



**Commonwealth of the  
Northern Mariana Islands  
FOREST ACTION PLAN  
2020 – 2030**

CNMI FORESTRY  
DIVISION OF AGRICULTURE-DEPARTMENT OF LANDS & NATURAL RESOURCES



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## Table of Contents

1. Introduction.....	1
Background and Setting.....	2
CNMI Forestry Program.....	3
2. CNMI Forest Resource Assessment .....	6
History of Forest Resources in the CNMI .....	6
Current Status of Forests in the CNMI.....	6
Conservation Areas in the CNMI .....	7
Forest Stewardship Areas in the CNMI.....	20
Micronesia Challenge .....	26
FOREST CONDITIONS AND TRENDS/THREATS .....	27
Forest Trends Since the Previous SWARS.....	27
Climate Change and Extreme Weather Events.....	34
Invasive Species.....	35
Wildfire.....	41
EXISTING PLANS RELATED TO FOREST RESOURCES IN CNMI.....	47
Wildlife Action Plan for the CNMI 2015-2025.....	47
Watershed Management Plans: Garapan, Laolao, Achugao, Talakhaya .....	47
Forest Health Plan.....	54
Action Plan for <i>Oryctes rhinoceros</i> 2018-2023.....	55
CNMI State Wildland Fire Plan 2014-2024 .....	56
CNMI Invasive Species Strategy and Action Plan .....	57
Forest Inventory Assessment.....	59
CRITICAL FORESTRY ISSUES IDENTIFIED BY STAKEHOLDERS .....	60
Issue 1 – Sustainability of Urban Forests .....	61
Issue 2 - Protection of Coral Reefs .....	74
Issue 3 - Conservation of Wetlands .....	75
Issue 4 - Maintaining Freshwater Quality .....	80
Issue 5 - Conservation of Native Flora and Fauna .....	81
3. CNMI Forest Resource Assessment .....	83
4. Stakeholder Groups Coordinated with for the Statewide Assessment and Strategy .....	109
STAKEHOLDER ENGAGEMENT .....	110

Stakeholder Group One-on-One Meetings ..... 110

Stakeholder Survey ..... 110

5. References..... 112

Appendix A: Existing Plans related to Forest Resources ..... 115

    Action Plan for *Oryctes rhinoceros* 2018-2023 ..... 115

    CNMI Invasive Species Strategy and Action Plan ..... 118

    Forest Health Plan..... 121

Appendix B: Stakeholder Survey ..... 127

## List of Tables

Table 1: Forest area by CNMI island, as calculated by Liske-Clarke 2015 from NOAA Coastal Change Analysis Program data (NOAA 2009a-n).....	3
Table 2: Plant and non-plant invasive species of concern in the CNMI (Source: Liske-Clarke 2015).....	36
Table 3: All invasive plant species, occurrence (# and % of subplots present), and average % cover in CNMI FIA invasive subplots.....	37
Table 4: Estimated area (acres) and % of total forest area affected by disturbance type (CNMI FIA plots). .....	38
Table 5: The Number of fires By Island and Year (CNMI State Wildland Fire Plan 2014-2019).....	42

## List of Figures

Figure 1: National themes and objectives as defined by the US Forest Service. ....	1
Figure 2: Conservation areas in the Northern Islands: Asuncion, Maug, Uracas, and Guguan. ....	9
Figure 3: Conservation areas on the island of Rota. ....	12
Figure 4: Conservation areas on the island of Saipan.....	18
Figure 5: Priority areas on Tinian.....	19
Figure 6: Forest Stewardship Areas in the CNMI. ....	24
Figure 7: Non-industrial private forestlands on Saipan, Tinian, and Rota. ....	25
Figure 8: CRB quarantine area (pink color) and locations of new infestations (orange color) detected in 2020 on Rota. Source: <a href="https://governor.gov.mp/news/press-releases/third-coconut-rhinoceros-beetle-site-discovered-on-rota/">https://governor.gov.mp/news/press-releases/third-coconut-rhinoceros-beetle-site-discovered-on-rota/</a> .....	28
Figure 9: Soil erodibility on Saipan, Tinian, and Rota. ....	33
Figure 10: Aerial photo of felled secondary forest in American Memorial Park after Typhoon Soudelor (Photo by M. Kottermair 2016, as found in Greene et al. 2019). ....	35
Figure 11: Destruction of coconut rhinoceros beetle host material on Rota, 2019. (Photo source: James Manglona, CNMI DLNR) .....	39
Figure 12: <i>Macuna pruriens</i> is a non-native plant to the Marianas. ....	40
Figure 13: Wildfire prevalence on the islands of Saipan, Tinian, and Rota from 2016-2020 (Julian Dendy) .....	43
Figure 14: Fires identified on Saipan with pixel color indicating the total number times pixel was identified as burnt from 2013-2020. (A) Fires identified in Marpi (B) Wireless Ridge (C) Mt. Tapochau (D) and Naftan (E). (Bubb and Williams 2020, submitted for publication).....	43

Figure 15: Fire vulnerability probability on Saipan. (Bubb, unpublished). Methodology for developing this map can be found at: [https://dcrm.gov.mp/wp-content/uploads/crm/fire\\_writeup-1.pdf](https://dcrm.gov.mp/wp-content/uploads/crm/fire_writeup-1.pdf). .....45

Figure 16: Priority watersheds in the CNMI. ....48

Figure 17: CNMI Priority watersheds (clockwise from upper left): Garapan/West Takpochao; Laolao; Achugao; and Talakhaya. ....53

Figure 18: Landcover and vegetation classifications for the islands of Saipan, Tinian, and Rota, as of 2016. ....65

Figure 19: Landcover and vegetation maps for Saipan, Tinian, and Rota, specific to Native Limestone Forest and Developed spaces.....72

Figure 20: Da’ok tree serves as a shade tree at the entrance of Marianas High School (Native Plant Guide, DCRM 2014). ....73

Figure 21: View of the Talakhaya watershed, Rota, CNMI. ....75

Figure 22: Kagman wetland serves as an important habitat for the endangered Marianas moorhen. ....77

Figure 23: Mangrove cover in American Memorial Park.....79

Figure 24: Okgok freshwater stream within the Talakhaya Watershed, Rota. ....80

Figure 25: Native limestone forest in the Laolao Watershed, Saipan. ....82

## List of Acronyms

AAC	Agricultural Advisory Committee
AMP	American Memorial Park
APC	Area of Particular Concern
BECQ	Bureau of Environmental and Coastal Quality
BTS	brown tree snake
CAP	Conservation Action Plan
CFAA	Cooperative Forestry Assistance Act
CFHP	Cooperative Forest Health Program
CNMI	Commonwealth of the Northern Mariana Islands
CRB	coconut rhinoceros beetle
CRCP	Coral Reef Conservation Program
CWPP	community wildfire protection plan
DCCA	Department of Community and Cultural Affairs
DCRM	BECQ Division of Coastal Resources Management
DEQ	BECQ Division of Environmental Quality
DFEMS	Department of Fire and Emergency Medical Services
DFW	DLNR Division of Fish & Wildlife
DLNR	Department of Lands and Natural Resources
DOA	DLNR Division of Agriculture
DPL	Department of Public Lands
EEZ	exclusive economic zone
FAP	Forest Action Plan
FDM	No'os / Farallon de Medinilla
FDP	Uracas / Farallon de Pajaros
FIA	Forest Inventory & Analysis
FLEP	Forest Land Enhancement Program
FSP	Forestry Stewardship Program
HPO	Historic Preservation Office
ISC	Invasive Species Councils
ISSAP	Invasive Species Strategy and Action Plan
LSR	Landscape Restoration
MC	Micronesia Challenge
MINA	Mariana Islands Nature Alliance
MOS	Office of the Mayor of Saipan
MPA	Marine Protected Area
NIPF	non-industrial private forest
NMC-A&NR	Northern Marianas College -Aquaculture & Natural Resources
NMC-CREES	Northern Marianas College-Cooperative Research, Extension, & Education Service
NOAA	National Oceanic and Atmospheric Administration
NOAA-OCM	NOAA-Office for Coastal Management
NPS	National Park Service
NRCA	National Resource Condition Assessment
NRCS	Natural Resource Conservation Service
OPD	Office of Planning and Development
PIRCA	Pacific Islands Regional Climate Assessment
RSIC	Regional Invasive Species Committee
SWARS	Statewide Assessment and Resource Strategy
SWG	State and Tribal Wildlife Grants



TNC	The Nature Conservancy
UCF	Urban and Community Forestry
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
WMP	Watershed Management Plans
WUI	Wildland Urban Interface

## 1. Introduction

This document represents the Statewide Forest Resource Assessment and Strategy, now known as the Forest Action Plan (FAP) for the Commonwealth of the Northern Mariana Islands (CNMI). The CNMI FAP is an analysis of forest resource conditions and trends, threats and opportunities, and a prioritization of strategies for forest resource management. State FAPs are required under the 2008 Farm Bill in order for states and territories to be eligible for funding under the Cooperative Forestry Assistance Act (CFAA), and must be updated at least every ten years. The CNMI completed the first of these plans in 2010, then referred to as the CNMI Statewide Assessment and Resource Strategy (SWARs). Future five-year reviews are conducted within the ten-year comprehensive assessment.

State Forest Action Plans offer a practical and comprehensive roadmap for investing federal, state, local, and private resources where they can be most effective in achieving three national conservation goals as defined by the US Forest Service (Figure 1).



*Figure 1: National themes and objectives as defined by the US Forest Service.*

The CNMI FAP is organized into two primary sections:

- The **CNMI Forest Resource Assessment** contains an assessment of the current state and trends of forest resources in the CNMI, a synopsis of other relevant plans in the CNMI, an

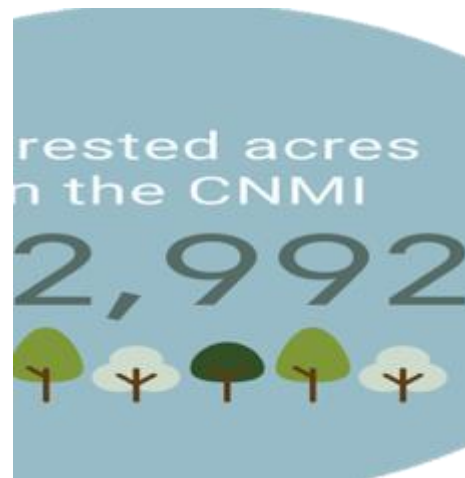
analysis of current and future threats to these forest resources, and the identification of priority forest areas or landscapes.

- The **CNMI Forest Resource Strategy** identifies and prioritizes strategies that can be undertaken by CNMI Forestry that will address some of the threats and priorities that were identified under the assessment.

The process of developing the CNMI State FAP is by design a collaborative effort with heavy reliance on the input and involvement of the councils, agencies, and private entities that manage or have interest in protecting the CNMI's natural resources, specifically the stakeholders who are a part of the State Forestry Stewardship Coordinating Committee – formerly known in the CNMI as the CNMI Forestry Advisory Council. At the time of the development of this Forest Action Plan, the CNMI Forestry Advisory Council had not assembled in several years. CNMI Forestry instead engaged stakeholders through the Planning and Development Advisory Committee's Natural Resources Task Force, under the Office of Planning and Development (OPD), as well as with other key private partners and local agencies such as the CNMI Department of Fire and Emergency Medical Services (DFEMS). All of these stakeholders were heavily involved in the identification of priorities and the development of strategies for this FAP. As such, a third section of this document is devoted to a discussion of stakeholder groups that were coordinated with in support of the development of this document and the methodology employed.

### **Background and Setting**

The Commonwealth of the Northern Mariana Islands is a commonwealth of the United States that comprises the fourteen northern islands of the Mariana Archipelago, located in the Western Pacific. These islands range in size from the smallest island of No'os / Farallon de Medinilla (FDM) at less than 1 km<sup>2</sup> to the largest island of Saipan with a land area of 119 km<sup>2</sup>. The islands of the CNMI can be divided into two geologic groups: the southern islands of No'os/FDM, Saipan, Tinian, Aguigan, and Rota comprise the older and larger islands that were formed approximately 15-30 million years ago; and the younger northern islands (Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrigan, Asuncion, Maug, and Uracas / Farallon de Pajaros (FDP)) which were formed 0-5 million years ago. All of the islands are volcanic in origin, however only the northern islands remain active, with the most recent major eruptions occurring at Uracas in 1967, Pagan in 1981, and Anatahan in 2003.



The climate of the CNMI is tropical, with a mean annual temperature of 28.3°C (83°F) and mean annual rainfall of 213 cm (84 in) (Starmer et al. 2008). The wet season generally occurs between July and November, with the dry season occurring between December and June. The CNMI lies in “typhoon alley”, dubbed the busiest location for tropical cyclones on earth with 41 super typhoons being recorded in the region between 2000 and 2014. An average of three tropical cyclones have passed within 300 nm of Saipan each year since 1970 (Lander 2004), including an uptick of activity in recent years. In the years since the 2010 SWARs, Typhoon Soudelor (Category 4, 2015), Typhoon Mangkhut (Category 4, 2018), and Super Typhoon Yutu (Category 5+, 2018) each caused millions of dollars in damage and severely damaged forest resources on the islands of Saipan, Tinian, and Rota.

The CNMI is divided into four municipalities: Rota, Tinian (including Aguigan), Saipan, and the Northern Islands which comprises the northern nine islands (No'os / FDM to Uracas / FDP). CNMI's population of 53,833 people (2010 Census) is concentrated on the southern islands of Saipan, Tinian, and Rota, with the vast majority (approximately 90%) of people and most of the CNMI's economic activity occurring on Saipan. A small population of people live seasonally on the northern islands of Agrigan, Pagan, and Alamagan, and there are plans within the CNMI government for resettlement of the island of Pagan following the evacuation of the island's population during the volcanic activity of the 1980s.

