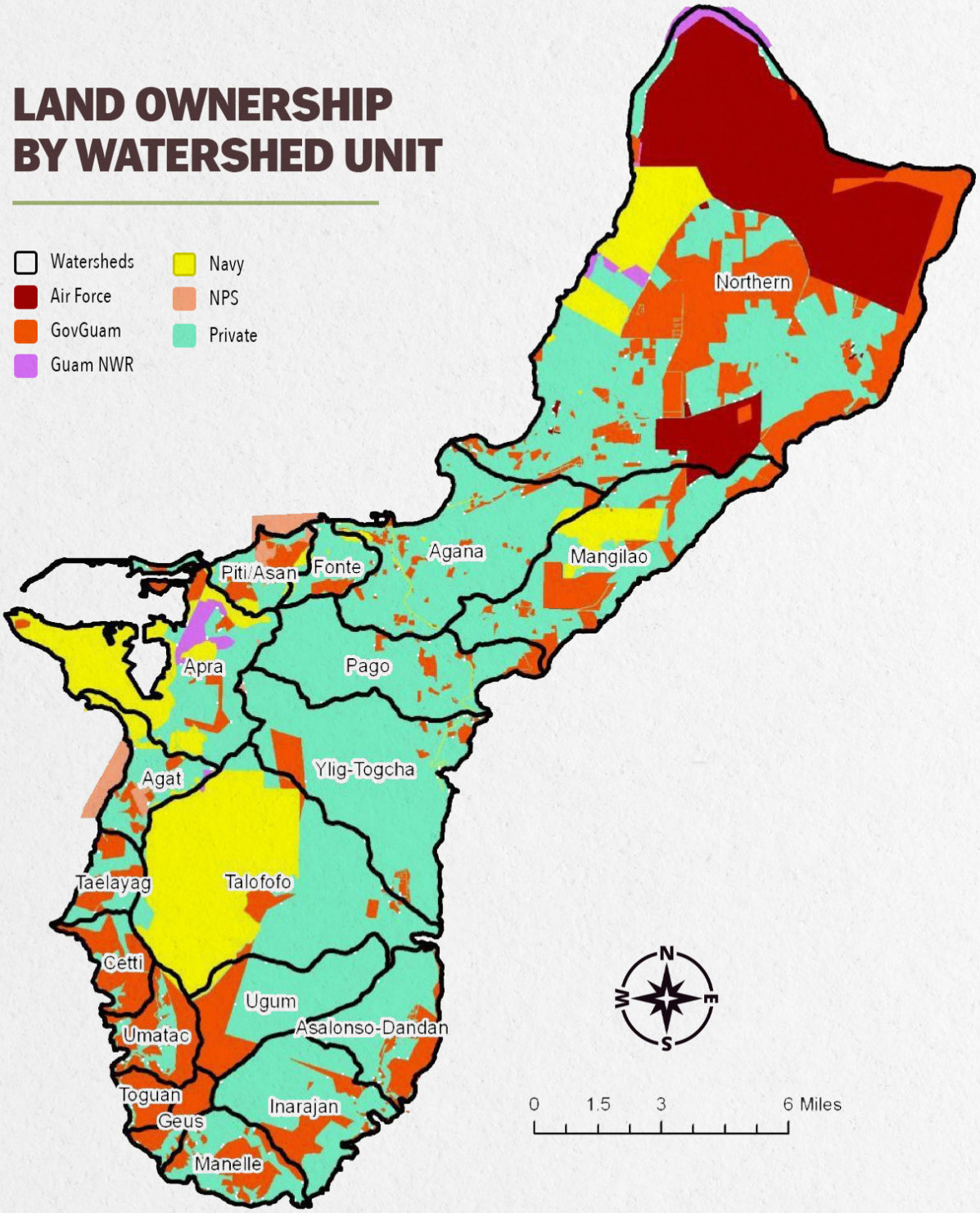
Developed cover types were predominantly found in the northern watersheds, and the western watersheds beginning in Agat and extending to the North and Ylig in the East. Overall, between 20% and 50% of the land area within these watersheds are developed.

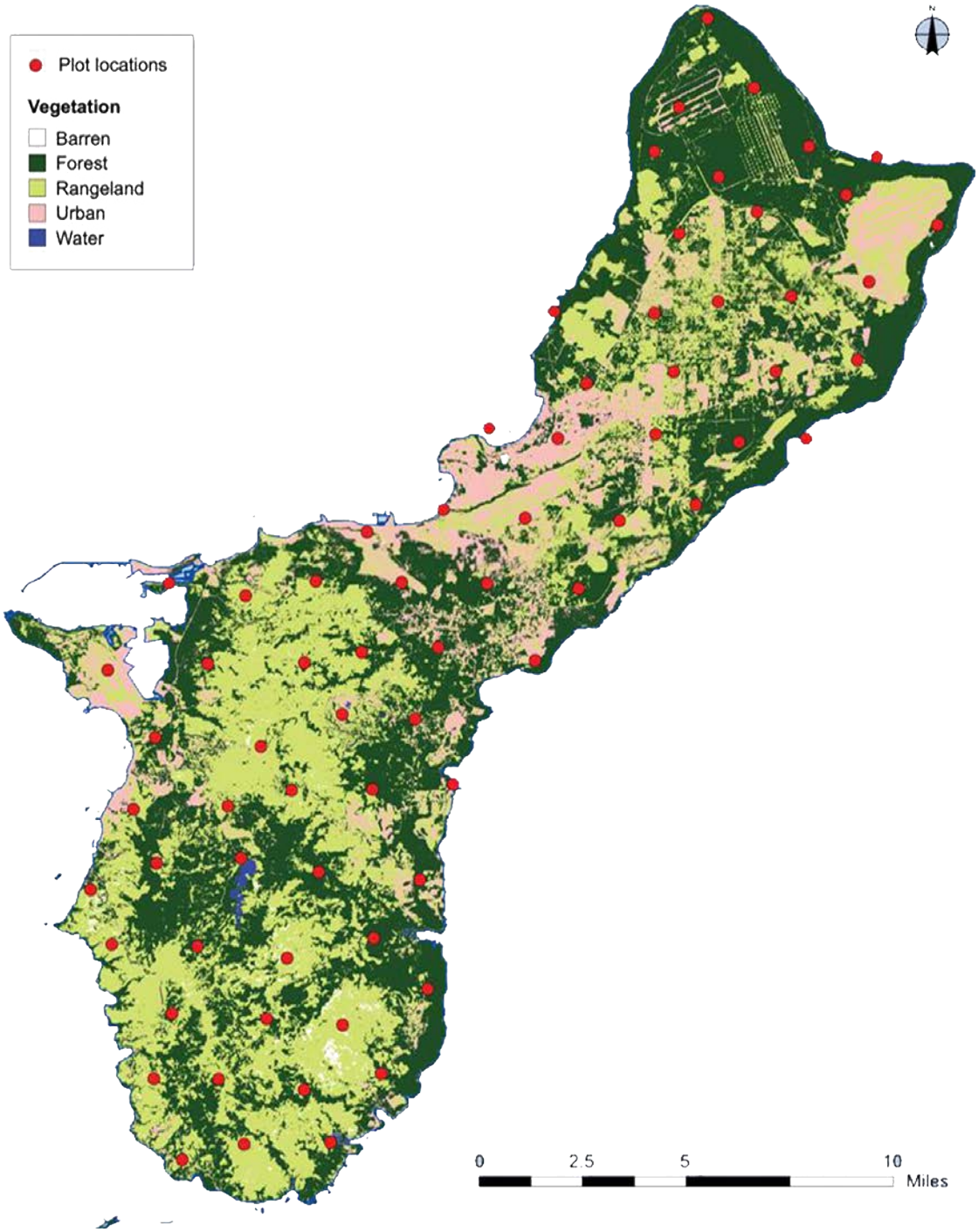
The highest proportions of forest lands were found in the Northern, Mangilao, and Talofofo watersheds; combined these three watersheds contain 59% of all the forest cover of Guam. This is of particular importance as they also contain the majority of the proposed military buildup lands.



Bar graph showing the 2016 percentage of area landcover within each watershed. Data depicted in the graph are derived from the geospatial dataset of Amidon et al. (2017).

LAND OWNERSHIP BY WATERSHED UNIT





Map of Guam showing location of Forest Inventory and Analysis (FIA) plots, and plots sampled by the Micronesian Challenge (MC) in 2013.

An orthomosaic map of the Yigo Triton Research Farm in Guam. The image was capture with a DJI Matrice M30T drone.

Source: Kaya Taitano, Christopher Salas

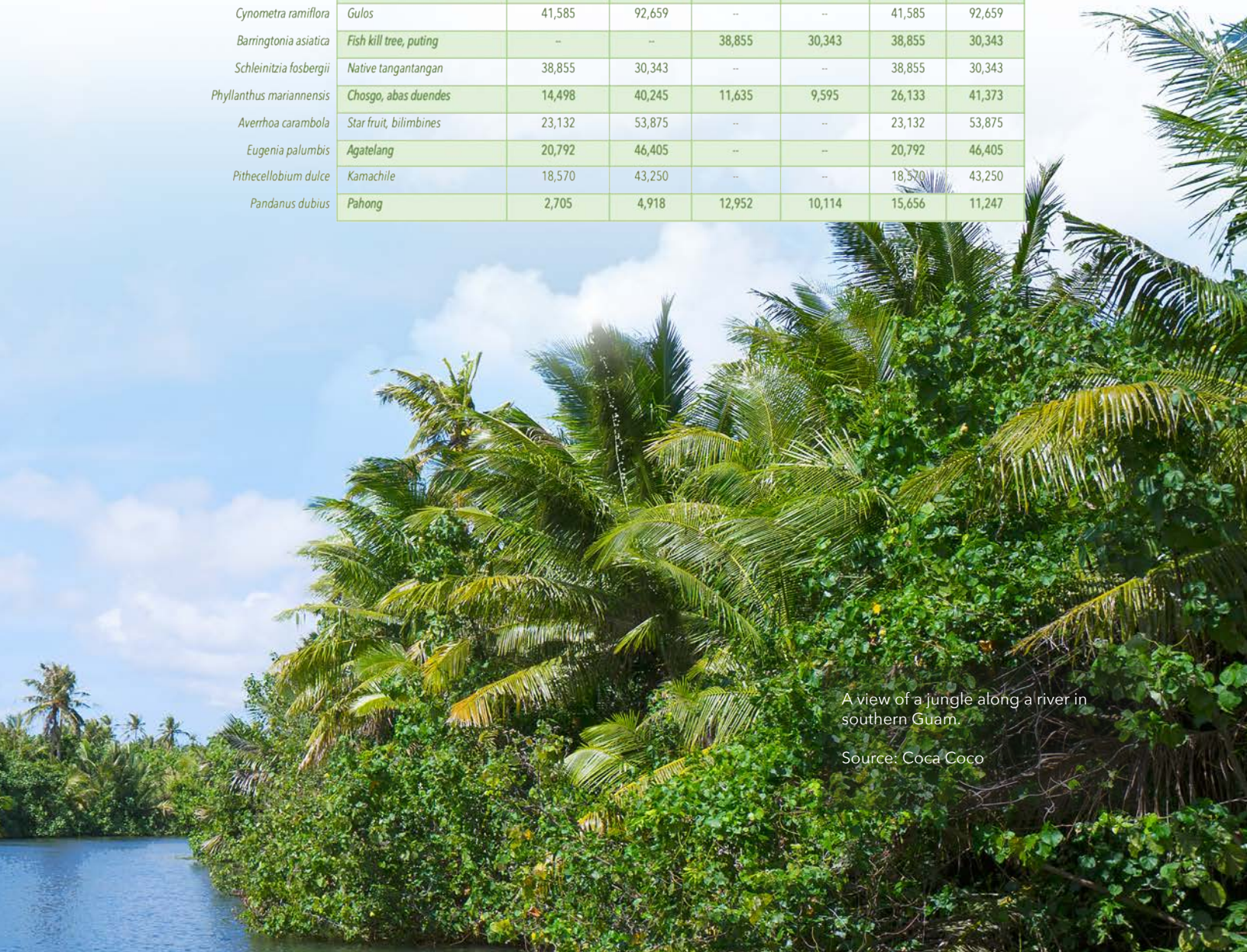
Forest Structure

Important factors in forest structure are tree species, diameter, height, and presence of damage. The FIA and MC forest inventories of 2013 identified 64 tree species on Guam. The five most prevalent species were Leucaena leucocephala, Hibiscus tilliaceus, Triphasia trifolia, Meiogyne cylindrocarpa, and Vitex parviflora. There was a total of 74 million trees estimated to be on Guam in 2013.