Approximately 75% of all forests in the CNMI are found on the larger, populated, southern islands (Table 1).

*Table 1: Forest area by CNMI island, as calculated by Liske-Clarke 2015 from NOAA Coastal Change Analysis Program data (NOAA 2009a-n).*

<b>Island</b>	<b>Hectares</b>	<b>Acres</b>	<b>% of CNMI Total</b>
Rota	5,180.4	12,801.2	20.32
Aguigan	404.6	999.8	1.59
Tinian	6,780.8	16,755.9	26.60
Saipan	7,265.9	17,954.9	28.50
No'os (FDM)	7.9	19.5	0.03
Anatahan	272.0	672.2	1.07
Sarigan	168.9	417.4	0.66
Guguan	170.3	420.7	0.67
Alamagan	484.7	1,197.6	1.90
Pagan	2,052.7	5,072.4	8.05
Agrigan	2,336.2	5,773.0	9.16
Asuncion	319.5	789.6	1.25
Maug	47.9	118.3	0.19
Uracas (FDP)	0.0	0.0	0.00
<b>TOTAL</b>	<b>25,491.7</b>	<b>62,992.4</b>	<b>100.00</b>

The scope of this document encompasses the entire archipelago, but the analysis and strategies will focus primarily on the southern municipalities of Saipan, Tinian / Aguigan, and Rota due to the concentration of forest resources and population on these islands.

**CNMI Forestry Program**

The forest resources of the CNMI are managed by the Forestry Section under the Division of Agriculture (DOA) under the CNMI Department of Lands and Natural Resources (DLNR). Besides the main office on Saipan, the islands of Tinian and Rota each have their own Forestry Section within their Department of

Lands and Natural Resources, which is under the Office of the Mayor. The heads of the departments on these islands are appointed by the mayor on each island. Their annual budget is appropriated by the CNMI legislature. They also get federal funds through the CNMI government to support their activities, including funds from the three U.S. forestry programs. Under Public Law 1-8 (1978), DLNR is empowered “To be responsible for the protection and enhancement of the natural resources of the islands...” and “To maintain and provide for the conservation of forests.” The Forestry Section is responsible for providing for the protection, management, and improvement of the forest resources of the CNMI, including those on both public and private land. The CNMI Forestry Mission Statement is as follows:

*To promote best land management practices while sustaining a healthy diversity and productivity on our limited and fragile forest and grassland resources for present and future generations. Its mission will be carried out through conservation, protection, and the enhancement practices while keeping the islands’ present landscape provisions in the process.*

CNMI Forestry is divided programmatically by issue and collaborate with DFEMS on fire:

- **Cooperative Forest Health Program:** The Cooperative Forest Health Program (CFHP) focuses on the maintenance of forest and tree health and detection and integrated pest management of invasive and detrimental species that threaten the CNMI’s forests resources.
- **Forest Stewardship Program:** The principal goal of the CNMI Forestry Stewardship Program (FSP) is to aid and influence landowners to promote good land and forest stewardship practices. A goal is to influence landowner behavior in regard to land use, promoting their practice of good stewardship. FSP complements this goal by investing in practices to establish, restore, protect, manage, maintain, and enhance the health and productivity of non-industrial private forest (NIPF) habitat for flora, soil, water, and air quality, wetlands, and riparian buffers. FSP also can fund (on private or Commonwealth land): afforestation, reforestation, improvement of bad and grass land, reducing the risks and helping restore, recover, and mitigate the damage to forests caused by fire, insects, invasive species, disease, and damaging weather.
- **Urban & Community Forestry Program:** Urban and Community Forestry (UCF) is a cooperative program with the US Forest Service (USFS) and other organizations that focuses on the stewardship of urban natural resources. This program seeks to facilitate the effective management of forests and trees in an urban and community environment, including towns, villages, boulevards, parks, schools, churches, government areas, residential areas, commercial areas and historical sites.
- **Landscape Restoration Program:** Under the Landscape Restoration (LSR) program, grants are competitively secured for projects that may include FSP, UCF, Forest Health and/or Fire program work.
- **Cooperative Forest Fire Program:** DFEMS has the responsibility for preventing and suppressing fires within the Commonwealth of the Northern Mariana Islands. Through the Cooperative Fire Program, DFEMS focuses on addressing wildland fire risk through training, education and prevention, and fire suppression and control efforts. DFEMS works closely

with the CNMI Forestry in fire mitigation and restoration by promoting fire prevention through the use of live fuel breaks on targeted areas.

## 2. CNMI Forest Resource Assessment

### History of Forest Resources in the CNMI

Native forests that once covered most of the inland areas of the islands of the Marianas have been under increasing anthropogenic pressure, beginning with Chamorro settlement of the islands about 4,000 years ago and ramping up with Spanish and German colonization and agricultural development beginning about 400 years ago. The Japanese administration of the islands in the first half of the 20<sup>th</sup> century was heavily oriented toward commercial agricultural production, with most accessible areas of the southern islands being cleared of native forest tree stand and mangroves and converted to agricultural land, primarily sugarcane. New forests of *sosugi* (*Acacia confusa*) were established to be harvested for fuel wood.

The invasion of Saipan and Tinian by the US military during World War II brought with it heavy artillery bombing and clearing of vegetation, causing further destruction to the little remaining native forests on the islands. A notable exception to this was Rota, which was not invaded during the war and retains a higher proportion of native forests than the other populated islands. Areas of mangrove wetland along the Saipan coast were then later used as a landfill up until 1978 (Greene et al 2019).

Following WWII and the soil disturbance and destruction of vegetation on Saipan and Tinian, the fast-growing tree *Leucaena leucocephala* (tangantangan) was further introduced and widely dispersed on the islands. This species now dominates much of the forest area of Saipan and Tinian, forming homogenous stands that shade out and compete with native vegetation.

### Current Status of Forests in the CNMI

The forests and forest resources in the CNMI can be classified into seven categories as outlined in Liske-Clarke 2015:

- **Native Forests:** Due to the aforementioned widespread disturbance that has affected the forests of the CNMI, the “native forests” do not refer to areas of intact, undisturbed forests but rather areas of forests where a higher number of native species are found. Native forests are characterized by a closed canopy of tall broadleaf trees and dark, humid conditions at the forest floor. Trees may reach heights of 14 meters (45 feet), with some trees being recorded as tall as 23 meters (75 feet), and understory vegetation is dense and multilayered. Much of the CNMI’s native forest can be found on Rota, with over 4,500 hectares of native forest (as cited from Donnegan et al. 2011).
- **Mixed Forest:** These forests comprise a mixture of native and nonnative species and represent forests that are recovering from disturbance such as agricultural production or WWII development or bombardment. The canopy is approximately 2-20 meters in height, and there is dense understory vegetation.
- **Tangantangan Forest:** As previously described, tangantangan is a fast-growing non-native tree species that was introduced to the Marianas and used for soil stabilization following WWII, particularly on Saipan and Tinian. These trees may reach a height of up to 10 meters with an open understory.
- **Agroforest:** This forest type comprises areas where people have planted tropical food trees. These areas are generally located near urban centers, and may either be currently tended or abandoned.

- **Developed:** This includes any urban area where trees, shrubs, and other vegetation may be present, and generally falls under the Urban & Community Forestry Program.
- **Grassland and Savanna:** These areas occur on limestone soils such as those found on the Sabana on Rota and around Mount Tapochau on Saipan. These ecosystems can be critical in erosion control but tend to be vulnerable to burns and other disturbances. CNMI Forestry plays a key role in the revegetation of these areas that have been cleared.
- **Wetlands:** Wetlands in the CNMI are limited in extent, totaling only 642 acres and occurring only on the largest islands (Liske-Clarke 2015). The largest wetlands in the CNMI are Lake Susupe on Saipan and Lake Hagoi on Tinian.

### **Conservation Areas in the CNMI**

A large proportion of the CNMI's forestland and wildlife habitat on public lands is legally protected as "Conservation Areas"; most of these Conservation Areas are under the administration of the DLNR Division of Fish & Wildlife (DFW). The northern islands of Guguan, Asuncion, Maug, and Uracas are protected under the CNMI Constitution as wildlife conservation areas and are to be used solely for the preservation and protection of natural resources (Figure 2). The northern island of Sarigan is under management of the CNMI Department of Public Lands (DPL) but is regulated by DFW. On the southern populated islands conservation lands comprise 9% of Saipan, 4% of Tinian, and 22% of Rota, including the following Conservation Areas under DFW jurisdiction:

- Rota (Figure 3):
  - Sabana Heights
  - Wedding Cake Conservation Area
  - I'Chenchon Park Bird Sanctuary
- Saipan (Figure 4):
  - Bird Island Wildlife Conservation Area
  - Kagman Wildlife Conservation Area
  - Susupe Wetland (Lake Susupe)
  - Costco Park Wetland Mitigation Pond
  - Saipan Upland Mitigation Bank Area (SUMBA/Marpi Forest)
  - Mariana Islands Housing Alliance Mitigation Bank





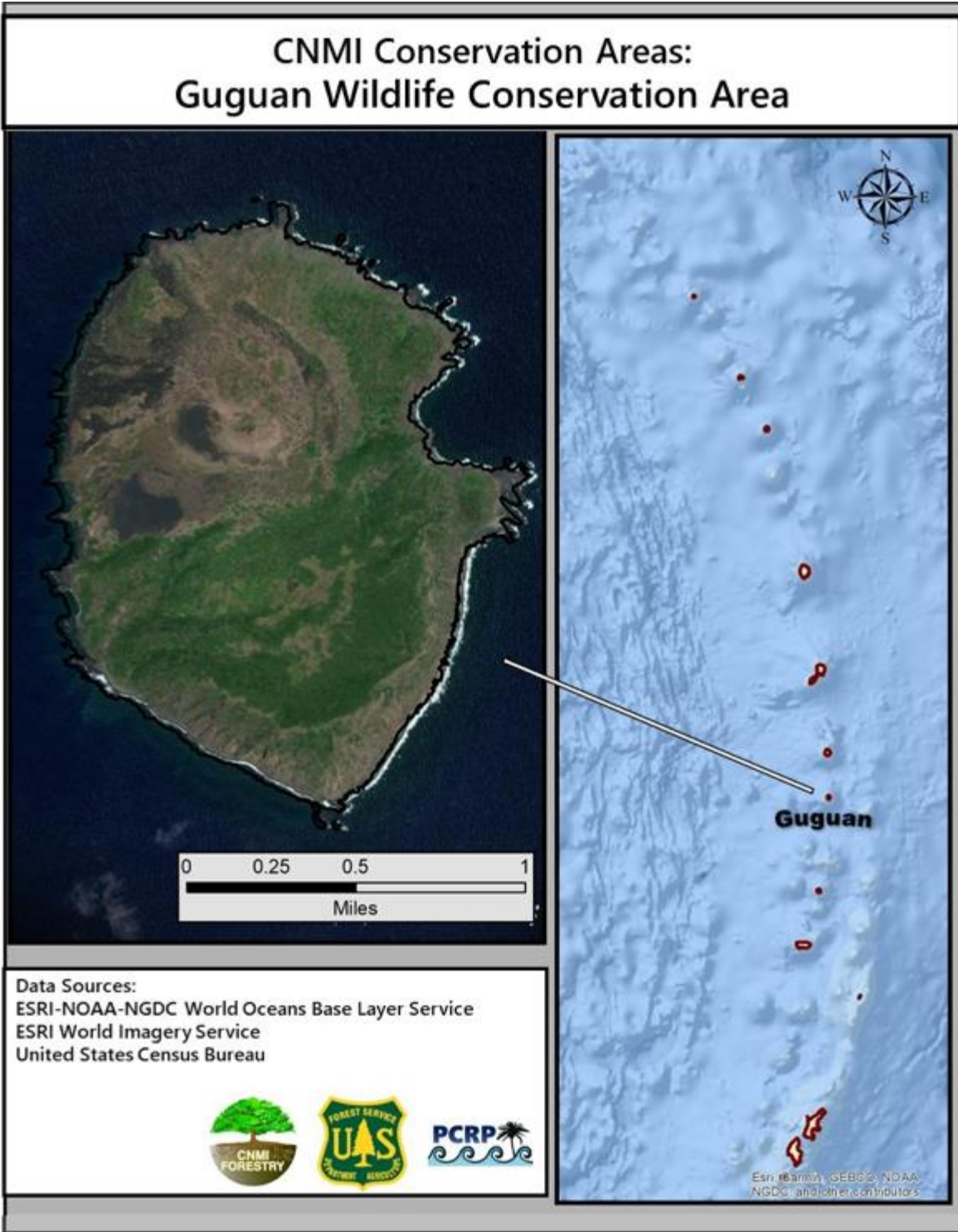
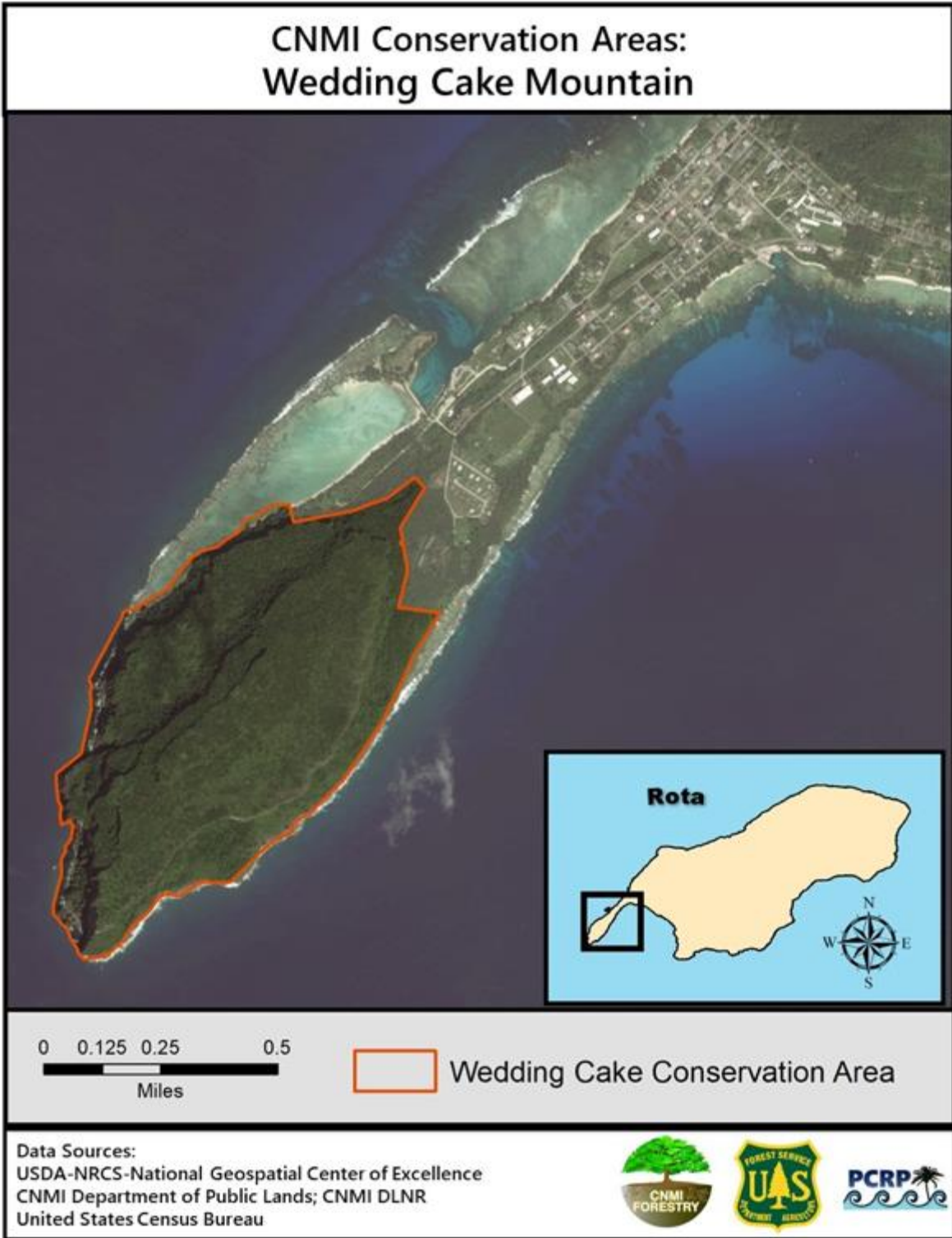
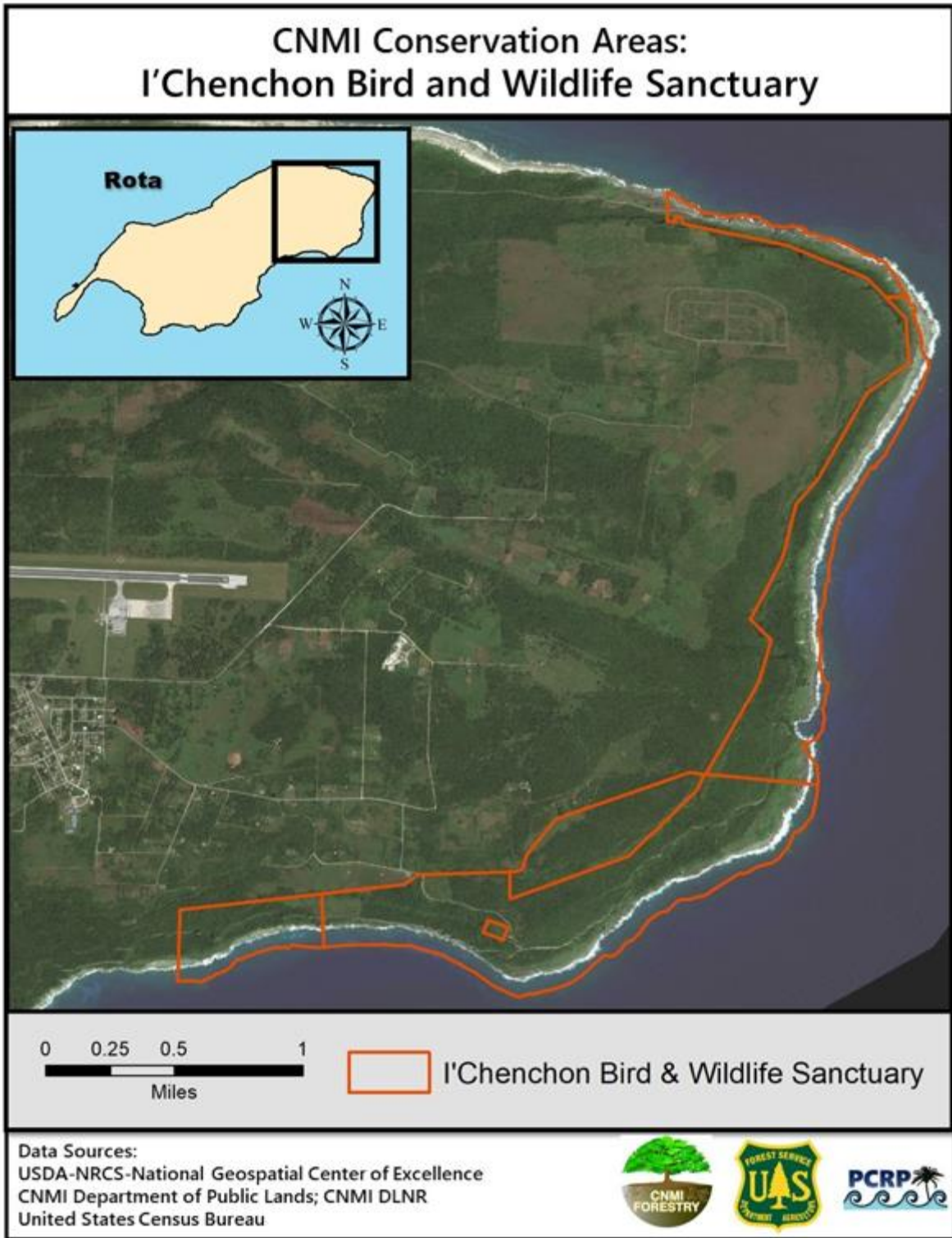


Figure 2: Conservation areas in the Northern Islands: Asuncion, Maug, Uracas, and Guguan.





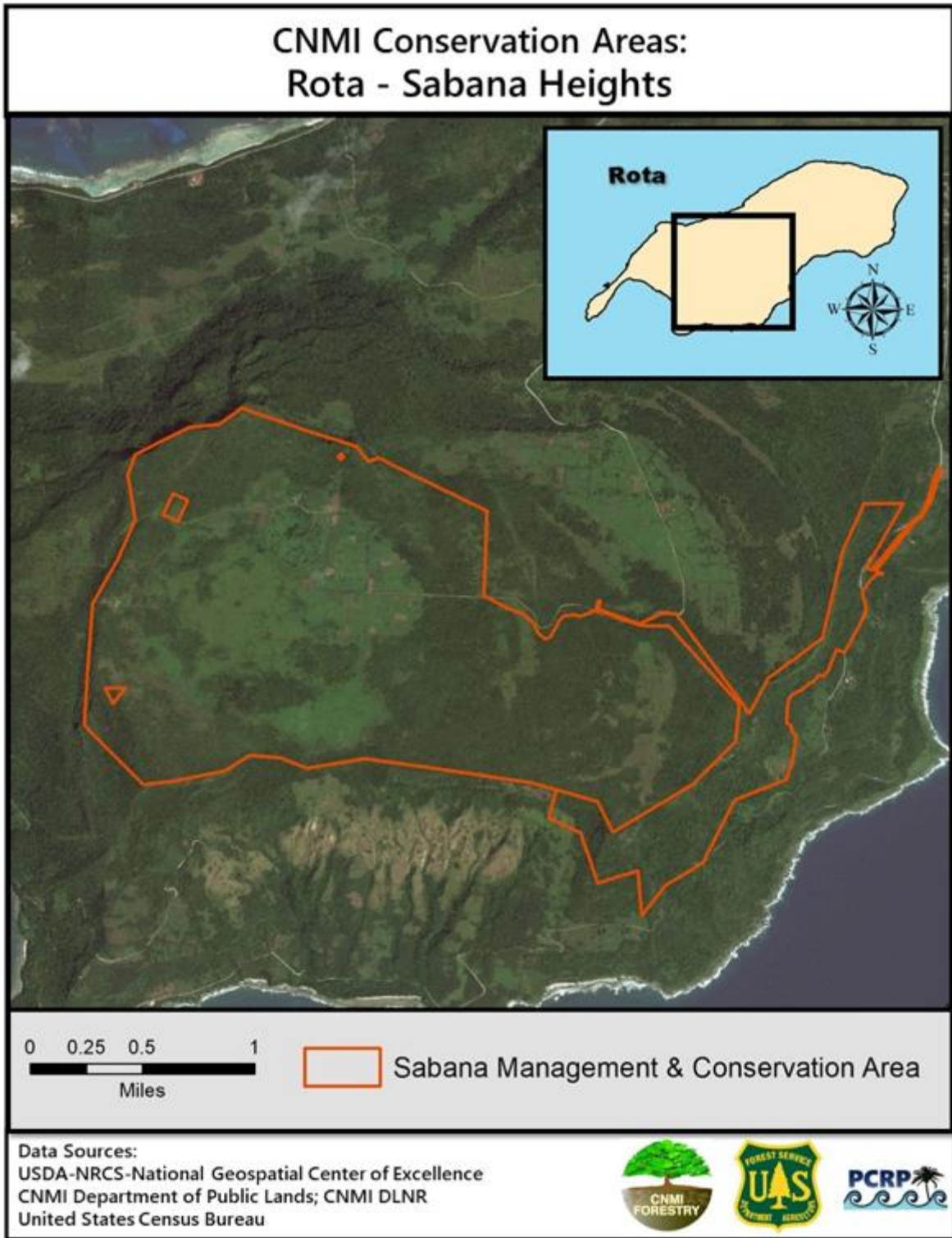
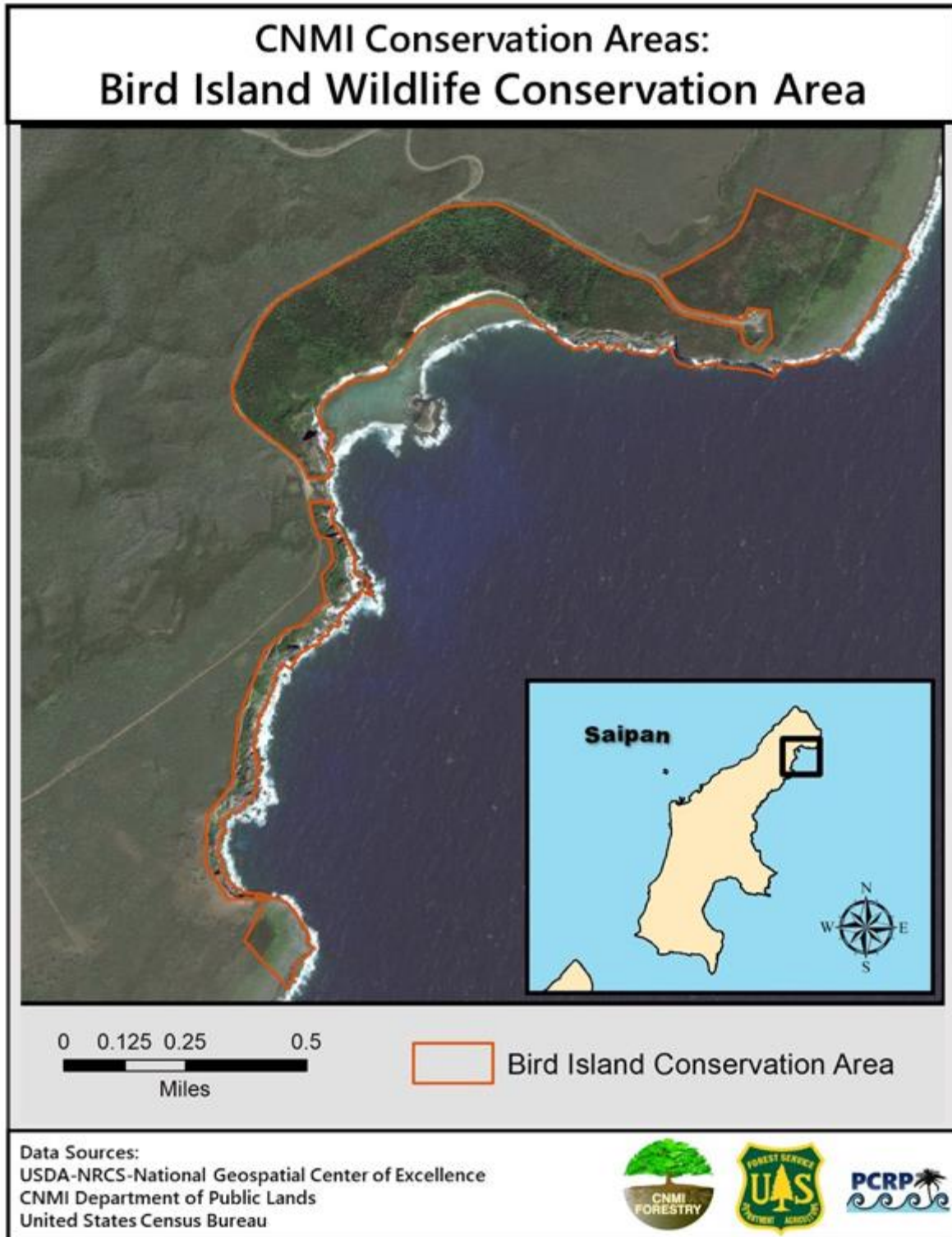


Figure 3: Conservation areas on the island of Rota.