Table 8. Estimated number of trees on Guam by species.

Tree Names		Micronesia Challenge Area		Outside Micronesia Challenge Area (FIA)		Overall	
Scientific	English[1] / *CHamoru*[2]	Subtotal	SE	Subtotal	SE	Total	SE
Leucaena leucocephala	*Tangantangan*	4,459,705	2,171,776	6,302,290	1,817,474	10,761,995	2,689,749
Hibiscus tilliaceus	*Pagu*	1,578,467	869,145	7,805,348	1,786,613	9,383,814	1,985,109
Triphasia trifolia	Limeberry, *lemon di china*	1,697,407	1,349,782	7,243,737	5,283,780	8,941,143	5,435,135
Meiogyne cylindrocarpa	*Paipai*	5,200,278	1,853,394	3,268,481	1,420,873	8,468,759	2,318,477
Vitex parviflora	Vitex	1,351,624	853,922	3,601,971	1,282,622	4,953,595	1,518,022
Morinda citrifolia	Indian mulberry, *lada, noni*	611,713	328,651	2,866,450	1,029,824	3,478,163	1,055,177
Ochrosia oppositifolia	*Fagot*	931,834	944,842	2,033,735	1,072,194	2,965,570	1,429,100
Premna serratifolia	*Ahgao*	531,183	291,923	2,130,232	816,616	2,661,415	848,394
Heterospathe elata	*Palma brava*	14,809	11,000	2,307,962	1,150,560	2,322,771	1,149,858
Aglaia mariannensis	*Mapunyao*	2,287,016	1,406,335	--	--	2,287,016	1,406,335
Averrhoa bilimbi	Pickle tree, *pikols*	836,046	631,612	1,355,450	1,058,491	2,191,497	1,210,989
Casuarina equisetifolia	Ironwood, *gagu*	81,838	120,515	1,495,881	880,929	1,577,719	888,275
Cocos nucifera	Coconut palm, *niyok*	275,301	149,756	907,506	307,845	1,182,807	340,068
Cananga odorata	*Ilang-ilang*	--	--	1,019,825	785,866	1,019,825	785,866
Pandanus tectorius	Pandanus, *kafu*	212,153	151,210	769,035	207,657	981,188	256,099
Adenanthera pavonina	Red bead tree, *kulalis*	--	--	883,076	680,588	883,076	680,588
Annona muricata	Soursop, *laguana*	--	--	637,128	353,797	637,128	353,797
Ochrosia mariannensis	Lipstick plant, *langiti*	539,821	663,350	--	--	539,821	663,350
Bauhinia monandra	Orchid tree, *mariposa*	--	--	509,913	398,198	509,913	398,198
Mammea odorata	Chopak	318,810	703,193	187,240	146,218	506,050	718,234
Calophyllum inophyllum	Palomaria, *da'ok*	--	--	403,301	229,116	403,301	229,116
Ficus tinctoria	*Hodda, tagete*	32,377	55,319	348,576	251,829	380,953	257,833
Tarenna sambucina	*Sumac-lada*	194,056	467,103	161,336	125,990	355,393	483,796
Cycas micronesica	*Fading, federico*	326,773	158,298	25,903	13,959	352,677	158,912
Areca catechu	Betel nut palm, *pugua*	184,469	293,102	137,202	62,558	321,671	299,704
Eugenia reinwardtiana	*A'abang*	247,966	319,511	--	--	247,966	319,511
Mangifera indica	Mango, *manga*	--	--	220,179	161,661	220,179	161,661

Melanolepis multiglandulosa	*Alom*	23,132	53,875	174,288	136,104	197,421	146,379
Annona reticulata	Custard apple, *annonas*	41,937	30,783	155,421	88,724	197,357	92,026
Chrysophyllum caimito	Star apple, *kaimito*	161,336	125,990	--	--	161,336	125,990
Maytenus thompsonii	*Luluhut*	154,013	326,649	--	--	154,013	326,649
Spathodea campanulata	African tulip tree	--	--	129,517	66,653	129,517	66,653
Pisonia grandis	Grand devil's claw, *umumu*	7,703	7,915	90,662	70,799	98,366	71,240
Ficus prolixa	Banyan, strangler fig, *nunu*	92,427	86,886	--	--	92,427	86,886
Scaevola taccada	Half-flower, *nanasu*	77,006	185,358	--	--	77,006	185,358
Tristiropsis obtusangula	*Faia*	10,785	19,095	64,759	50,571	75,543	54,056
Macaranga thompsonii	*Pengua*	69,331	64,832	--	--	69,331	64,832
Artocarpus altilis	*Breadfruit, lemmai*	3,714	5,909	64,759	41,232	68,473	41,653
Eugenia thompsonii	*Atoto*	63,917	78,381	--	--	63,917	78,381
Intsia bijuga	*Ifit*	21,570	19,023	38,855	30,343	60,425	35,812
Cestrum diurnum	*Inkberry, tintan-china*	57,755	102,693	--	--	57,755	102,693
Hernandia Sonora	*Nonak*	54,536	100,606	--	--	54,536	100,606
Cordia subcordata	*Niyoran*	53,924	72,547	--	--	53,924	72,547
Psychotria mariana	*Aploghating*	46,207	67,356	--	--	46,207	67,356
Dendrocnide latifolia	*Katot*	44,666	93,081	--	--	44,666	93,081
Artocarpus mariannensis	*Seeded breadfruit, dukduk*	4,938	6,753	38,855	16,663	43,794	17,980
Cynometra ramiflora	*Gulos*	41,585	92,659	--	--	41,585	92,659
Barringtonia asiatica	*Fish kill tree, puting*	--	--	38,855	30,343	38,855	30,343
Schleinitzia fosbergii	*Native tangantangan*	38,855	30,343	--	--	38,855	30,343
Phyllanthus mariannensis	*Chosgo, abas duendes*	14,498	40,245	11,635	9,595	26,133	41,373
Averrhoa carambola	*Star fruit, bilimbines*	23,132	53,875	--	--	23,132	53,875
Eugenia palumbis	*Agatelang*	20,792	46,405	--	--	20,792	46,405
Pithecellobium dulce	*Kamachile*	18,570	43,250	--	--	18,570	43,250
Pandanus dubius	*Pahong*	2,705	4,918	12,952	10,114	15,656	11,247



A view of a jungle along a river in southern Guam.

Source: Coca Coco

RIDGE-TO-REEF APPROACH

Introduction

Coral reefs are degraded by sediment runoff from watersheds, particularly from the steep landscapes in southern Guam. Deforestation, invasive species, fire, and land management practices increase the sediment flux from the uplands to rivers that empty into the fringing reef and bays. In addition to harming water quality in rivers and freshwater bodies, these chronic sediment plumes contribute to significant declines in coral reef health.

The Ridge-to-Reef management approach provides an important connection between land management practices and the health of Guam's fringing reefs. Guam Forestry provides a critical role in abating the threat of declining water quality issues to waterways and coral reefs through maintaining and improving forest health, forest stewardship, fire control programs and watershed-scale restoration efforts. Organizing spatial information and issues by watershed provides a powerful tool in developing multi-objective strategies to abate the pollution of these critical water resources.

Underwater photograph of Tumon Bay Marine Reserve, Guam, showing some of the amazing biologic diversity of coral reefs.

Source: Curt Storlazzi, Pacific Coastal & Marine Science Center / Public Domain

Watersheds on Guam

The island of Guam has been subdivided into 19 watersheds, categorized into three groups: Eastern, Western and Northern Guam watersheds. Watersheds on the eastern side of Guam are generally larger in size and gentler in slope then those found on the western side of the island.

The three northern Guam watersheds generally lack significant stream systems, reflecting the porous nature of the limestone geology of the northern half of the island. Precipitation increases with elevation in all of the watersheds.