## CNMI Conservation Areas: Costco Mitigation Wetland

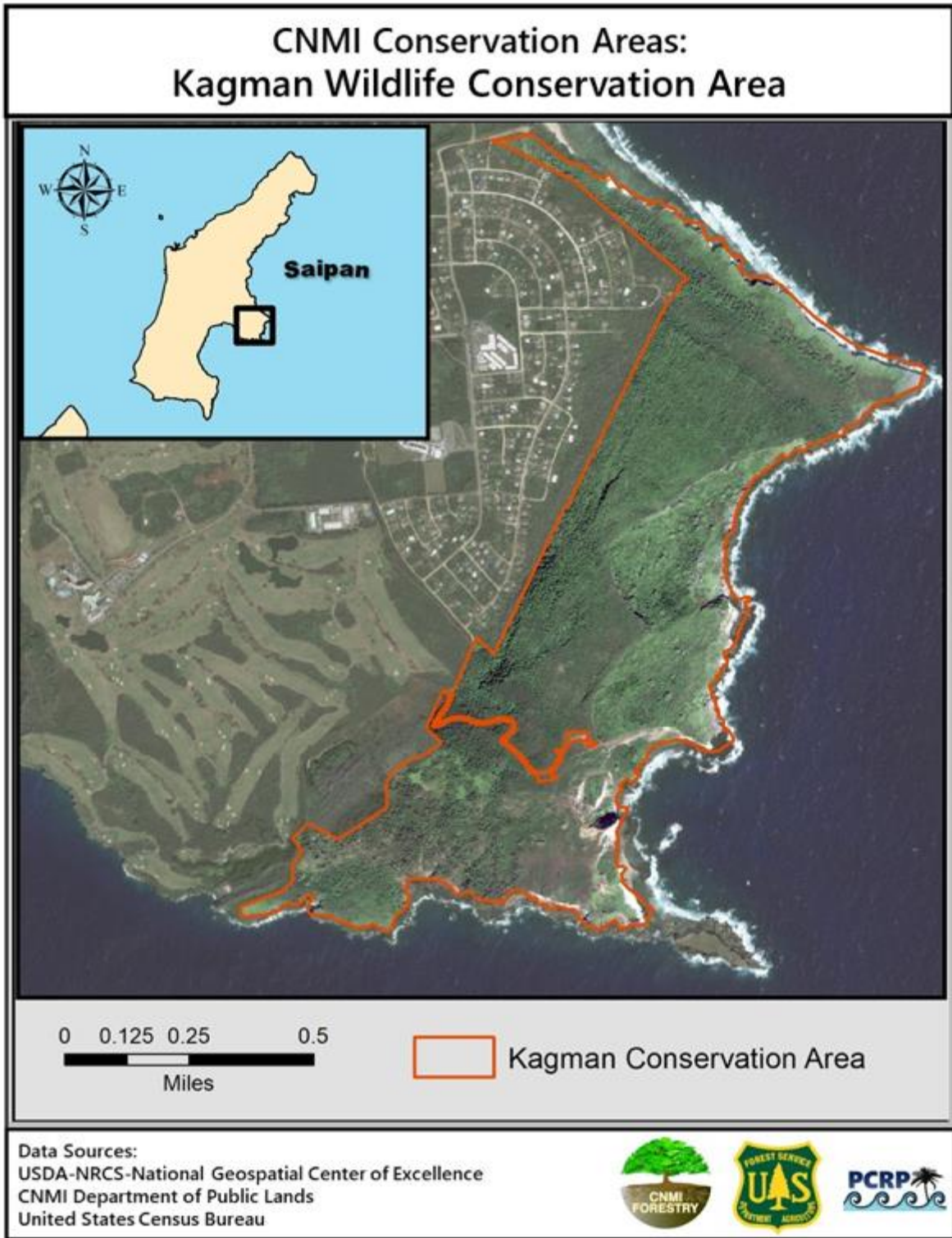


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Feet

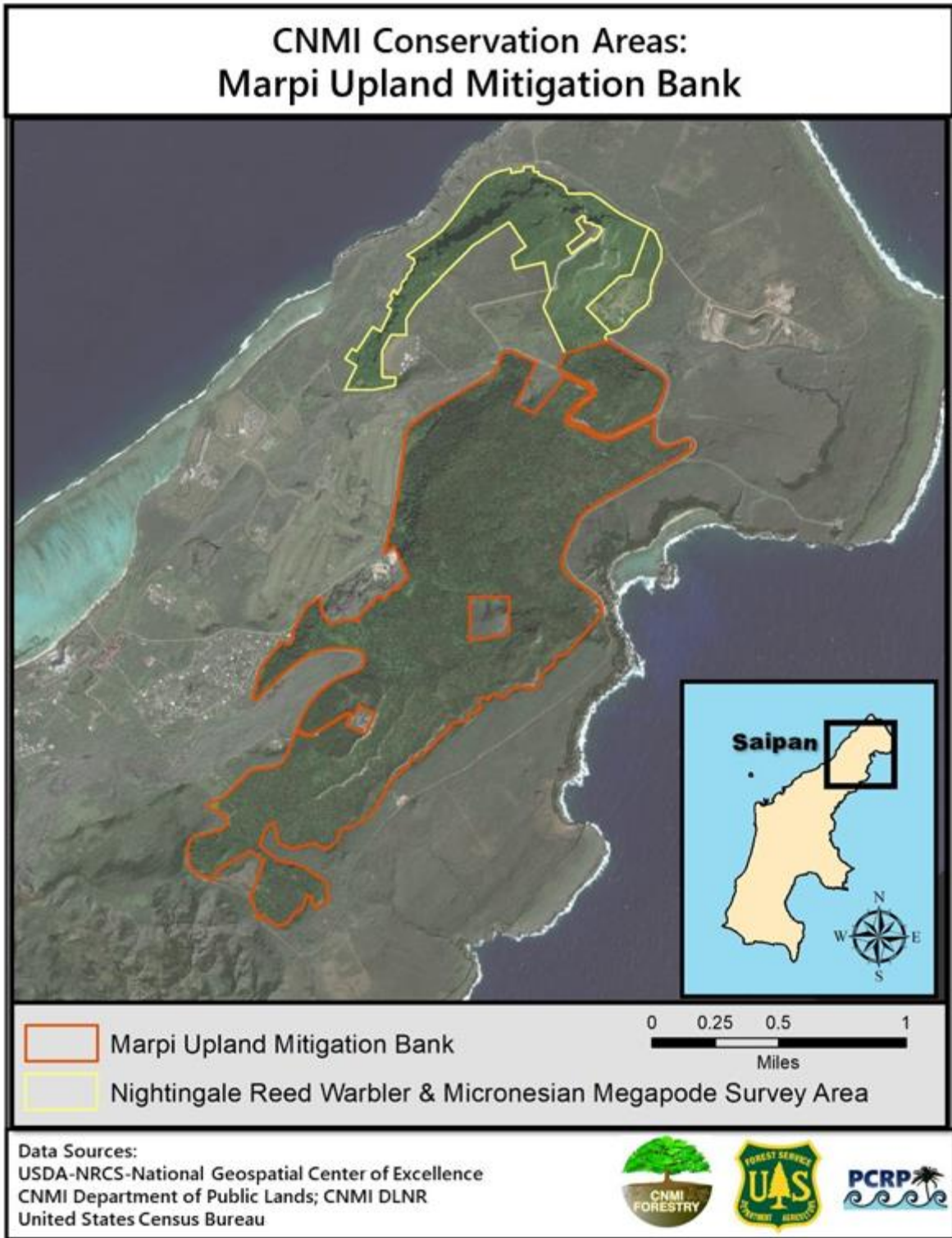
 Costco Mitigation Wetland

Data Sources:  
USDA-NRCS-National Geospatial Center of Excellence  
CNMI Department of Public Lands; CNMI DLNR  
United States Census Bureau

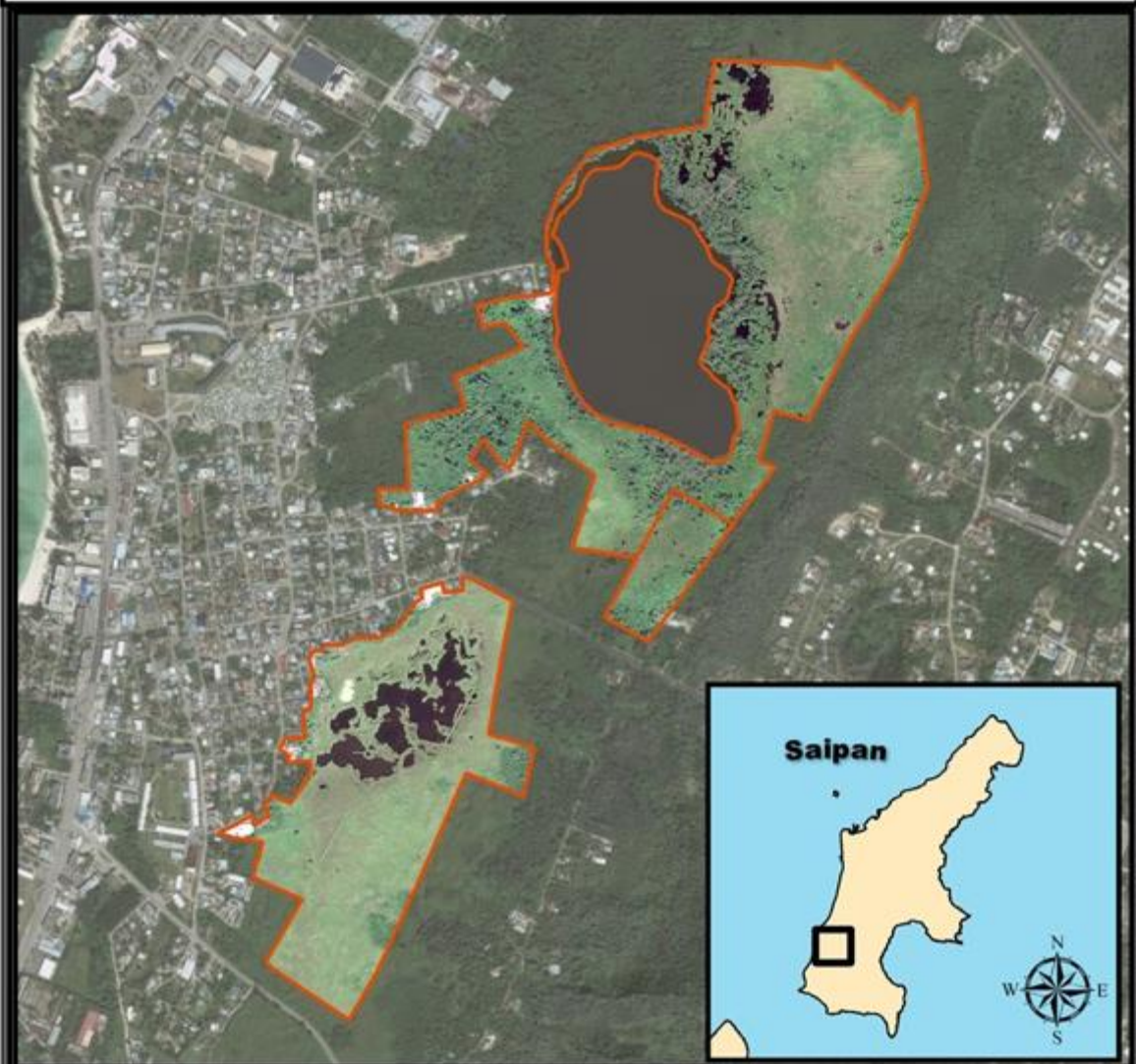








## CNMI Conservation Areas: Lake Susupe Wetland Complex



0 0.125 0.25 0.5  
Miles

 Susupe Wetland Complex

Data Sources:  
USDA-NRCS-National Geospatial Center of Excellence  
CNMI Department of Public Lands  
United States Census Bureau