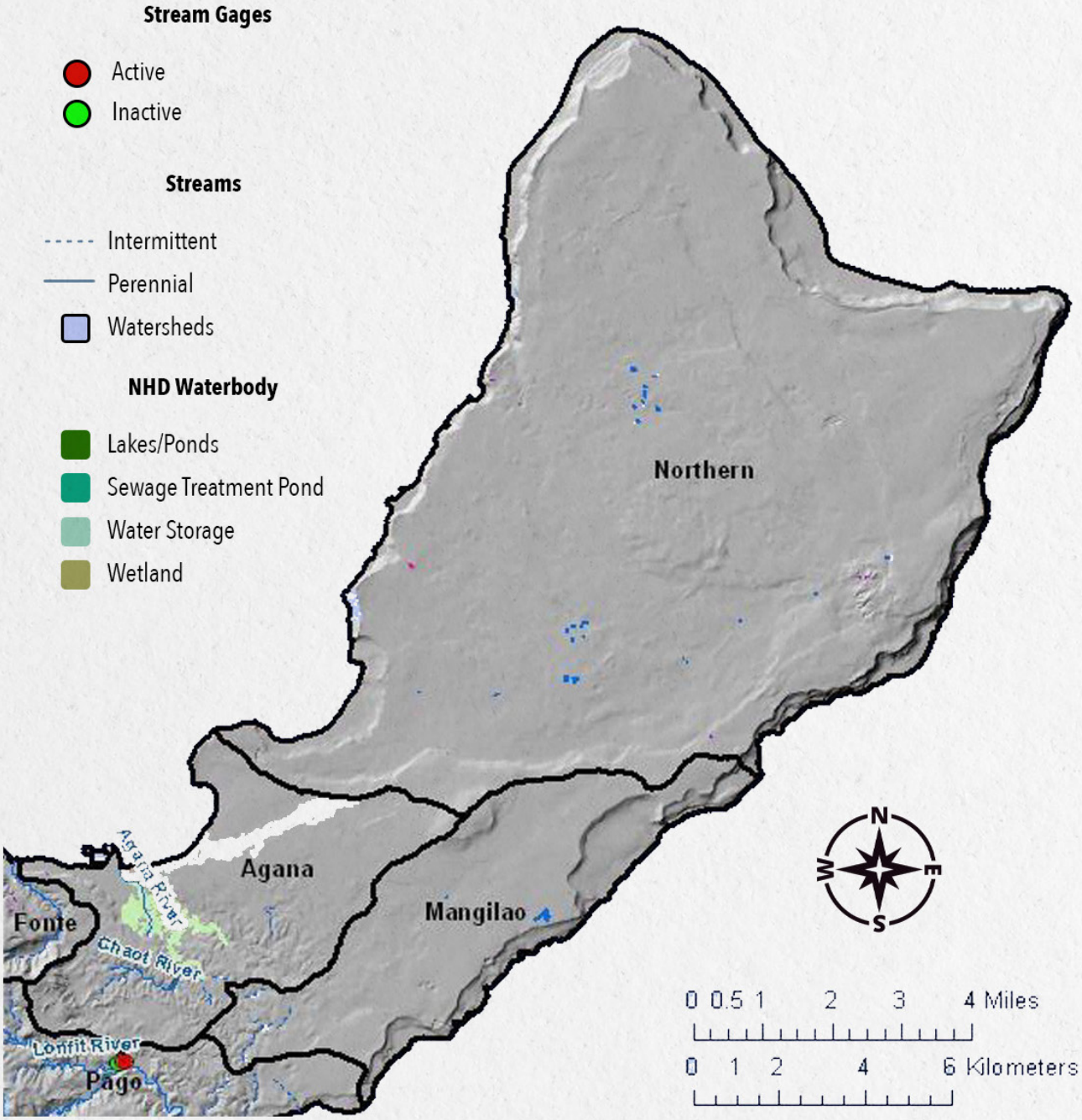
Our Urban Community Forestry coordinator checks on the native seedlings in the COTAL conservation area. The acacia trees in the background were planted almost 20 years ago by the Forestry divisio to help rebuild the soil in badlands and also provide shade while the natives have time to grow and get strong.

Source: Guam Department of Agriculture

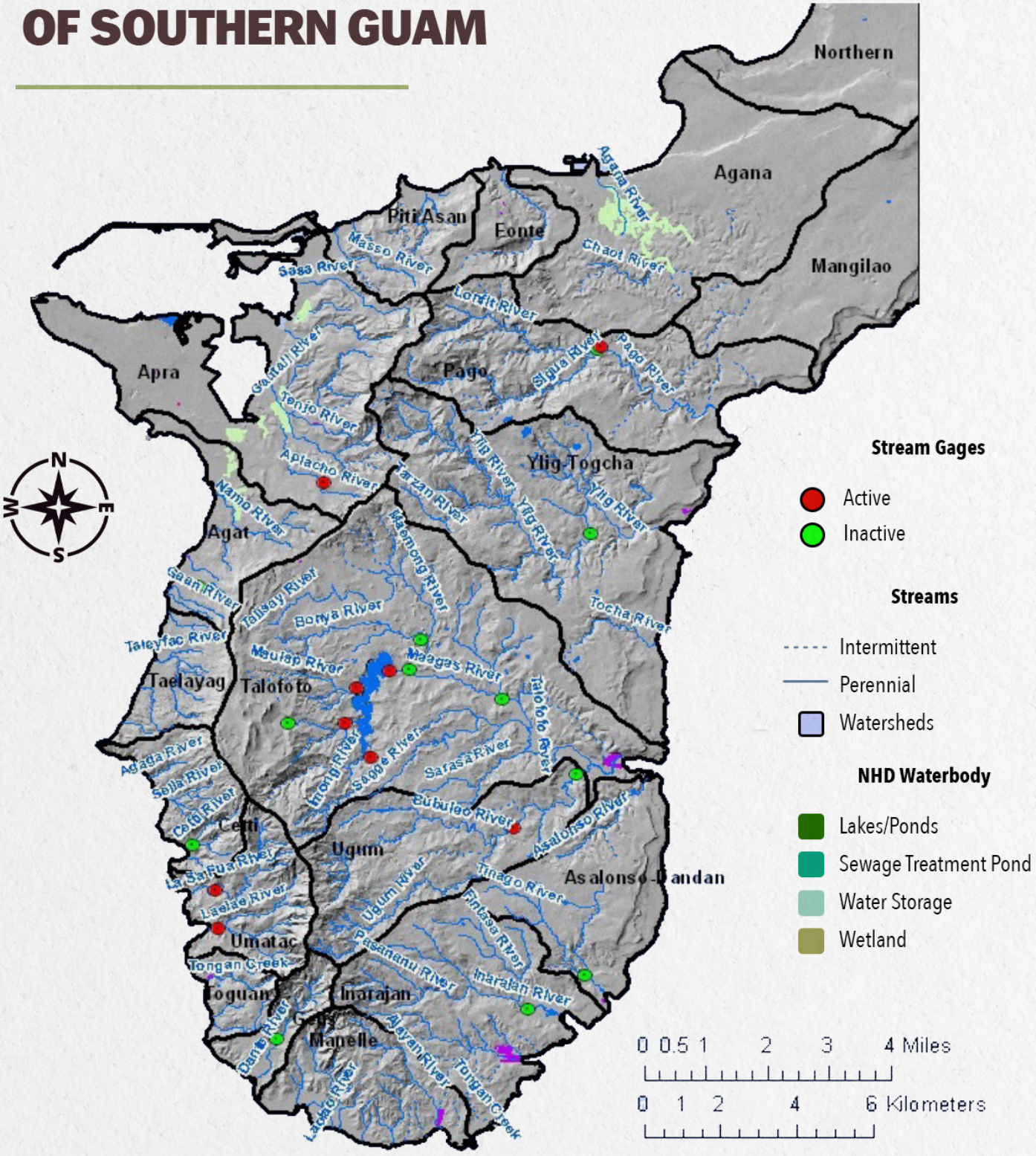
A Guam Green Growth (G3) Conservation Corps member plants an acacia tree (Acacia auriculiformis) at the Ugum watershed, March 30, 2022, in Inalåhan, Guam. The G3 Conservation Corps joined the Guam Restoration of Watersheds Initiative in watershed conservation activities to combat erosion at the site.

Source: University of Guam

WATER FEATURES OF NORTHERN GUAM



WATER FEATURES OF SOUTHERN GUAM



Inland Water Bodies

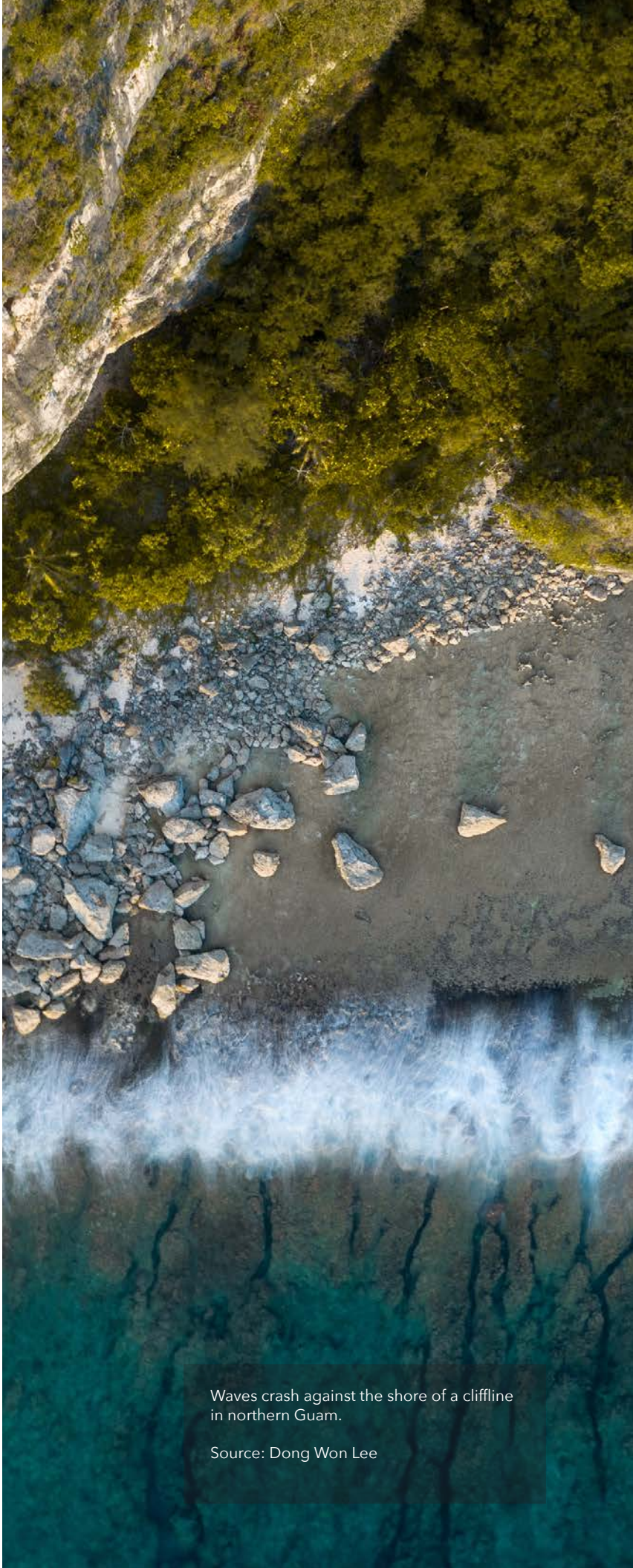
Approximately 260 miles of streams are mapped on the island of Guam; the majority are identified as having perennial flow. Few streams occur in the limestone- dominated northern Guam watersheds, and none in the Northern watershed itself. The largest water body on the island is the human-made Fena Reservoir located in the Talofofo watershed (195 acres). Large, primarily estuarine wetland areas occur in the Agana, Apra and Agat watersheds.

Reef Resources

Guam is surrounded by an extensive and species-rich reef system that provides many services including cultural and traditional uses, tourism and recreation, fisheries, and shoreline and infrastructure protection. Over 38 square miles of shallow coral reef are found within 3 miles of Guam's coastline. Guam's reef resources are currently in decline due to degradation of water quality, chronic crown of thorns seastar (COTS) outbreaks, and low abundance of major herbivorous (algae-eating) fishes. There is also a documented decline of coral recruitment rates over the past few decades.

Primary threats to Guam's coral reefs include sedimentation and pollutants associated with terrestrial runoff, and overfishing. Secondary threats include COTS outbreaks, coral diseases, dredging, boat groundings, marine debris, coral bleaching, and recreational misuse and overuse. Storm activity can also cause direct damage to reef structure, and coral bleaching is emerging as a potential threat which will likely become more severe with increasing sea surface temperatures associated with global climate change.