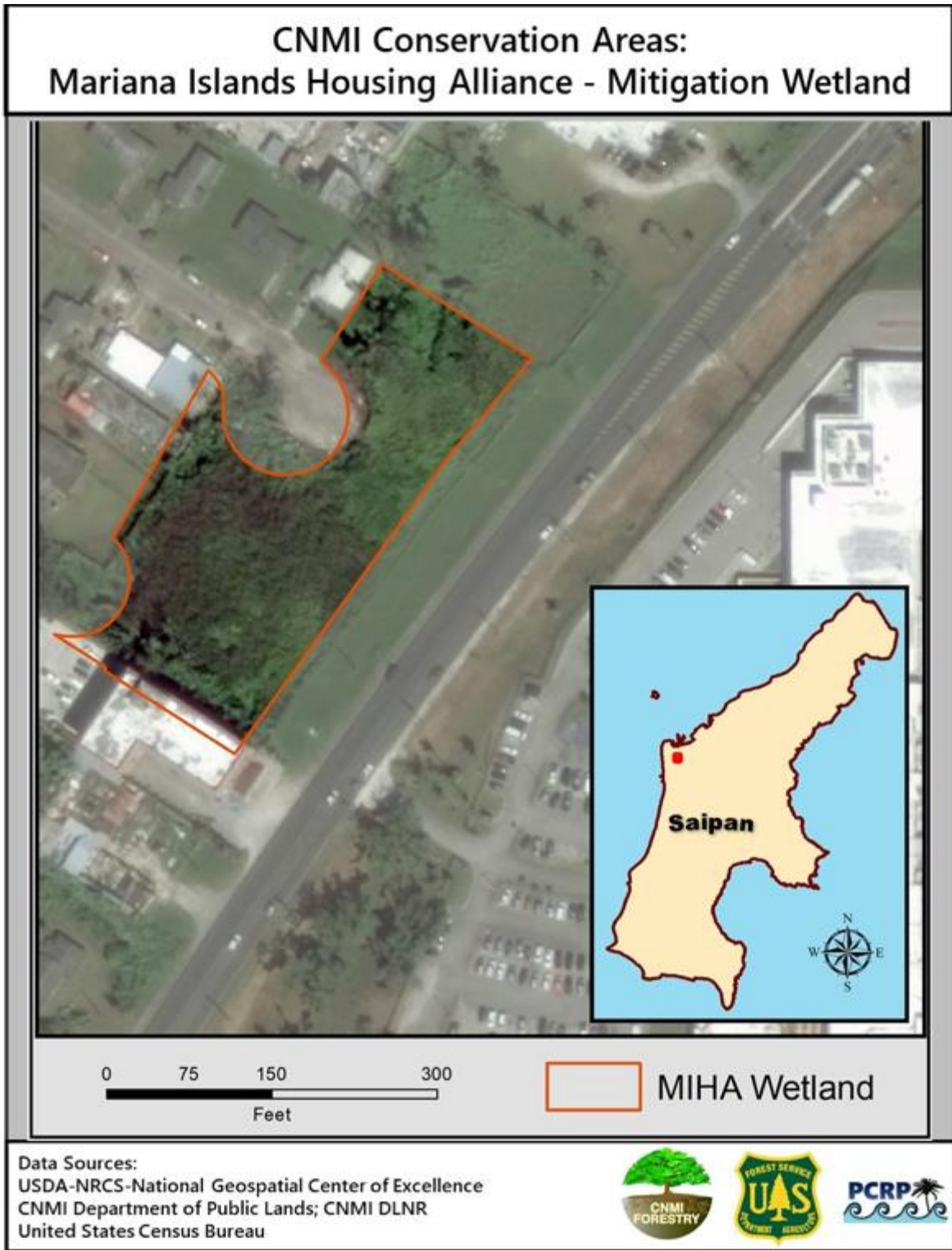


Figure 4: Conservation areas on the island of Saipan.

In addition, there are several areas on Tinian designated as priority areas that are not legally protected as Conservation Areas (Figure 5):

- Tinian
  - Carolinas Heights
  - Kastiyu

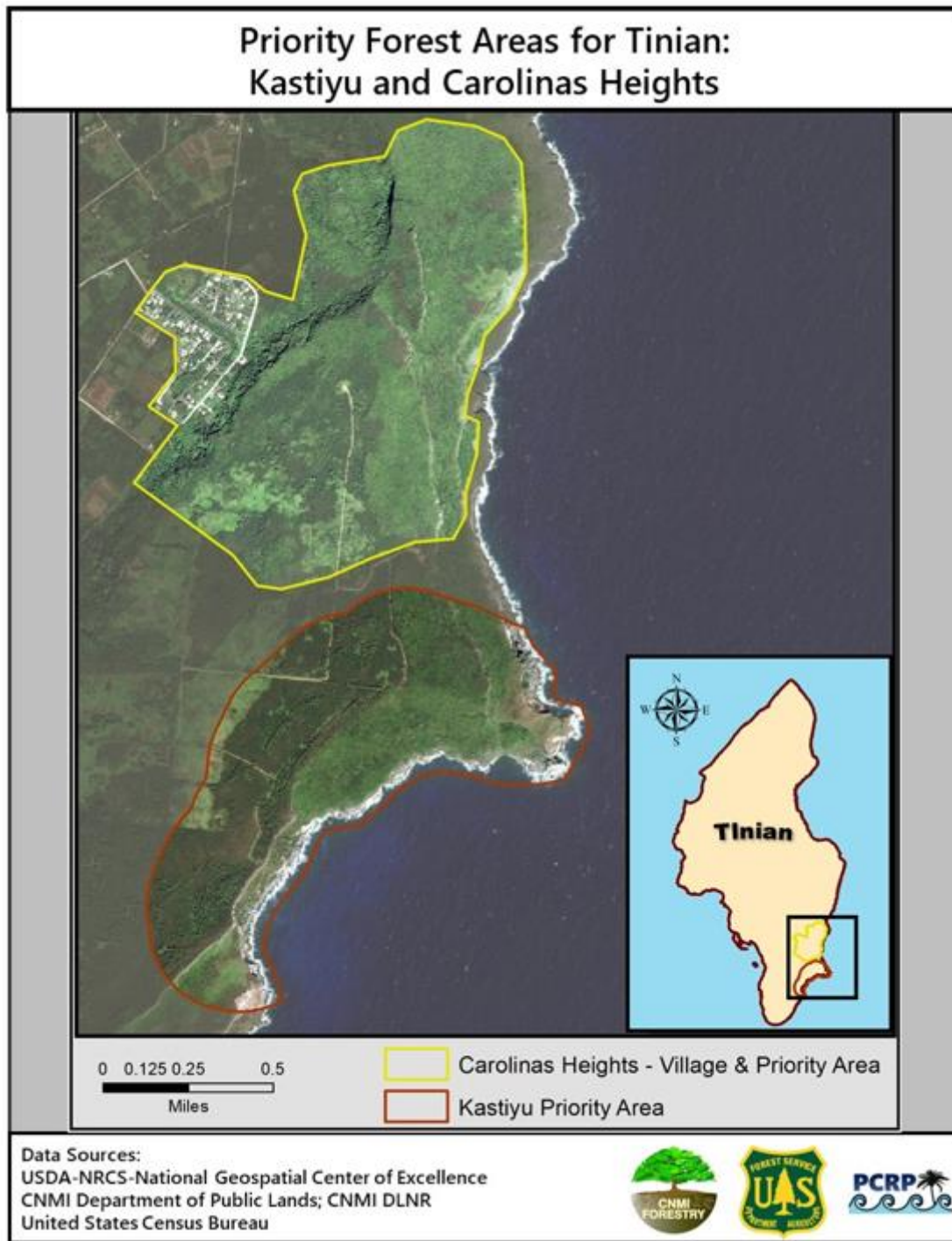
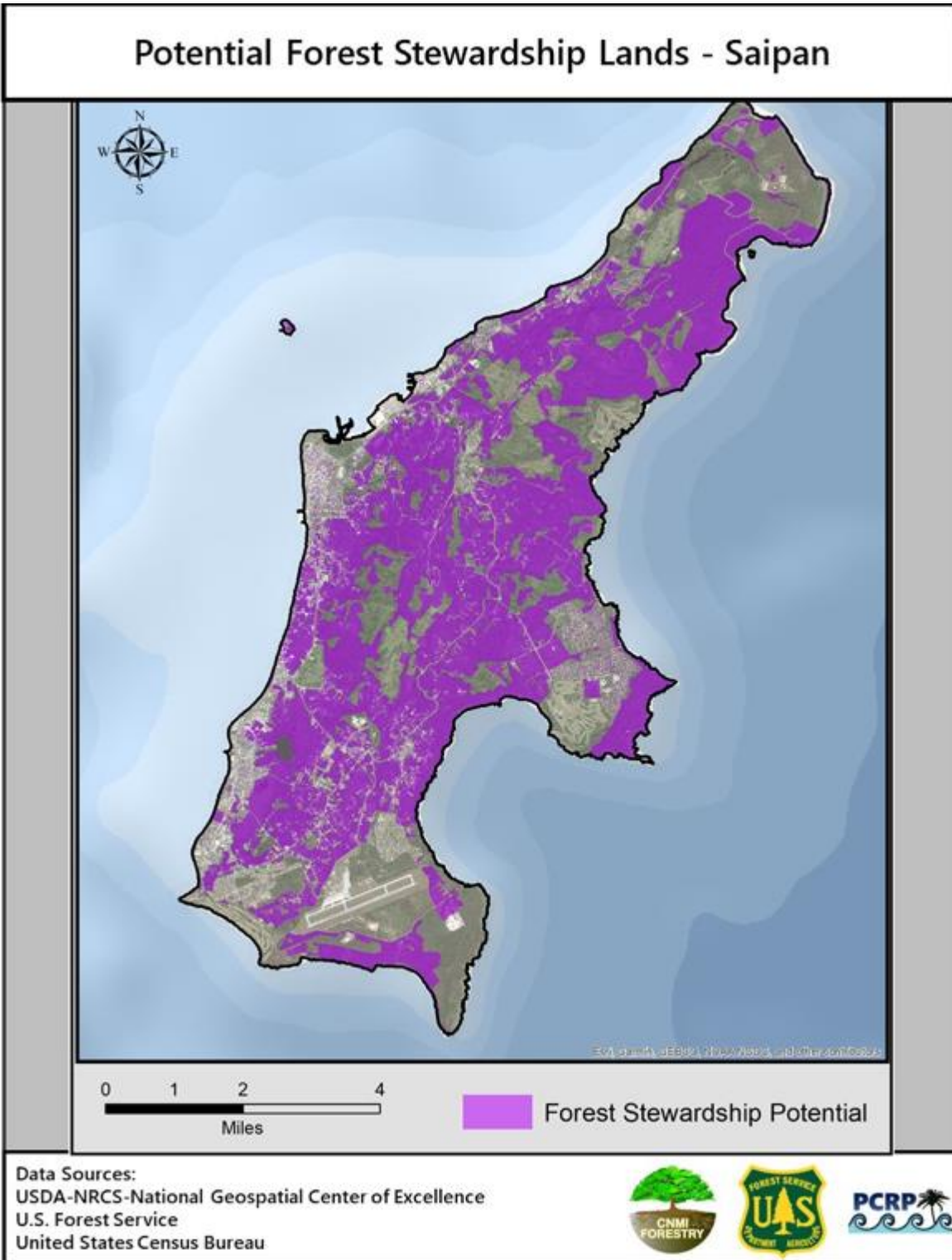
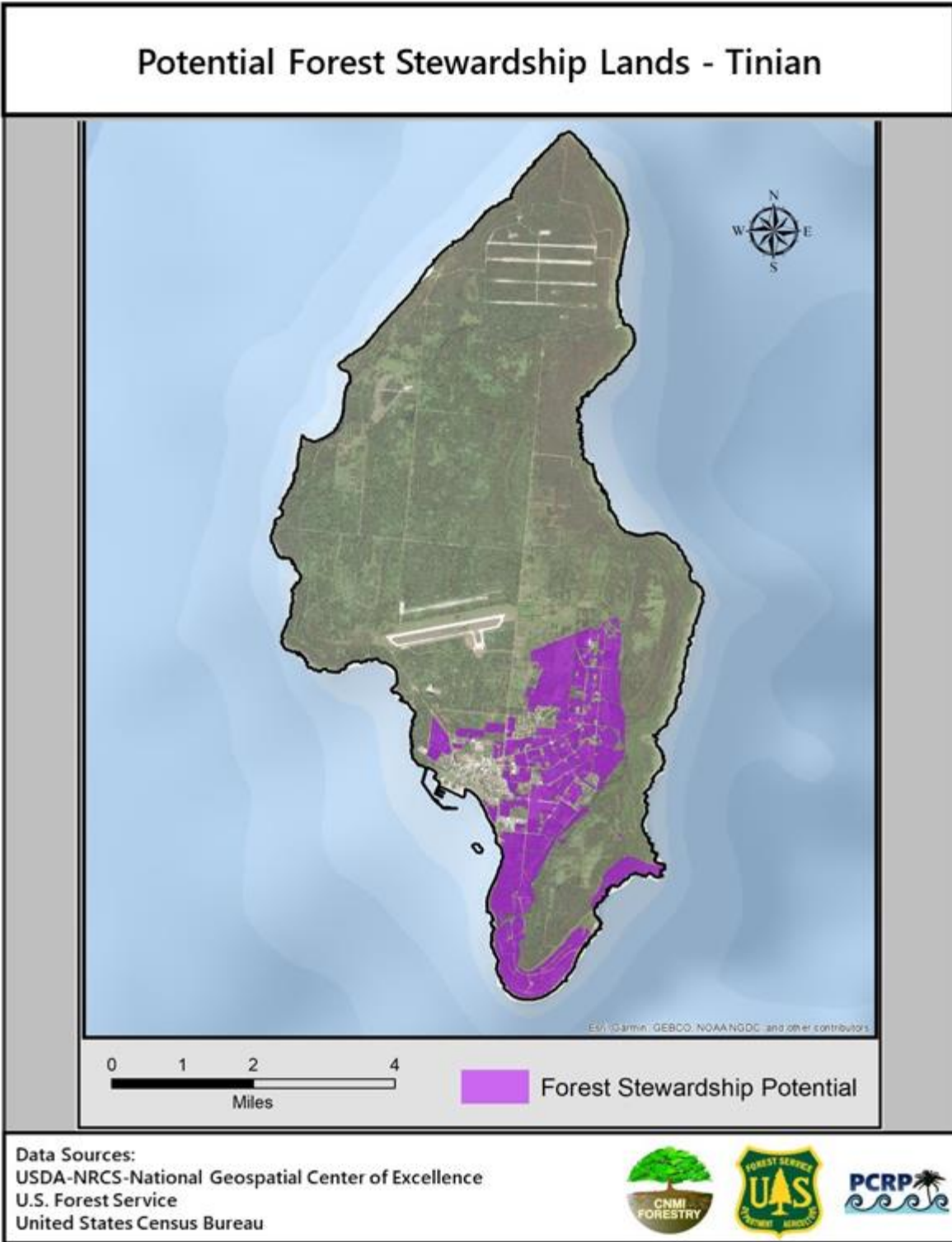
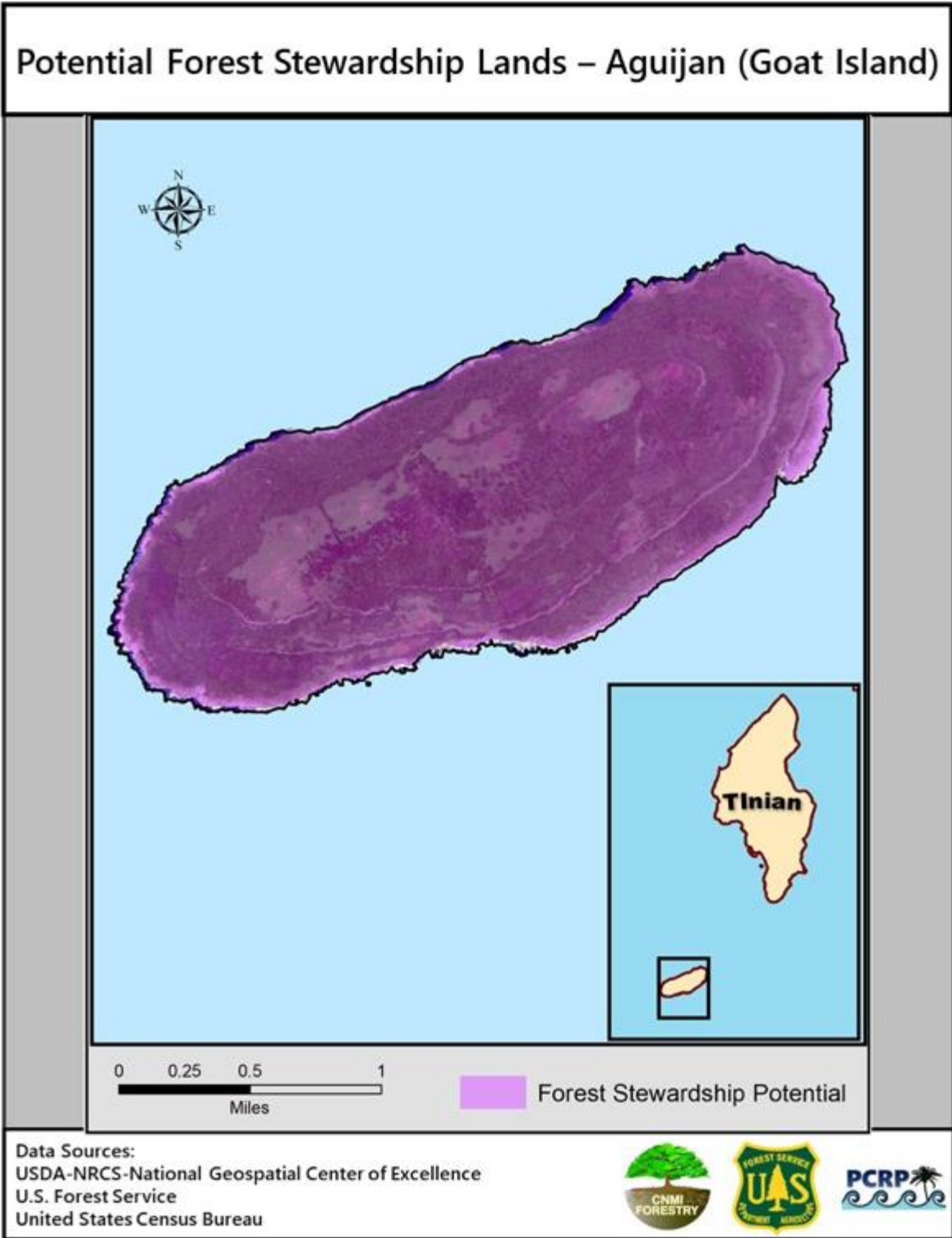


Figure 5: Priority areas on Tinian.

**Forest Stewardship Areas in the CNMI**







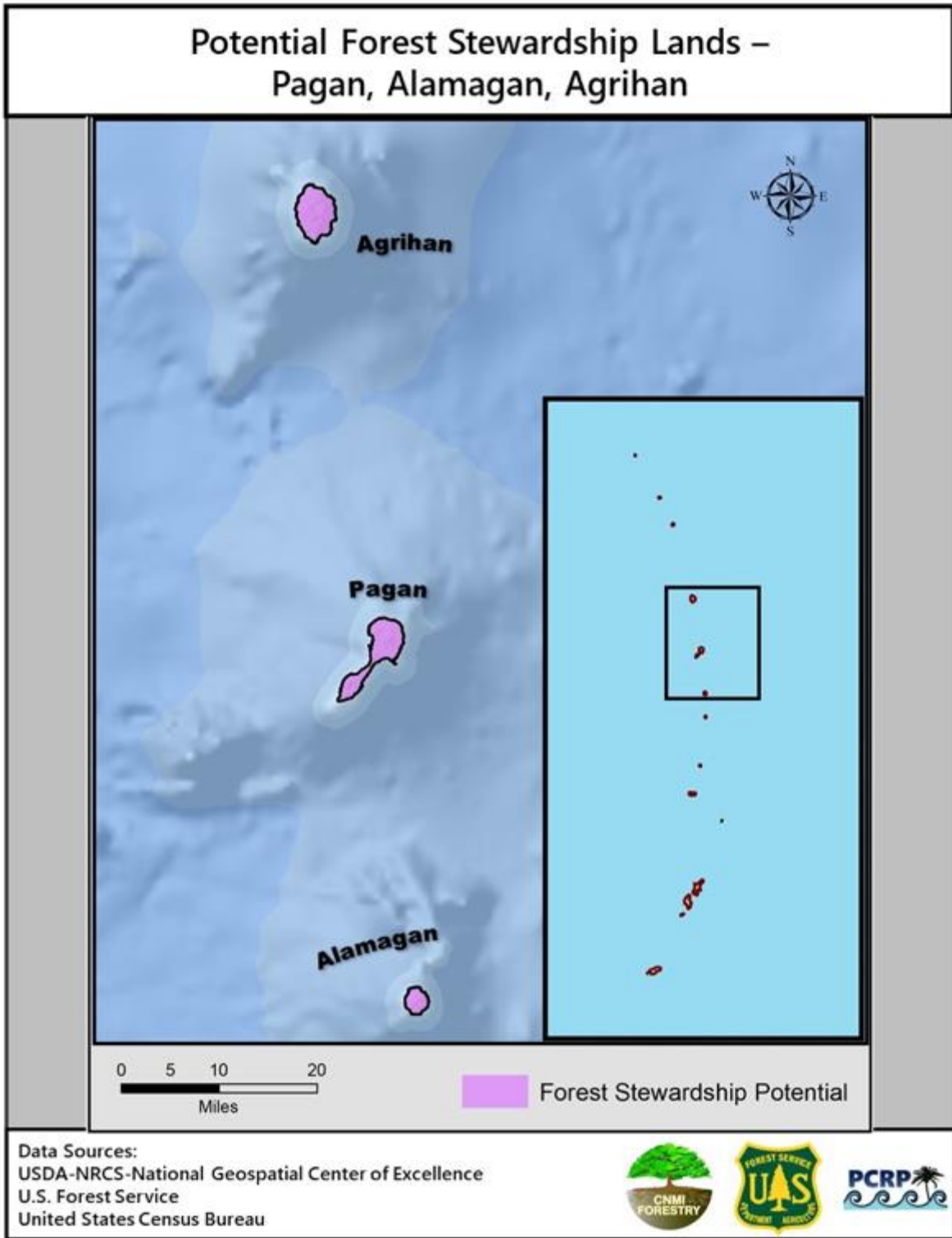






Figure 6: Forest Stewardship Areas in the CNMI.

These “Stewardship Potential” maps were prepared in October 2020 to indicate “High Stewardship Potential” lands (purple), meaning rural private lands and commonwealth lands that are forested or have potential to be forested. Federal, federally leased, and urban lands, and water, are not eligible for the

Forest Stewardship program and are shown as “Non-Stewardship Potential.” Besides guiding program implementation, these maps are used in the national Forest Stewardship accomplishments system, and are variously called “Stewardship Priority Areas,” “Important Forest Resource Areas,” or “Forest Stewardship Federal/State Investment Areas.” They will be updated when local priorities have changed, with advice from the CNMI Forest Stewardship Program Coordinating Committee.

## MAP 09: 01 Non-industrial Private Forestland

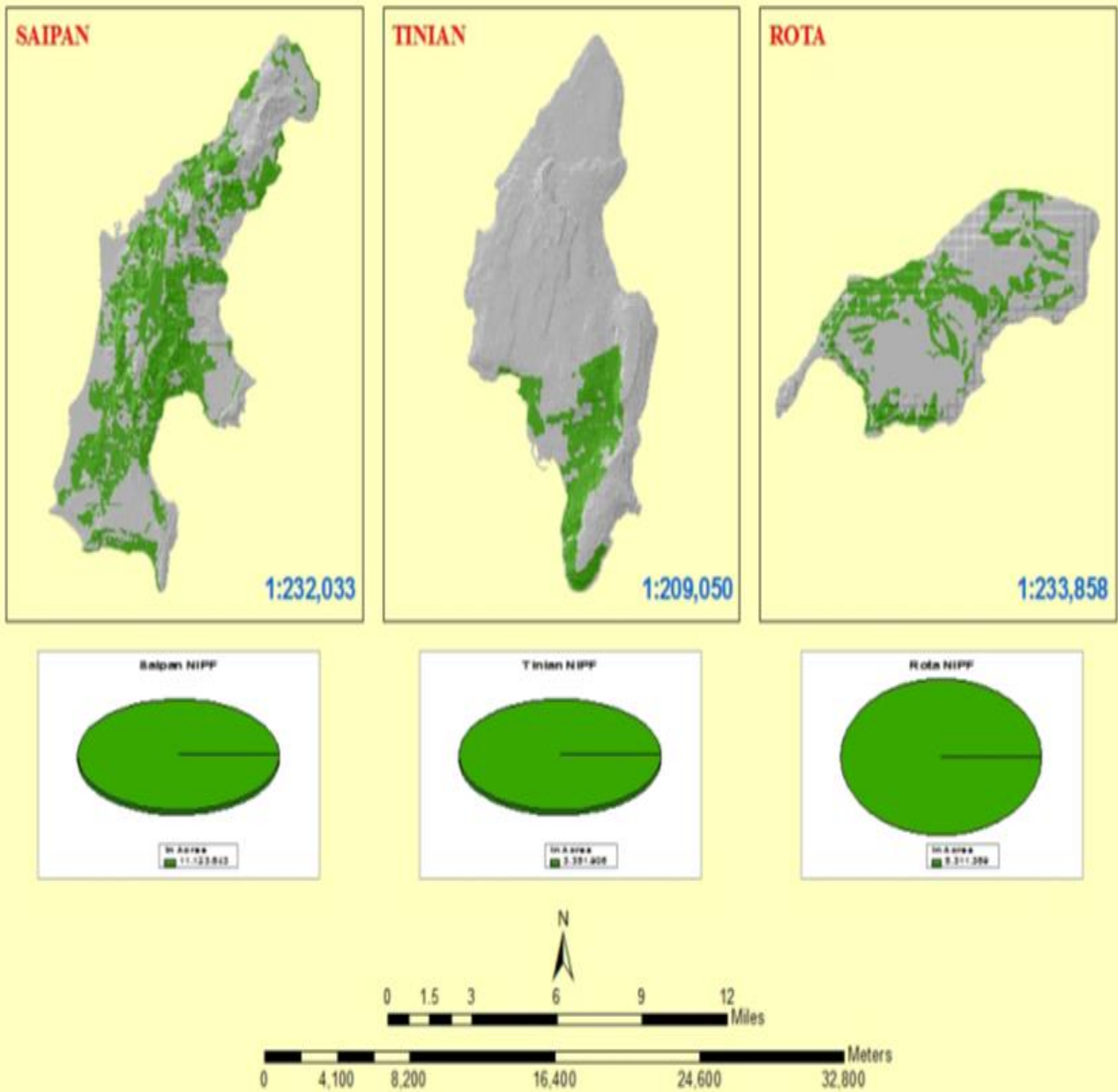


Figure 7: Non-industrial private forestlands on Saipan, Tinian, and Rota.

The principal goal of the CNMI Forestry Stewardship Program is to aid and influence landowner in-regard to land management, promoting good stewardship practice by incorporating the Forest Land Enhancement Program (FLEP) program objectives and complementing other federal, local, and private forestry assistance programs. Under the advisement of the State Forest Stewardship Committee, the CNMI Forestry will work with its federal, local, and private partners during the next five years to identify opportunities for enhancement and better management of its forest on State and NIPF throughout the CNMI. Program goals, objectives, and strategies will continuously be improved to meet the needs of stakeholders to address challenges and changes in our governmental policies, economic conditions, and environmental impacts, social and cultural aspects. The CNMI Forest Stewardship Program provides technical and financial assistance to owners of non-industrial private forestland who are committed to the restoration, maintenance, enhancement and/or conservation of their forest resources. The strategic direction of the FSP is to assist the non-industrial private forestland to more actively manage their forestland and related resources of those owners through the use of State, Federal, and private sector resource management expertise, financial and technical assistance, and educational programs.

### **Micronesia Challenge**

The Micronesia Challenge (MC) is a shared commitment made by the Federated States of Micronesia, Guam, Palau, CNMI, and the Republic of the Marshall Islands originally launched in 2006 to effectively conserve 30% of marine resources and 20% of terrestrial resources by 2020. During the 24th Micronesia Island Forum in 2019, the Leaders recognized the success of the first 15 years of the Micronesia Challenge and endorsed the new Micronesia Challenge 2030 goals to effectively manage 50% of marine resources, including the exclusive economic zone (EEZ), and 30% of terrestrial resources by 2030. The goal now also includes a larger voice for fisheries management, reducing invasive species, restoring habitats, increasing livelihood opportunities and reducing risks to communities from climate impact in Micronesia.