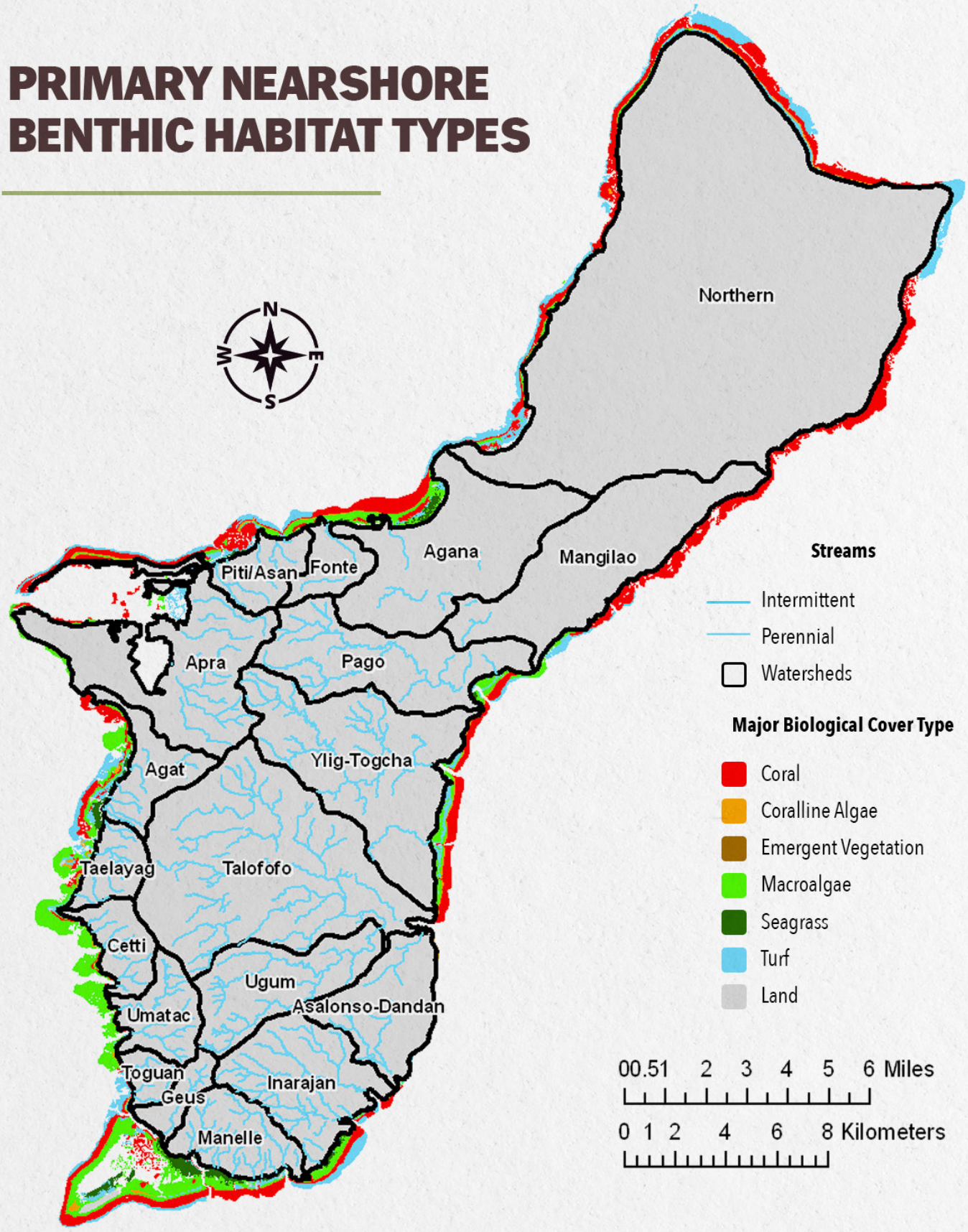
Linkages between Guam's coral reef communities and Guam Forestry objectives are directly related activities that affect the quantity and quality of water and sediment pollution runoff to the reef communities. In particular, reef resources are affected by fire and post-fire management, and quality and health of forested upland and riparian systems that can increase sediment trapping from grass or bare ground hill slopes.

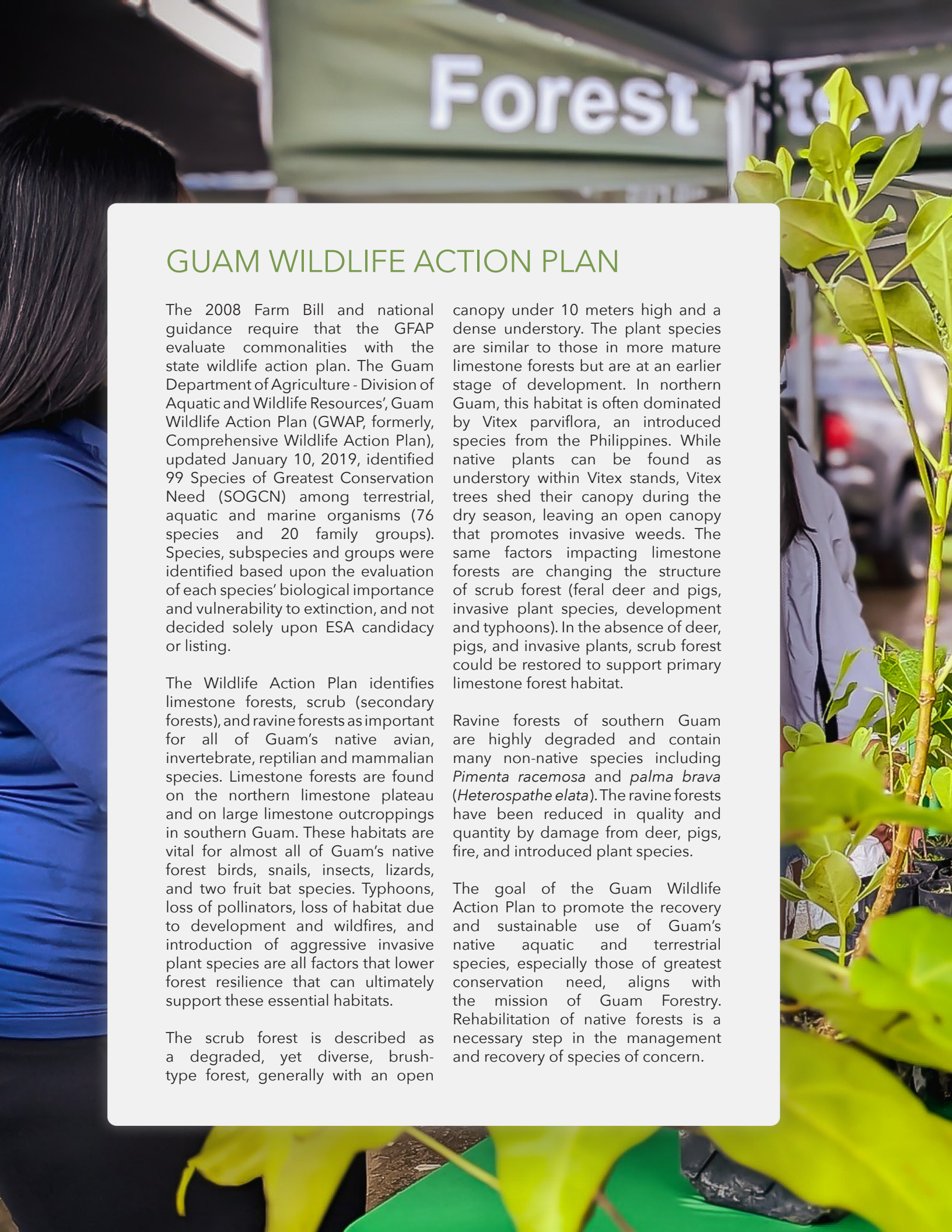


Waves crash against the shore of a cliffline in northern Guam.

Source: Dong Won Lee

PRIMARY NEARSHORE BENTHIC HABITAT TYPES





GUAM WILDLIFE ACTION PLAN

The 2008 Farm Bill and national guidance require that the GFAP evaluate commonalities with the state wildlife action plan. The Guam Department of Agriculture - Division of Aquatic and Wildlife Resources', Guam Wildlife Action Plan (GWAP, formerly, Comprehensive Wildlife Action Plan), updated January 10, 2019, identified 99 Species of Greatest Conservation Need (SOGCN) among terrestrial, aquatic and marine organisms (76 species and 20 family groups). Species, subspecies and groups were identified based upon the evaluation of each species' biological importance and vulnerability to extinction, and not decided solely upon ESA candidacy or listing.

The Wildlife Action Plan identifies limestone forests, scrub (secondary forests), and ravine forests as important for all of Guam's native avian, invertebrate, reptilian and mammalian species. Limestone forests are found on the northern limestone plateau and on large limestone outcroppings in southern Guam. These habitats are vital for almost all of Guam's native forest birds, snails, insects, lizards, and two fruit bat species. Typhoons, loss of pollinators, loss of habitat due to development and wildfires, and introduction of aggressive invasive plant species are all factors that lower forest resilience that can ultimately support these essential habitats.

The scrub forest is described as a degraded, yet diverse, brush-type forest, generally with an open canopy under 10 meters high and a dense understory. The plant species are similar to those in more mature limestone forests but are at an earlier stage of development. In northern Guam, this habitat is often dominated by Vitex parviflora, an introduced species from the Philippines. While native plants can be found as understory within Vitex stands, Vitex trees shed their canopy during the dry season, leaving an open canopy that promotes invasive weeds. The same factors impacting limestone forests are changing the structure of scrub forest (feral deer and pigs, invasive plant species, development and typhoons). In the absence of deer, pigs, and invasive plants, scrub forest could be restored to support primary limestone forest habitat.

Ravine forests of southern Guam are highly degraded and contain many non-native species including *Pimenta racemosa* and *palma brava* (*Heterospathe elata*). The ravine forests have been reduced in quality and quantity by damage from deer, pigs, fire, and introduced plant species.

The goal of the Guam Wildlife Action Plan to promote the recovery and sustainable use of Guam's native aquatic and terrestrial species, especially those of greatest conservation need, aligns with the mission of Guam Forestry. Rehabilitation of native forests is a necessary step in the management and recovery of species of concern.

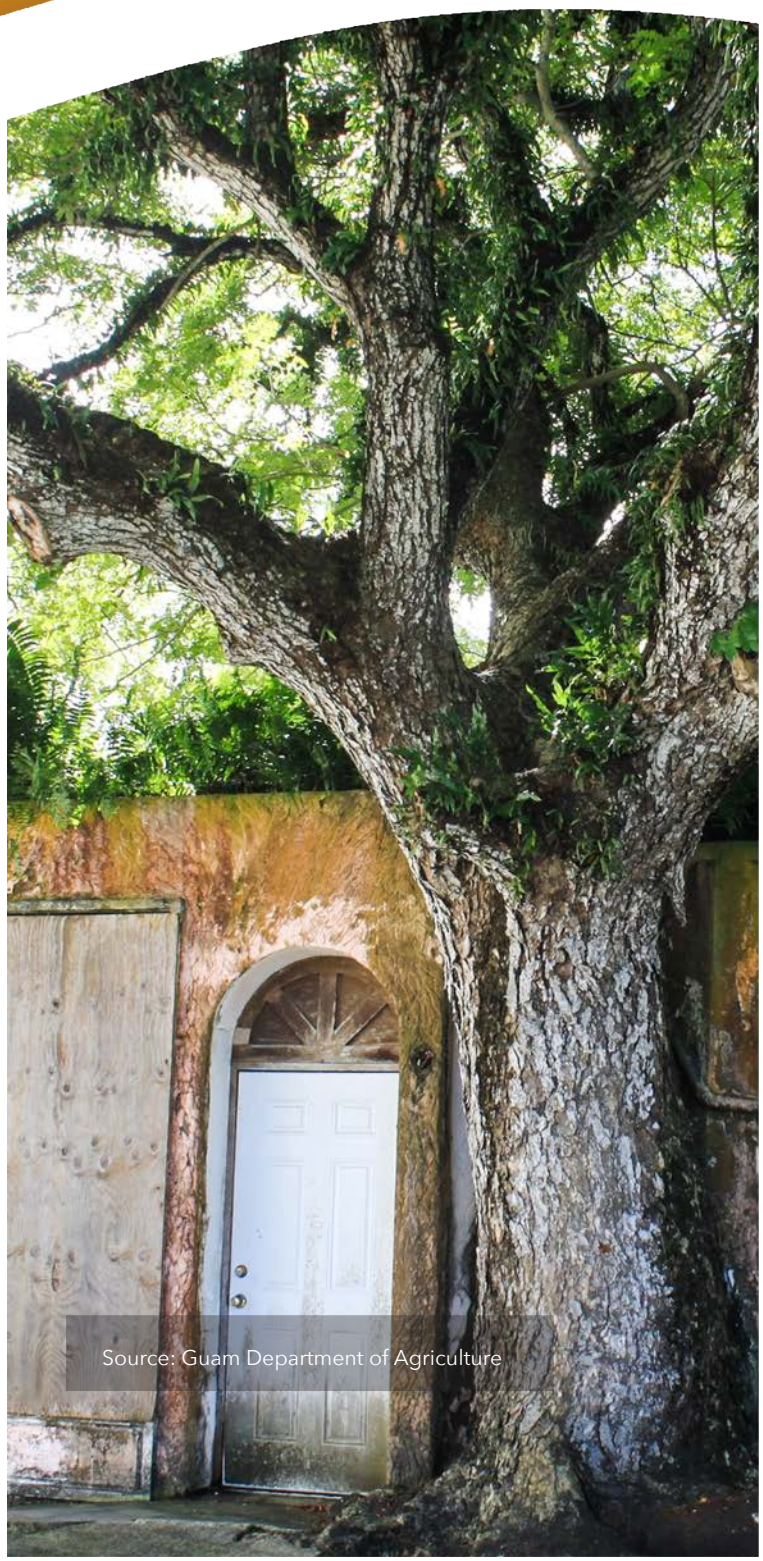

ardship Pro

IDENTIFICATION OF KEY ISSUES

Approach

As described under the Conditions and Trends of Forest Resources section, vegetative cover on Guam can be classified coarsely as Forest, Non-Forest (savanna and grasslands), Developed and Bare Ground. Because of the high degree of loss and conversion of forests and the mosaic of cover types on the landscape, it is important to evaluate issues and threats at the landscape scale, rather than focus only on the current forest cover. For example, the threat of fire to existing forests occurs on the edge of forest in the grasslands and savannas. For this reason, the threats to forest ecosystems should focus not only within forest boundaries, but across all landscape cover types to determine the best actions for management to prevent further impacts to forests.

The identification of issues and threats followed a two-step process. The first step was a Stakeholder process that identified six major related issues developed for Guam. The second step involved fine-tuning the strategies and updating maps (vegetation, fire risks and forest stewardship priority maps).



Source: Guam Department of Agriculture

Source: Guam Department of Agriculture

IDENTIFICATION OF **ISSUES AND THREATS**

TO GUAM LANDSCAPES

1

ISSUE 1

WILDFIRE & PUBLIC SAFETY

2

ISSUE 2

WATER QUALITY & WATER SUPPLY

3

ISSUE 3

DEFORESTATION OF NATIVE & OLD FORESTS

4

ISSUE 4

URBAN FOREST SUSTAINABILITY, POPULATION GROWTH & URBANIZATION

5

ISSUE 5

DEGRADED LANDS

6

ISSUE 6

INVASIVE SPECIES & FOREST HEALTH

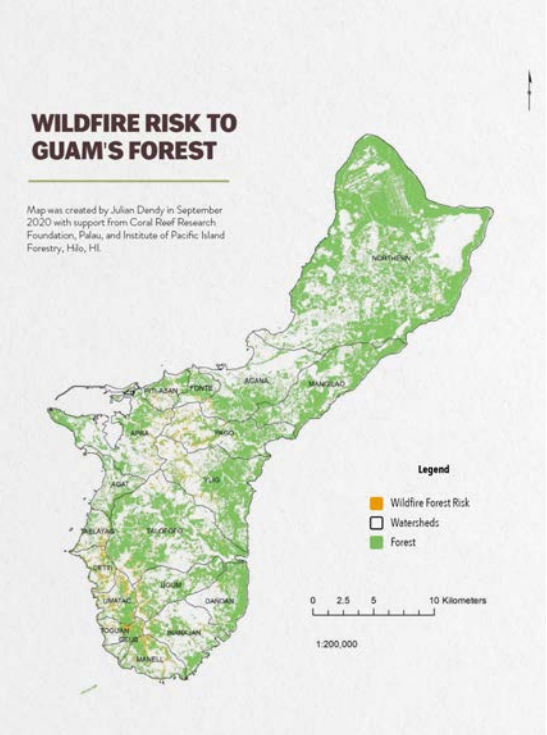
Stakeholder Identification of Issues

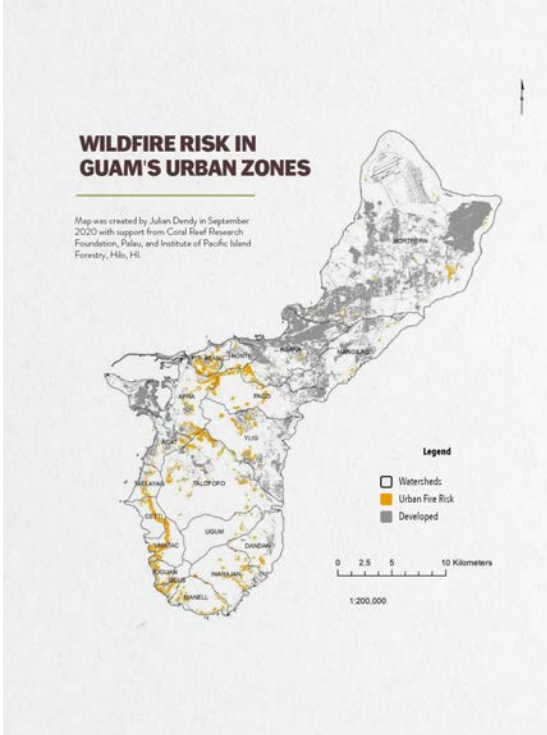
Guam Forestry, in coordination with the Guam Bureau of Statistics and Plans (BSP), completed the spatial analysis involving stakeholder ranking of environmental attributes. Six issues were identified by the GFAP Advisory Council, and the table below is a synthesis of threats and major drivers to issues identified by stakeholders.

Stakeholder Issues	Fragmented Forests and Conversion to Grasslands & Savannas	Fire Risk	Development and Military Build-up
1. Wildfire and Public Safety	Increases fire risk	Associated with altered veg. cover	Fire risk increases expansion into forests
2. Water Quality and Supply	Reduces water capture & increases sedimentation	Removal of veg. cover increases sedimentation	Construction and development directly impact water quality; increased water supply demand
3. Deforestation of Native and Old Forests	Limited (and unknown) intact forests remaining	Fire threat to remaining intact forest	Direct risk of deforestation by construction of military facilities, as well as private development driven by the buildup
4. Urban Forest Sustainability, Population Growth and Urbanization	Altered forests threatened from invasive plants, insects and disease; Increased population contributes to forest removal and pressure on remaining forests	Direct threat of fire in urban areas; Fire risk increases with increase in Wildland Urban Interface	Increased population – removal of forest canopy in developed areas; direct population increase due to military buildup
5. Degraded Lands	Conversion to non- forest communities increases acreage of degraded lands	Increased fire frequency is a primary cause of degraded lands	Increased development and population are factors for increasing acreage of degraded lands
6. Invasive Species and Forest Health	Increases edge effect and exposure invasive flora/fauna introductions impacts	Opens corridors for invasive species introductions, and increases fragmentation of forest resources.	Increased development exposes vulnerable forest resources to potential threats.

ISSUE 1

WILDFIRE & PUBLIC SAFETY



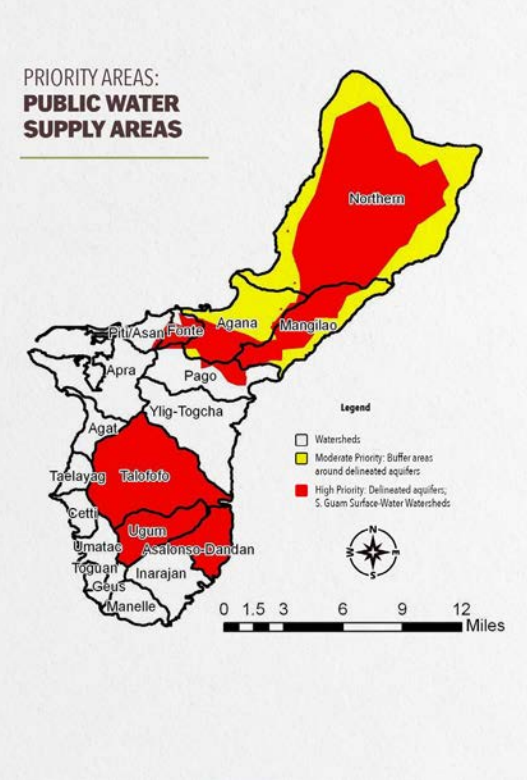


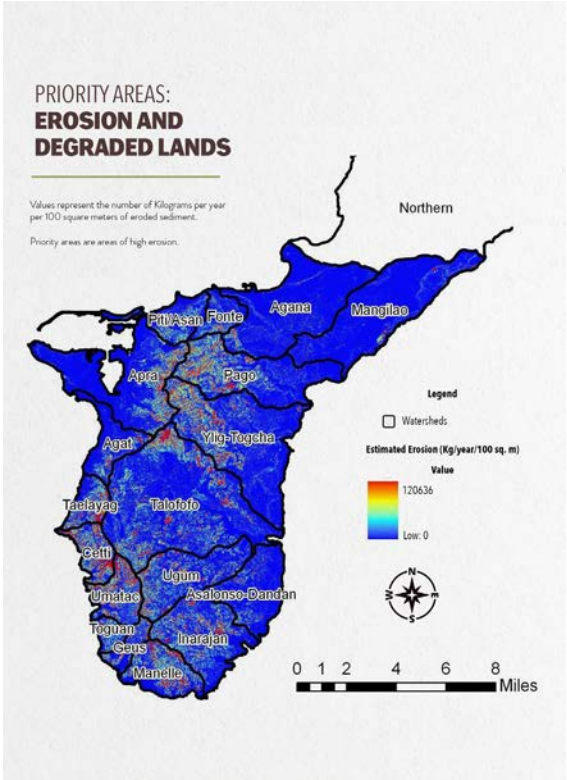
Wildfire is a primary disturbance that affects forest and watershed health and is a keystone issue that is linked with other identified stakeholder issues. Fire is an anthropogenic disturbance that directly interferes with the establishment and expansion of native forests, threatens standing forests, opens corridors for invasive species intrusions, accelerates erosion, and contributes to the decline of the coral reef system. Hence, the issue of "wildfire and public safety" includes other stakeholders' issues (i.e. Issue 2. Water Quality and Water Supply, Issue 3. Deforestation of Native and Old Forests, Issue 4. Urban Forest Sustainability, Population Growth and Urbanization, Issue 5. Degraded Lands and Issue 6. Invasive Species and Forest Health).