## **Forest Conditions and Trends/Threats**

The CNMI forests are faced with many challenges ranging from the destruction of typhoons to soil erosions and forest fires, with the latter two usually a result of man-made activities. These challenges continue to persist throughout the CNMI history since the islands were discovered and settled by the natives about 4,000 years ago. The economic boom resulting from the garnet industry in the early 1980s also impacted our forest resources, as more people were clearing lands for residential dwellings or business establishments.

Despite these challenges, the people are beginning to be more conscious about their environment and have been implementing programs to protect and restore their forest resources, as well as to detect and destroy invasive species from making the islands their home. With assistance from USFS, and occasionally from other federal agencies, the CNMI will be able to address some of these threats and priorities identified in this plan, including the mucuna and coconut rhinoceros beetle infestations, the two most devastating treats to treat in the CNMI.

### **Forest Trends Since the Previous SWARS**

#### *Coconut rhinoceros beetle on Rota*

The coconut trees and other palm trees on the island of Rota are being threatened by a new invasive species, the coconut rhinoceros beetle (CRB). In October 2017, the first siting CRB was found on the Island of Rota at Twerksberry Beach Park and the former Paupau Hotel. CRB was considered a high priority to eradicate to avoid spread all over the island of Rota. CRB was found in 2020 in the Gagani and Talakhaya areas of Rota four miles from the original CRB quarantine areas at Twerksberry Beach Park and Paupau (Figure 8). After confirming that decaying coconut trees and scissor cuts on the palm leaves existed via drone-conducted surveys the CRB team immediately began dissecting trees, setting traps, and recording CRB findings in these new areas – 660+ larvae and over 60 adult beetles were found. DFEMS and Department of Community and Cultural Affairs (DCCA) assisted DLNR in the response.

The new infestations prompted the Mayor of Rota to declare a State of Significant Emergency due to the negative impacts by CRB on Rota's agriculture and food security. Collaboration with local landowners remains critical to detect and eradicate CRB. With continued support from the public, federal partners, and local governments the Municipality of Rota is optimistic in containing the spread and preventing CRB reaching Tinian and Saipan.

The latest findings of CRB larvae and new breeding sites on Rota by the Invasive Species Team was on March 3, 2021 at the Benjamin Taisacan Manglona International Airport. Damage to palms was also found. The new site is in the northeastern part of the island, approximately 7 road miles from the finds in 2020 in the Gagani and Talakhaya areas.



Figure 8: CRB quarantine area (pink color) and locations of new infestations (orange color) detected in 2020 on Rota. Source: <https://governor.gov.mp/news/press-releases/third-coconut-rhinoceros-beetle-site-discovered-on-rota/>

### Forest conditions on Rota

The original vegetation on Rota was probably very simple. On the limestone terraces, a mixed forest existed. On the lower terraces, the forest was semi xerophytic, that is, dry season deciduous, and on the highest terraces, it was moist forest. The indigenous Chamorro's who have inhabited Rota for three thousand years unquestionably made major modifications to the island's native vegetation. Today, some areas on Rota show evidence of having been terraced in ancient times for the cultivation of rice and taro.

Rota has two tree species, *Serianthes nelsonii* and *Osmoxylon mariannense*, and a perennial herbaceous species, *Nesogenes rotensis*, which are federally listed as endangered. *Osmoxylon mariannense* and *Nesogenes rotensis* are both endemic to Rota. The US Fish and Wildlife Service (USFWS) has also identified three plant species found on Rota, *Lycopodium phlegmaria*, *Coelogyne guamensis* and *Nervilia jacksoniae*, as species of concern. The CNMI has also classified *Serianthes nelsonii* and *Lycopodium phlegmaria* var. *longfolium* as threatened/endangered species

To date, only 121 specimens of *Serianthes* have been found on Rota. *Osmoxylon* is endemic to Rota where only about 20 specimens have been found. This small, unique population of *Osmoxylon* appears to be in decline as evidenced by the death of several previously mapped older trees and the lack of evidence of any new saplings being noted as new generation. The primary factors threatening these rare tree

species are lack of regeneration probably caused by ungulate browsing and insect predation on seeds. Native flora of the Northern Mariana Islands evolved in an environment free of ungulates making several species vulnerable to heavy browsing. Three species of ungulates, Philippine deer (*Cervus mariannus*), feral pig (*Sus scrofa*), and domestic cattle (*Bos taurus*) are likely involved in the destruction of these tree species. Attempts to propagate *Osmoxylon* from cuttings have so far been unsuccessful. *Nesogenes rotensis* is another species found only on Rota, thriving within the salt spray zone of Poña Point and that population is believed to consist of less than 20 individuals.

Also, Rota provides habitat for several animal species listed by the USFWS and the CNMI as threatened or endangered, or as candidates for listing. Three bird species, the Mariana crow (*Corvus kubaryi*), the Rota bridled white-eye (*Zosterops conspicillatus rotensis*), and the Mariana common moorhen (*Gallinula chloropus guami*) are federally listed as endangered. The Mariana fruit bat (*Pteropus m. mariannus*) is now listed as a threatened species. The Mariana crow and the Rota bridled white-eye populations have significantly declined in recent decades. The Mariana common moorhen is found at one location on Rota, the Rota Resort, where the island's only freshwater wetland habitat exists. Two species, the Mariana swiftlet (*Aerodramus bartschi*) and the Micronesian megapod (*Megapodius l. laperous*), were historically present on Rota, but have since been extirpated. A small population of the Mariana common moorhen has become established at the wastewater treatment ponds of the Rota Resort. Recent analysis conducted by the DFW has shown that most other bird populations on Rota also have substantially declined over the past few decades.

**Lower Limestone Terraces.** In drier northeastern Rota where the terrain is more level and less rocky, small to medium size *Intsia bijuga* is common. The forest here is relatively low and scrubby with *Hibiscus tiliaceus* and *Pandanus* spp. being common. Other species here include *Guamia mariannae*, *Guettarda speciosa*, *Eugenia* spp., *Morinda citrifolia*, *Maytenus thompsonii*, *Triphasia trifolia*, *Polyscias grandifolia*, *Cycas circinalis*, *Flagellaria indica*, and *Caesalpinia major*.

**Mid-elevation Limestone Terraces.** A substantial portion of the limestone terraces of the Sabana contain native forest in good condition. Species found here include: *Serianthes nelsonii*, *Heritiera longipetiolata*, *Artocarpus* spp., *Hibiscus tiliaceus*, and *Osmoxylon mariannense*. Understory species include *Macaranga thompsonii* and *Pipturus argenteus*. Epiphytes are abundant and include *Freycinetia reineckeii*, *Asplenium nidus*, *Davallia solida* and other ferns; *Coelogyne guamensis* and other orchids; and mosses.

**Upper Limestone Terraces.** At the higher altitudes, the forest changes to a wetter type which is very luxuriant and has a full canopy. In these wet parts the principal trees are *Elaeocarpus joga*, *Hernandia labyrinthica*, *Fagraea berteriana*, *Pandanus*, *Guettarda*, *Ficus prolixa*, *F. tinctoria*, *Artocarpus mariannensis*, *Pipturus*, *Laportea*, *Guamia*, *Claoxylon*, *Osmoxylon*, *Macaranga*, *Pisonia umbellifera* and others, with *Psychotria*, *Piper*, *Discocalyx*, *Maesa* and other shrubs and many ferns in the undergrowth. *Freycinetia* and *Alyxia* are common lianas. Epiphytic ferns and orchids are abundant.

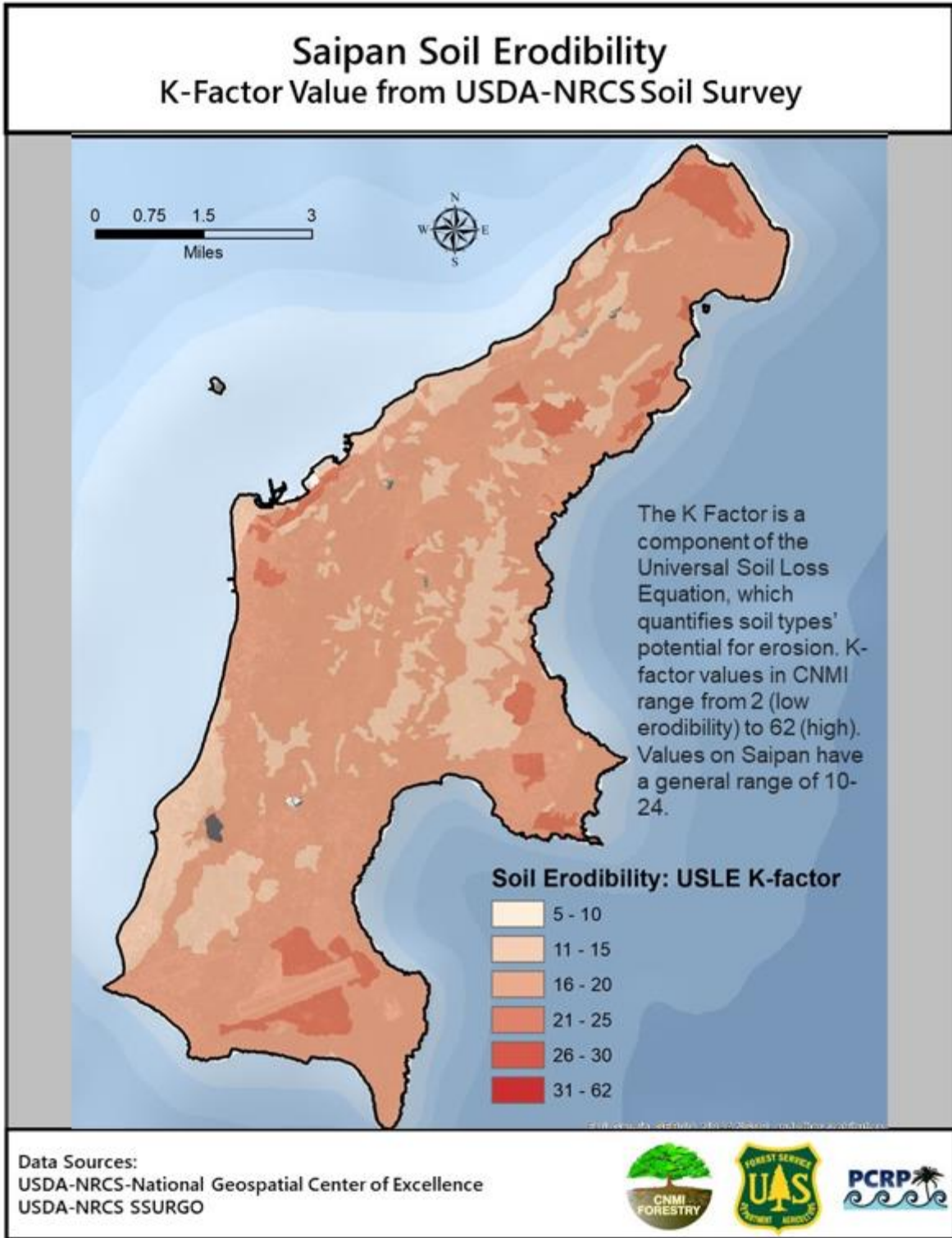
#### *Development pressures on CNMI forests*

The rapid growth and expansion of development left little time to consider proper vegetative planning, beautification or protection of our islands' ecosystem. Most available land in the CNMI is located in an undeveloped area covered with limestone forest, ranging from the far southern to the northern coastline. Now, public lands are being divided for homestead lots as well as for governmental or commercial function. These actions resulted in fewer indigenous trees for wildlife habitat and a constant depletion of our natural resources. Natural disasters such as typhoons and floods are a recurring nightmare as