A fire risk assessment conducted in 2004 identified the key vegetation types and topographic influences that would likely contribute to hazardous burn conditions in a given climate scenario. In general, fires are more difficult to suppress when flame lengths exceed 3-6-ft, and when they occur in inaccessible terrain. Flame lengths and rates of spread increase proportionally with slope. The fire assessment suggested management actions such as reforestation or afforestation to change fuels structure, and establishment of fuel breaks on grasslands on steep slopes. These management strategies are synergistic, with breaks helping to establish new plantings and older plantings, in turn, shading out grasses that fuel fires.

A wildfire mapping effort commenced in 2015 which has resulted in the production of annual wildfire summary maps. The 2010 SWARS document noted that previous assessment reports lacked sufficient spatial data, detailing specific land areas for fuels treatments to improve fire protection. The current wildfire mapping effort has provided additional data, to include the mapping of installed and proposed green belts and firebreaks.

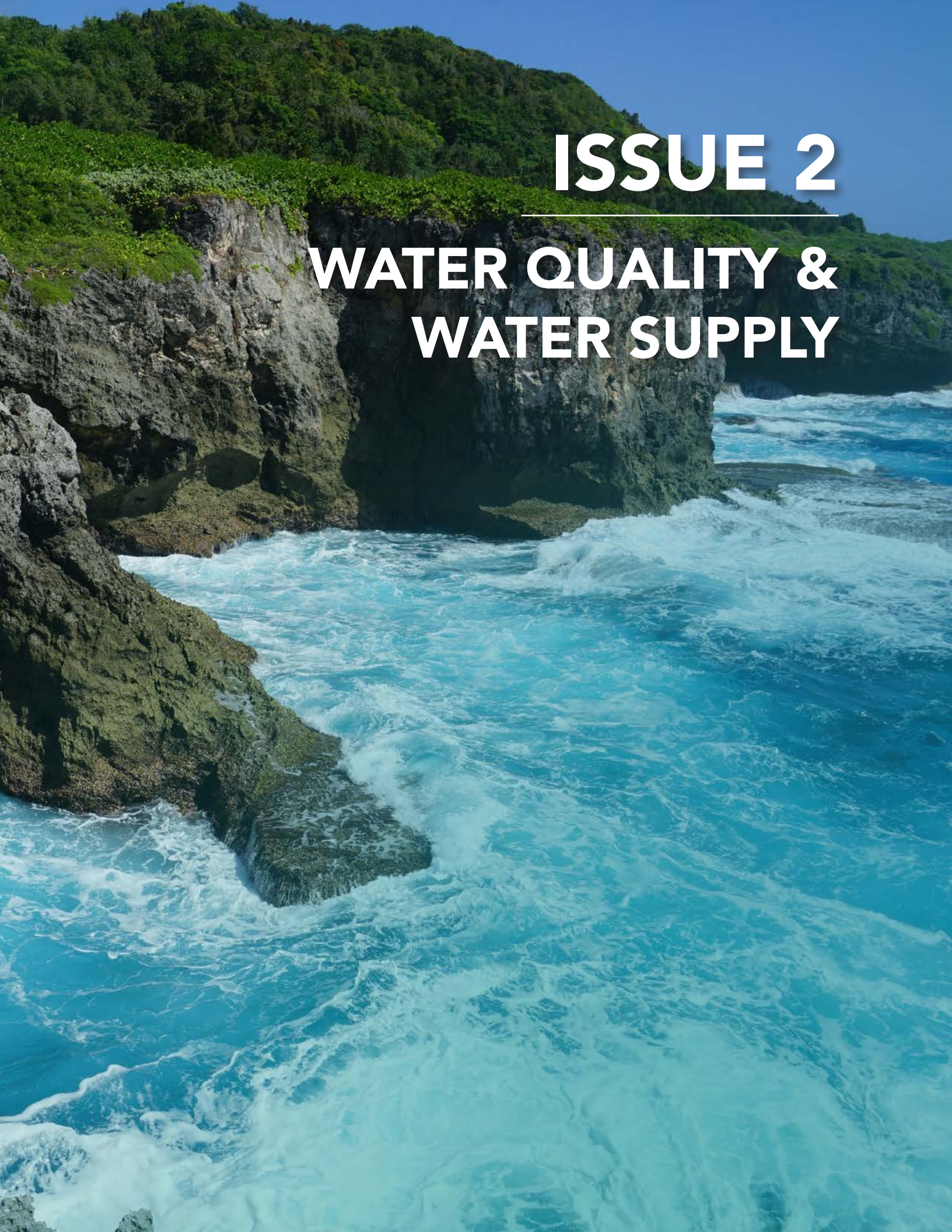
Since wildfire is prevalent and a threat on multiple levels (safety, forests, water quality) in wildland and urban areas, a more detailed potential fire behavior map was produced for this assessment using the GFAP vegetation map and LiDAR-derived ground surface information. The output is designed to identify specific sites of hazardous fire behavior potentials that can be prioritized for treatments addressing risk to wildfire in watersheds and communities, as intended by the Farm Bill and USFS agency guidance.





Water quality is monitored and regulated by Guam EPA programs. Guam Forestry has a critical role in water quality programs in providing surface conditions that allow for the safe capture and storage of water within key watersheds (surface and groundwater resources). Movement of sediment from erosion into waterways is one of the most pervasive problems associated with poor land cover, which degrades surface waters, domestic water supplies, and fragile reef systems.

Guam Forestry programs can reduce erosion through forest stewardship, fire management, and restoration activities to protect water quality and domestic water supplies (firebreaks, greenbelts or tree plantings in areas prone to erosion and a source of soil delivery to streams). Further, Guam Forestry can assist in the protection of groundwater resources through avoiding deforestation and degradation in the northern watershed zone through implementation of S&PF programs (e.g., Stewardship, Legacy, Urban Forestry and Forest Health). This section describes the water resources on Guam, the stakeholder evaluation of water quality and water supply, and the assessment of sediment source and transport by watershed area.

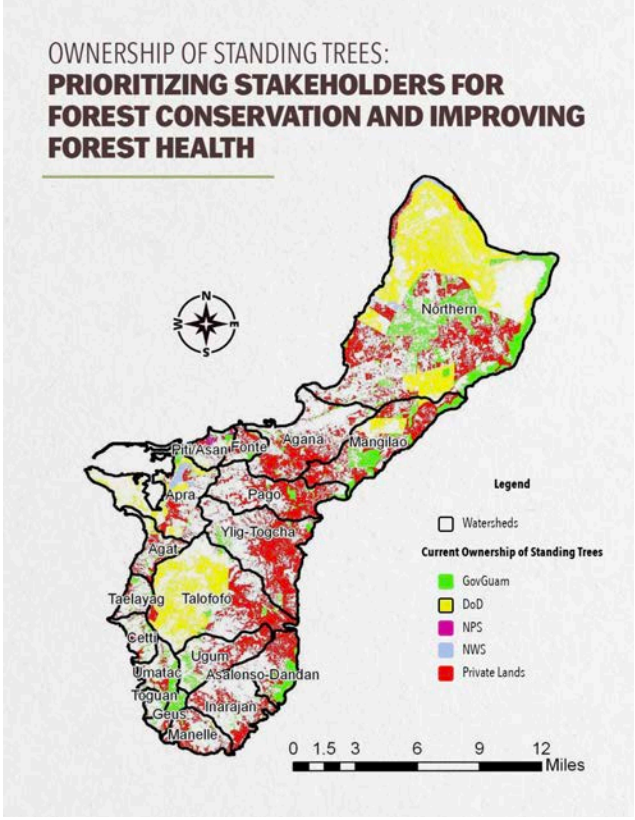


ISSUE 2

WATER QUALITY & WATER SUPPLY

ISSUE 3

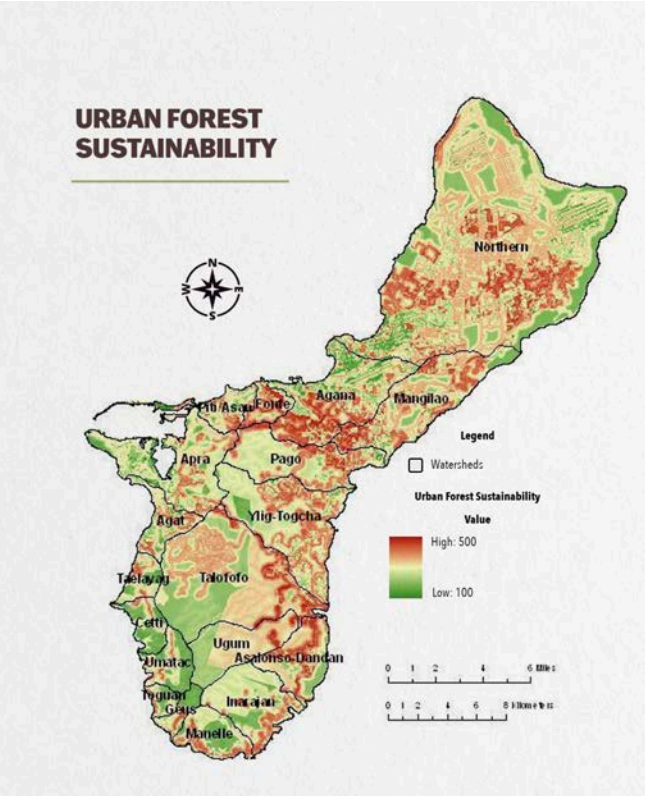
DEFORESTATION OF NATIVE & OLD FORESTS



The evaluation of Deforestation of Native Forests (especially old forests) is an estimate of the threat posed to unique forest environments on Guam. These forests have not been surveyed for forest structure, composition, and overall health, though the GFAP process has identified these areas as priority areas for conservation and gathering of ground-truth information through inventory surveys.

The stakeholder evaluation was qualitative in nature and identified potential deforestation threats to native and old growth stands in the headwater portions of southern Guam watersheds, and the coastal fringe in northern Guam. Some of these areas also have a high likelihood of development associated with the proposed military buildup.