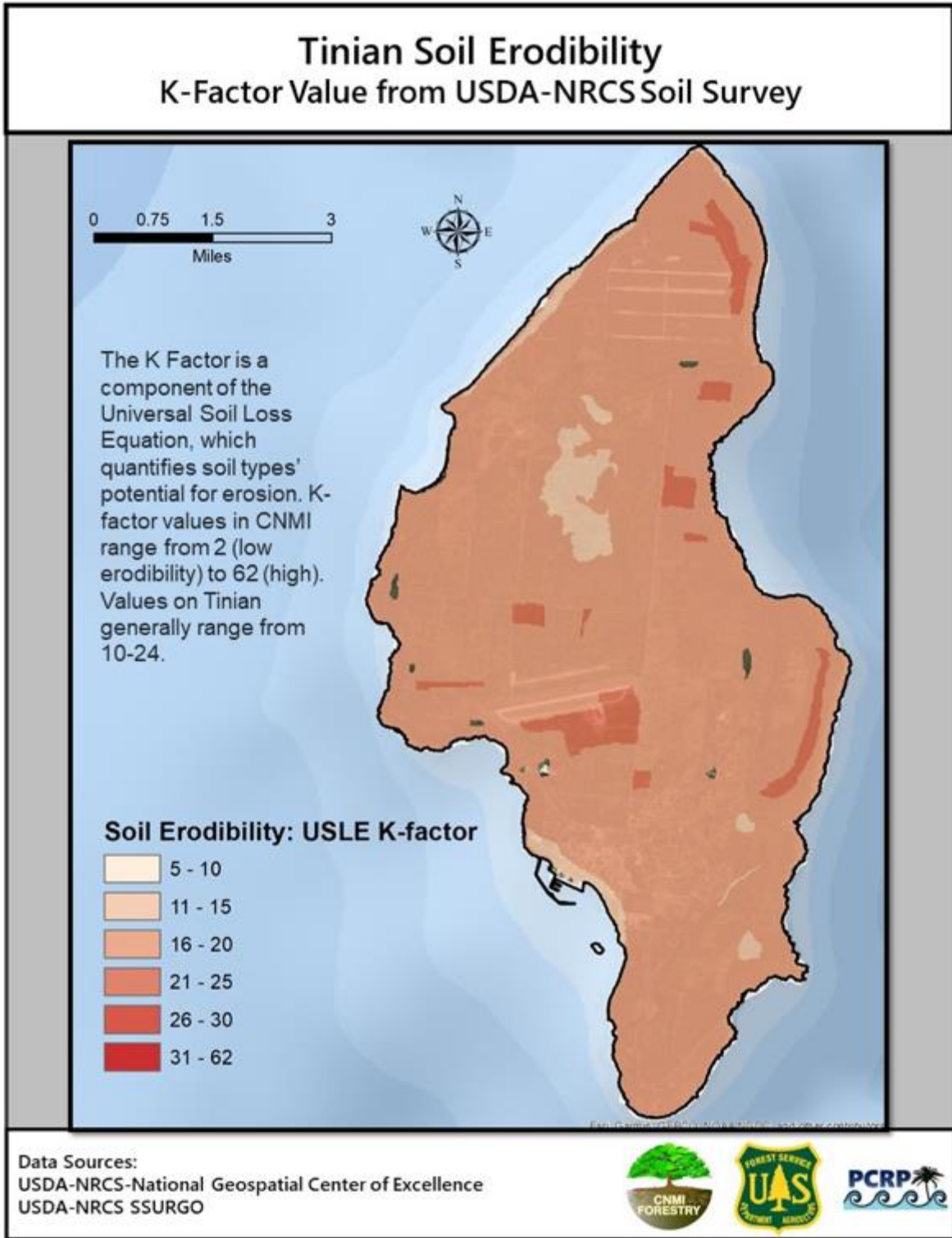
elsewhere in the Pacific. With the increase of developed environment, the native vegetation has been opened, allowing disasters to rip away valuable resources such as soil on erodible areas and vegetation on urban forest. In part, by the break of the urban forest, an increasing damage to homes and farms is inevitable. As for the CNMI economic, tourism remains a major and consistent industry second by small entrepreneurs, exporting agricultural goods and livestock. However, with the recent marketing strategy, a more powerful development will soon be a reality. These investors will be developing high casino and gambling arenas, followed by complementary businesses. These developments increase the demands for expansion on land use development.

*Soil erosion*

Soil erosion is affecting many local food sources. Not only is the loss of valuable topsoil decreasing agricultural productivity, but ocean resources are affected as reef and lagoon areas are silted in. Erosion of topsoil not only affects productivity through loss of nutrients and organic matter, but the rooting zone in an eroded soil is usually denser, has less water holding capacity, and generally can be a more difficult environment for plant growth (Figure 9).







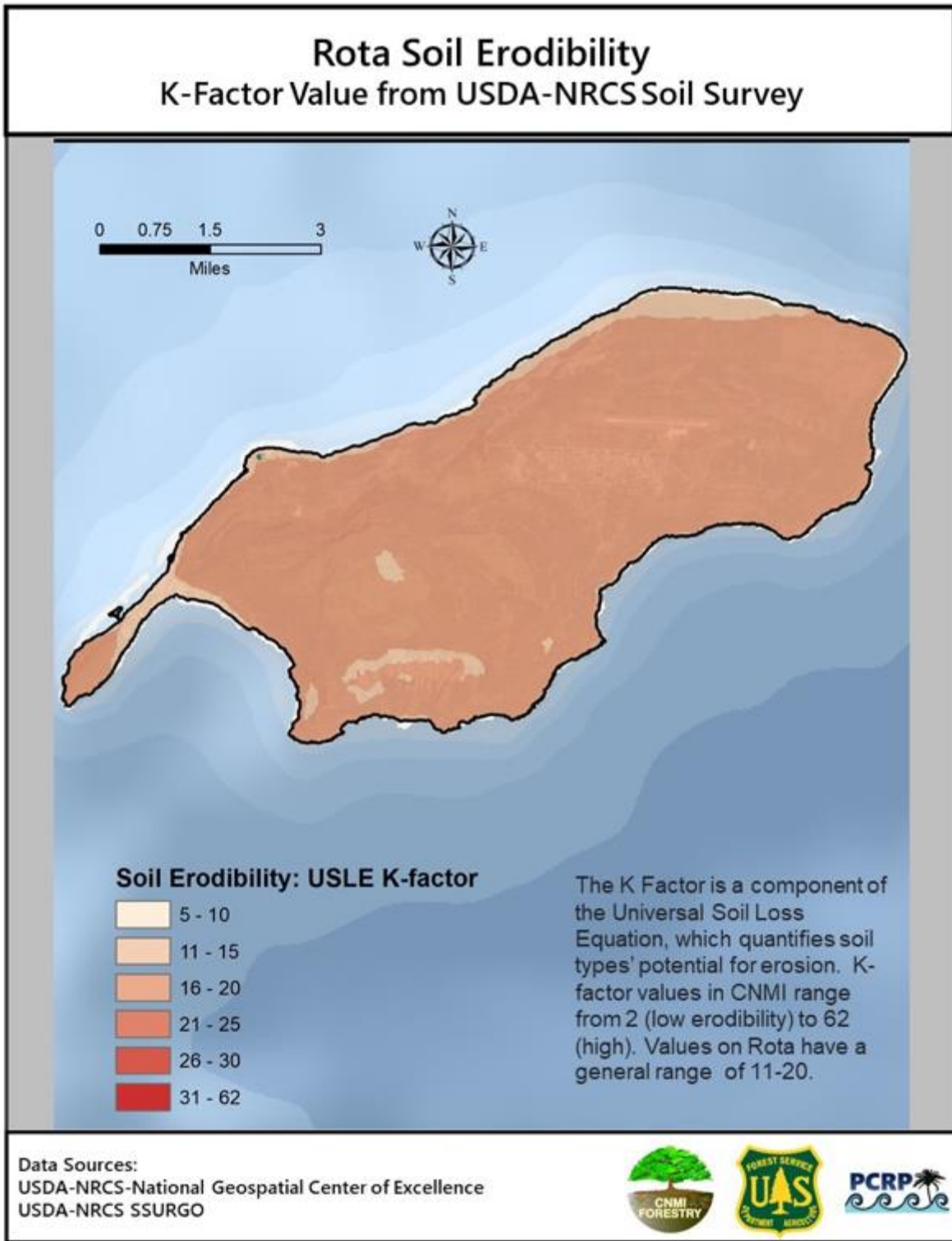


Figure 9: Soil erodibility on Saipan, Tinian, and Rota.

#### Soil and nutrient depletion

Expensive fertilizer and a lack of land management skills also contribute to a reduction in soil productivity. The loss of soil nutrients in some soils is not always replaced with fertilizers or other

sources of important nutrients. The use of leguminous trees for fixing nitrogen, or green manure as a fertilizer, can increase quantities of soil nutrients. Farmers are not aware of the impacts on the soil from the practices they are using. Meanwhile, nutrients lost from the land are harmful to life in the lagoon and on the reef.

#### *Water shortage*

On Saipan, many areas do not have water 24 hours a day. Part of this is the result of an antiquated distribution system, which leaks water at a rate estimated as high as 50%. Over pumping of existing wells and urban development in watersheds also contribute to the problem. Although an abundance of water is available underground, over pumping in an aquifer reduces the localized water supply beyond what can be naturally replaced by rainfall. It also causes salt water to enter the water supply. Urban development in watersheds reduces the surface area that can absorb rainfall to re-supply the underground aquifers.

#### *Flooding*

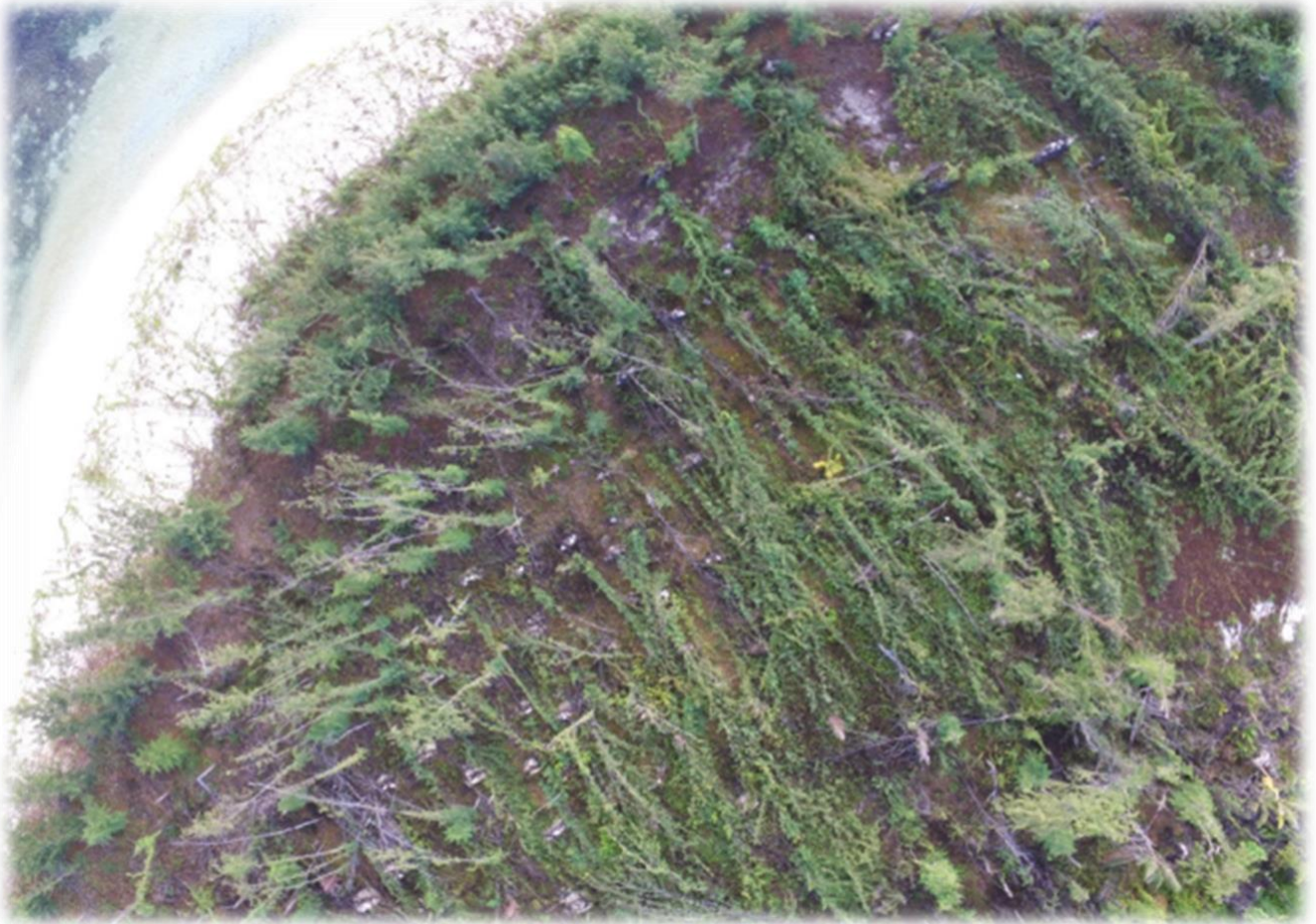
Six populated areas of Saipan are subjected to flooding during heavy rainstorms and typhoons. A number of factors working together causes this, including: developing structures in natural floodplain areas; removal of vegetative cover from the land; improper design of structures that affect water runoff. This problem can be averted by reestablishing forest cover on abandoned lands now covered by grass. Forests absorb more rainfall than does grassland.

### **Climate Change and Extreme Weather Events**

The “Climate Change in the Commonwealth of the Northern Mariana Islands” report under the Pacific Islands Regional Climate Assessment (PIRCA), recently released by the East-West Center (Grecni et al. 2021) summarized the potential threats and challenges that climate change may pose to the CNMI. These are summarized as:

- Average temperatures have risen and are likely to continue to rise.
- Changes in rainfall patterns may cause more extreme drought or flooding events.
- Stronger tropical storms and typhoons are expected globally and around the Mariana Islands, although their frequency in the region may decrease.
- Sea level rise threatens infrastructure, including housing, businesses, and transportation, as well as ecosystems and cultural sites. More frequent and intense coastal flooding and erosion are anticipated as sea level rise accelerates.
- Oceans are warming, causing coral bleaching that is already widespread and severe and may lead to extensive coral loss in the coming decades.

These projected impacts have already affected CNMI forest resources in recent years. Most notably, as described above the CNMI has experienced three tropical cyclones since the previous SWARS that resulted in federal disaster declarations: The Category 4 Typhoon Soudelor in 2015, and the Category 4 Typhoon Mangkhut and Category 5+ “Super Typhoon” Yutu in 2018. Major storm events may damage or destroy trees and tree crops, delay fruiting and flowering, and affect pollinator species.



*Figure 10: Aerial photo of felled secondary forest in American Memorial Park after Typhoon Soudelor (Photo by M. Kottermair 2016, as found in Greene et al. 2019).*

In addition, changes in rainfall patterns leading to longer or more intense dry periods may increase the risk of wildland fires and hinder regrowth efforts. Changes in temperature and rainfall patterns may also increase native tree and crop species' vulnerability to pests and diseases (Greene et al. 2021). The small and highly fragmented remains of native limestone forest are particularly vulnerable to invasive species, and the hydrological features underlying and surrounding Saipan's coastal wetlands and mangroves may be quite sensitive to changes in sea level, salinity, and sedimentation that may be exacerbated by climate change (Greene and Skeele 2014).