Avoiding deforestation is highly dependent upon willing stakeholders and the capacity of land management agencies to administer and facilitate local conservation and conservation groups. The Forest Legacy Program may enable the Territorial government to purchase private forest lands in fee simple, or to pay for a conservation easement under which the Territorial government would monitor the private landowner's conservation of the forest. The Community Forests and Open Space program may enable a local government or land trust to purchase private forest land in fee simple. In addition, the existing forest fragments can be coupled with areas delivering sediment to streams. Avoiding deforestation (and planting trees, and improving forest health) is extremely relevant to all Stakeholder Issues on Guam. Coordinating stakeholders that are willing to implement conservation (and enhancement projects) is paramount to the success of the project for further discussion on ownership and forest cover).



This issue focuses on the establishment and use of urban forests in planning within an urban intermix zone, rather than on the direct threats of development to forests. This issue was evaluated using two methods. The first was by the GFAP Advisory Council using qualitative measures of threat of development as identified from the PIC Veg layer. The second involved a fine-scale assessment of the current urban forest conditions using the GFAP vegetation map.

Stakeholder Evaluation of Urban Forest Sustainability

The GFAP Advisory Council identified that the threat to Guam's urban forest resources was primarily associated with development and the lack of ordinances to protect urban forest resources. The environmental attribute layer used to evaluate this issue was a measure of the proximity to areas of existing development, and private ownership.

Stakeholder Evaluation of Threats of Development to Forests

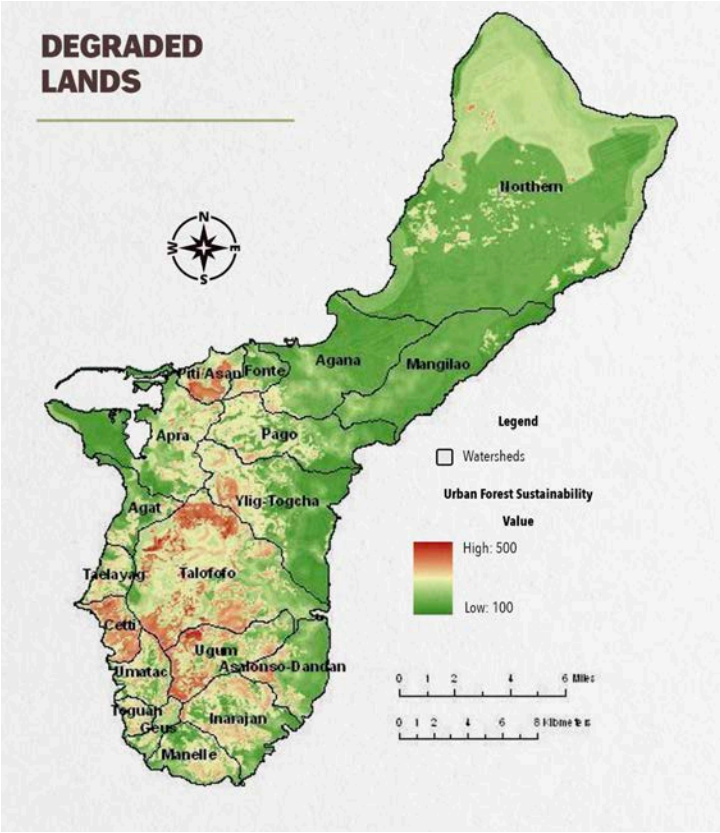
The threat of population growth was evaluated by the GFAP Advisory Council and by a specific evaluation of the effect of military expansion on forest resources (previous section). The GFAP Advisory Council evaluated the threats of population increase based on the current distribution of cities and towns, with the threats of increased impervious surfaces (from roads, buildings, etc.). Population growth was assessed as having the highest threats and urban development within the northern watersheds. These are also the areas with the highest likelihood of development associated with the proposed military buildup.

ISSUE 4

URBAN FOREST SUSTAINABILITY, POPULATION GROWTH, & URBANIZATION

ISSUE 5

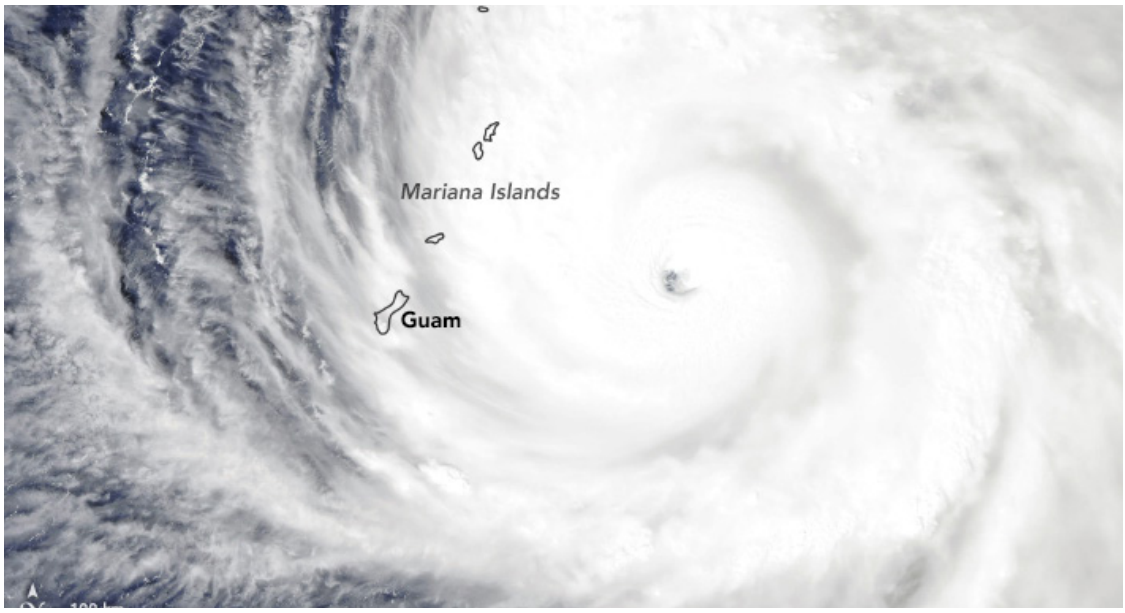
DEGRADED LANDS



The GFAP Advisory Council identified areas that are considered a threat to future ecosystem health, with lands that have limited vegetative cover or are barren areas. The Degraded Lands map was developed from several environmental attribute layers during the Stakeholder evaluation period from the 2010 SWARS assessing – fire risk, proximity to protected and managed areas, riparian areas, wetlands, public water supply/priority watersheds and threats associated with development and slope. Threats are concentrated primarily in the headwaters and higher elevation areas of the Cetti, Piti/Asan, Ugum and Talofofo watersheds.

This issue overlaps with many of the other issues described in the assessment. In particular, the rate of potential recovery from degraded lands status is dependent upon the ability to successfully be reforested, while maintaining a fire-free environment for several years following planting. Because degraded lands have larger areas of exposed soils and can contribute to higher amounts of eroded sediment to streams and reefs, prioritization of degraded lands is similar to the prioritization of high-risk fire-prone areas that are within a delivery distance to streams.

The priority areas and rational discussed in Issue 2. Water Quality and Water Supply, specifically the Water Quality Priorities: Soil Erosion and Sedimentation beginning on page 65, is especially relevant to this Stakeholder Issue. Priority Areas for degraded lands are mapped for sites to plant having high erosion, with higher priorities set for those eroding areas where sediment is being delivered to streams.



"Forest health" is defined as a descriptor for forest conditions and trends, including the resilience of forested environments to a range of biotic (living) and abiotic (non-living) disturbances. This section begins with quantitative discussion on the current structure of forests, an analysis of available trend information in forest cover, and a qualitative discussion on a range of abiotic and biotic disturbance regimes and their known status and effects on the forests of Guam. The information presented in this section is drawn from a forest inventory analysis (FIA) conducted by the U.S. Forest Service in 2013. Forty-eight plots spaced uniformly at 1.9-mile intervals in a hexagonal grid were sampled over the entire island. In addition, 67 plots were sampled by the Micronesia Challenge (MC) in 2013 using similar methodology, but with a focus on protected conservation areas in northern Guam and in ravine forests in southwestern Guam.

There are a number of abiotic or non-living threats to island forests in the form of storms, droughts, urban development, and fire. Guam's climate is uniformly warm and humid throughout the year, with two distinct seasons. There is a dry season between December and May and a wet or rainy season from June to November.

Biotic threats include invasive plants and animals, such as the Asian cycad scale, brown tree snake, feral ungulates, coconut rhinoceros beetle, and the little fire ant.

Approximately 49% of island trees exhibit damage from a wide range of causes which include animals, insects, weeds, fire, disease, and storms.

ISSUE 6

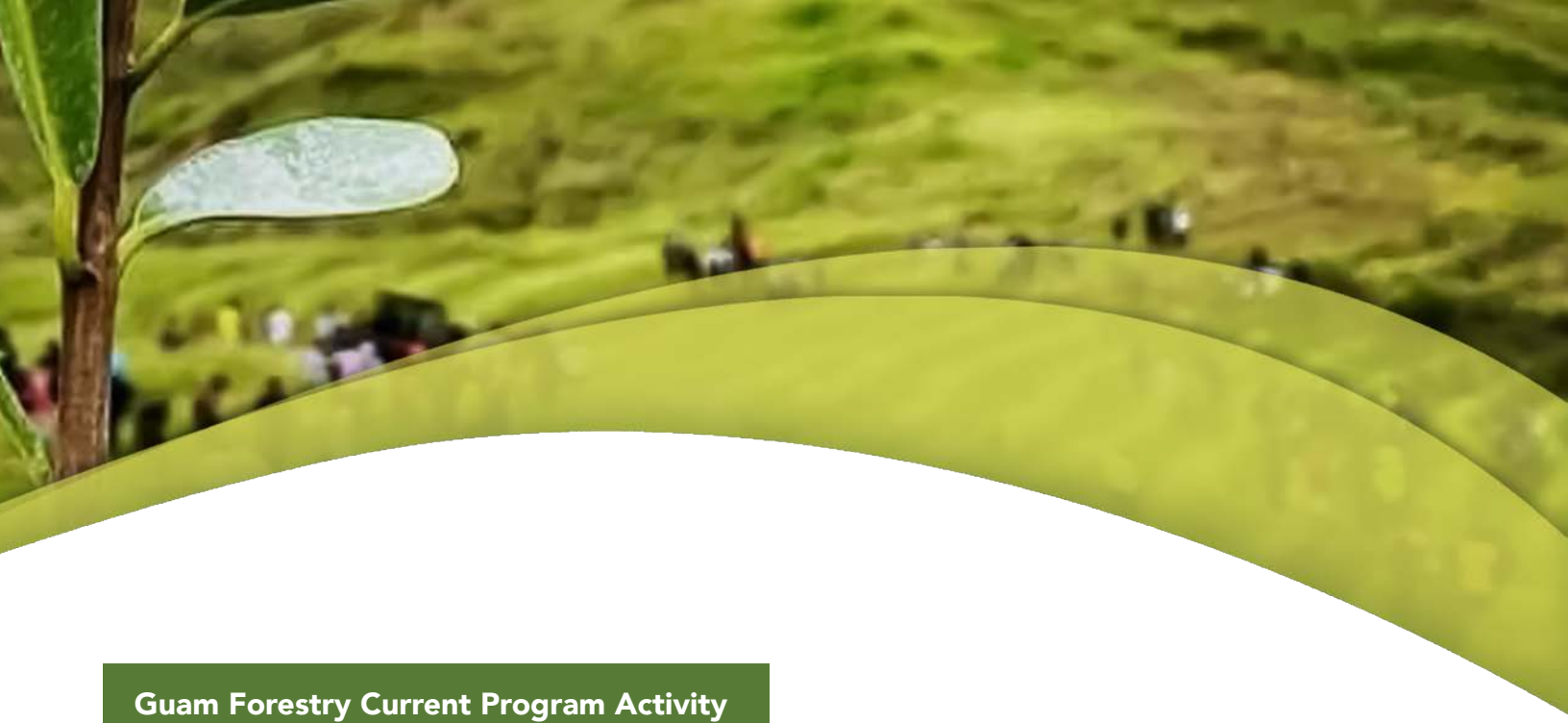
INVASIVE SPECIES & FOREST HEALTH

Strategies for Addressing Threats

Introduction

The purpose of this section is to transition the assessment of stakeholder issues and data synthesis into a 10-year strategic plan that achieves the desired outcomes. Specifically, in this section, the following are outlined:

- **Resource Strategies (10 years).** Four major strategies are presented, including a description, action plan of next steps, Forest Service programs that could be leveraged, key stakeholders, resources needed (staff and funding) and an overall timeline with internal performance measures of success.
- **Strategy Implementation Approach.** An outline of how project planning and implementation can be prioritized to take a proactive "vision to out outcome" approach. This assures that resources are expended at maximum efficiencies and individual projects fit within the overarching Resource Strategies.
- **Program Capacity Plan.** An assessment of the current resources and programs within Guam Forestry, with a summary of the needed resources and allocation of staff to accomplish the 10-year strategy.

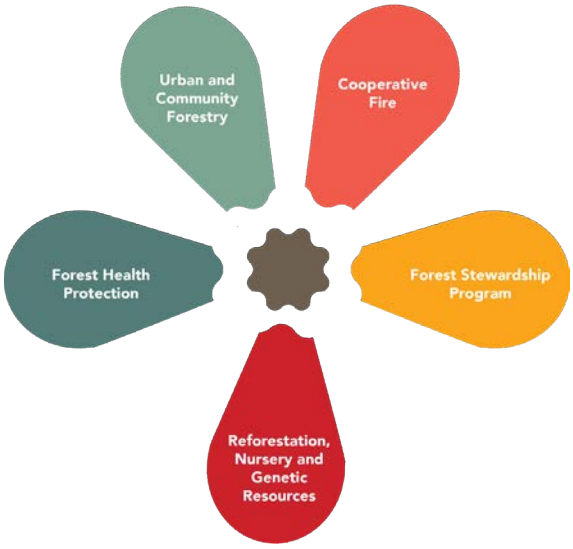


Guam Forestry Current Program Activity

It is important to evaluate Guam Forestry's accomplishments and challenges to design a feasible 10-year strategy. This section describes the current activities and performance measures associated with each of the S&PF-compatible programs that Guam Forestry has been or is currently engaged in. Following this section, specific strategies are outlined, future plans and goals are described, and the current program capacity is described to evaluate what will be needed to implement each strategy.

The mission of Guam Forestry is to conserve, protect and enhance Guam's vegetative environment and sustain natural resources that are dependent on healthy forests. The agency works with stakeholders to promote healthy and productive forests in rural and urban areas throughout the island in partnership with the USDA Forest Service and other Federal and GovGuam partners. The Assessment section of this GFAP identified stakeholder inputs and a science-based assessment of priority areas to address stakeholder issues that are affecting Guam Forestry's healthy forest mission.

Guam Forestry's program is currently comprised of five program elements that parallel the USFS S&PF organization.



Current Guam Forestry Programs

- Forest Health Protection
- Forest Stewardship Program
- Reforestation, Nursery, and Genetic Resources
- Urban and Community Forestry
- Cooperative Fire

Forest Health Protection

The Cooperative Forest Health Management Program (Forest Health Protection) targets enhancement of native forests that have been impacted by the effects of invasive species, forest pests, development, drought and typhoons. Guam Forestry's Forest Health Management Program can use cost-share funds from the USFS for activities such as monitoring and managing outbreaks of invasive pest and plants at the island scale, as well as within conservation areas and plant nurseries. Guam Forestry has a close working relationship with the University of Guam, other staff in Guam Agriculture, and APHIS.

Forest Stewardship Program

Under the Forest Stewardship Program, Guam Forestry provides technical assistance and planting materials to private landowners for establishing forests, managing forests or for agroforestry practices. The FSP supports the Guam Forestry nursery which provides native and non-native plants for erosion control projects and other uses such as establishment of wind breaks and Urban and Community Forestry planting programs. Currently, the program encourages private landowners to adopt conservation practices on their land by replacing non-native species with desired native plants, and to develop and implement stewardship plans, by educating the public on the importance of protecting and expanding the surrounding forest on their lands.

Reforestation, Nursery, & Genetic Resources

Plant nursery operations are directly related to all programs, especially UCF and FSP. The numbers of plants to be propagated are determined by the number of cooperators who signed up for the stewardship program. UCF plants are determined by planting activities from the prior year. The federal Forest Stewardship budget line item includes Rural Forestry Assistance, which authorizes use of FSP grants for reforestation on territorial lands. The Landscape Scale Restoration program includes the authorities of several S&PF programs including Stewardship.

Urban & Community Forestry

Guam Forestry participates in urban planting in public and private schools, public parks, public rights-of-way, government agencies and private businesses. Guam Forestry coordinates with public and private entities on planting efforts in the urban landscape, Arbor Day activities, and pest eradication efforts. The division assists and advises communities about wildfire risk and treatments in the urban interface zones. Guam Forestry also coordinates with nonprofit and volunteer groups in planting activities and educating the public on the importance of planting trees in the urban setting.

Cooperative Fire

Guam Forestry participates in urban planting in public and private schools, public parks, public rights-of-way, government agencies and private businesses. Guam Forestry coordinates with public and private entities on planting efforts in the urban landscape, Arbor Day activities, and pest eradication efforts. The division assists and advises communities about wildfire risk and treatments in the urban interface zones. Guam Forestry also coordinates with nonprofit and volunteer groups in planting activities and educating the public on the importance of planting trees in the urban setting.

RESOURCE STRATEGIES

10 Year Plan

This assessment identified forestry-related issues at island and watershed scales, identified a range of needs to address stakeholder issues, and identified a synthesis of the priority acres where multiple objectives can be addressed in each watershed. While this information is important for planning purposes, and for understanding the extent and locations of resource concerns, there is a need to develop strategies that describe the approach to the problems within the context of the capacity of Guam Forestry (personnel, infrastructure, and available skills). In addition, a strategy is needed that addresses building program capacity within Guam Forestry to meet the challenges of implementing the strategic plan.

The strategies described below are intended to lay out the road map for Guam Forestry to move forward with assistance from the USFS State & Private Forestry as well as other partner organizations. This section describes four major strategies in detail; further discussion of capacity needs is presented in the Program Capacity section.

Strategies are described in the following order to address restoration, conservation of intact forests, reduce impacts to water quality and the reef system, mitigate for the impact of the military expansion and other development, and address invasive species – all unifying themes developed from stakeholder issues.

STRATEGY
ONE

Implement Highest Priority Plantings in Urban, Rural and Undeveloped Areas that Meet Multiple Objectives.

STRATEGY
TWO

Protect, Conserve and Restore Forests on Public, Private, and Other Non- Military Lands

STRATEGY
THREE

Improve Fire Prevention, Control, Suppression and Prescribed Fire Activities through Organizing, Training and Equipping Staff and Resources

STRATEGY
FOUR

Implement a Forest Health Program and Unify Interagency Efforts to Control Invasive Species

Strategy One

Implement Highest Priority Plantings in Urban, Rural and Undeveloped Areas that Meet Multiple Objectives.

This strategy emphasizes identification of lands outside of the military boundaries since Guam Forestry has the ability to implement projects in these lands directly. The approach is to identify candidate forest fragments that can be conserved and expanded to increase forest size to increase forest resiliency. These can be done in urban zones as well as in upland environments. Conservation is achieved through three avenues:

(i) reduce stressors to existing forests through enhancement of current stands (e.g., forest health and protection from deforestation); (ii) expansion of current stands to treat external "edge" threats of disturbance (fire, wind, invasive colonization, etc.); and (iii) legal acquisition and conservation of forests now on public lands, through Forest Legacy or Community Forests and Open Space programs.

Strategy Two

Protect, Conserve and Restore Forests on Public, Private, and Other Non- Military Lands.

This strategy emphasizes identification of lands outside of the military boundaries since Guam Forestry has the ability to implement projects in these lands directly. The approach is to identify candidate forest fragments that can be conserved and expanded to increase forest size to increase forest resiliency. These can be done in urban zones as well as in upland environments. Conservation is achieved through three avenues:

(i) reduce stressors to existing forests through enhancement of current stands (e.g., forest health and protection from deforestation); (ii) expansion of current stands to treat external "edge" threats of disturbance (fire, wind, invasive colonization, etc.); and (iii) legal acquisition and conservation of forests now on public lands, through Forest Legacy or Community Forests and Open Space programs.

Strategy Three

Improve Fire Prevention, Control, Suppression and Prescribed Fire Activities through Organizing, Training and Equipping Staff and Resources.

There is an urgent need to increase the capabilities and capacities of Guam Forestry staff to manage fire. This strategy focuses on reducing risk from wildfire across Guam through prevention, preparedness, cause investigation, suppression, and post-fire activities. Preventative measures include public awareness, education and outreach, and pro-active measures of prescribed fire activities to change the fuels profile prior to fire events. Control measures involve additional attack and suppression resources and training, including additional law enforcement initiatives.

Overall, the goal is to reduce arson-based fire incidents through active outreach, education, investigations and enforcement, and provide well-trained crews to respond, attack, suppress and investigate fires when they do occur.

Strategy Four

Implement a Forest Health Program and Unify Interagency Efforts to Control Invasive Species

Forest health is a serious concern on Guam and the capacity of Guam Forestry to respond to all forest health concerns as a single agency is severely limited. The purpose of this strategy is to form partnerships that pool human, funding and infrastructure resources to actively target species-based strategies and site-based control mechanisms for invasive species. Some of the partners in these efforts will be University of Guam (UOG), APHIS, GISAC, and Guam EPA.

This strategy aims to connect other strategies identified above for Guam Forestry, as well as helping to create a unified, cross-agency platform for invasive species prevention, detection, control and monitoring with other stakeholder groups. Forest health concerns associated with fragmentation, compaction, fire risk and degradation are addressed in other Strategies.

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- US Fish & Wildlife

About this booklet

"Bridging Forestry Through Stewardship" is an abridged version of the 2020 Guam Forest Action Plan. This document was created by Keanno Fausto and John I. Borja, under the direction and guidance of Christine Fejeran (Guam Department of Agriculture) and Dr. Romina King (University of Guam). The full version of the 2020 Guam Forest Action Plan is available online on the Guam Department of Agriculture's website.

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