

Invasive Species

Under Executive Order 13112 the definition of 'Invasive species' means, with regard to a particular ecosystem, a non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health. Whether introduced deliberately or unintentionally, or through natural means, an invasive species finds itself in a new environment, removed from the restraints of competitive factors and possibly even bolstered by environmental conditions. The result can be devastating to native species, causing severe ecological and economic damage.

In the Mariana Islands, native species are being lost at an alarming rate. CNMI has 102 native species (all major groups of organisms) currently listed as threatened with about 10% of all native animals are categorized as Extinct, Extinct in the Wild, Critically Endangered, Endangered or Vulnerable. The situation for native plants is worse – 15% of both Guam's and the CNMI's plants are in these categories.

The impact of these numbers goes beyond individual species. In isolated island environments there are far fewer species than are found on continents. A 10-15 percent loss of native species, accompanied by invasions of non-native species, is an ecological catastrophe. No longer in equilibrium, native ecosystems are susceptible to being overrun and overwhelmed by invading species, bringing cascading effects.

In the CNMI, as in most island states, there is a strong interdependence between ecosystem services and the local economy. We depend upon our marine and terrestrial ecosystems for wild foods and indigenous medicines. Forests provide materials for outdoor structures, traditional buildings and roofing, woven products and art. We enjoy recreation and find solace in our natural spaces. Our wetlands protect our coral reefs by filtering surface runoff and provide important wildlife habitat. Our well water is filtered through soils that remove impurities and contaminants and our tourism-based economy is directly tied to the appeal of our natural environment to our visitors.

Invasive species have altered the terrestrial habitats of all islands in the Marianas, both significantly and permanently, reducing the value of ecosystem services. Each island has its own combination of invasive species, providing a preview of the potential impacts of specific invasive species on other island ecosystems.

In its *Wildlife Action Plan for the CNMI 2015-2025*, DFW lists plant and non-plant invasives of concern to wildlife across all islands of the CNMI (Table 1). There is also concern about invasive ants, snails and wasps that can have devastating impacts by preying on or parasitizing native invertebrates. Invasive vines and other plants are identified as major threats to island forests and habitat. Scarlet gourd (*Coccinia grandis*), chain-of-love (*Antigonon leptopus*), alalaga/paper rose (*Operculina ventricosa*), bitter vine (*Mikania micranthra*), bitter gourd (*Momordica charantia*) and wood rose (*Merremia tuberosa*) are of particular concern as they are visibly rapidly spreading across many islands. Water hyacinth (*Eichhornia crassipes*), is called out as a threat to wetland habitats. Lantana (*Lantana camara*) is another concern. Recognized world-wide as a noxious weed infesting millions of hectares of land, lantana can be found on all the large islands and now dominates large areas of Aguigan with its dense and thorny thickets.

Table 1: Plant and non-plant invasive species of concern in the CNMI (Source: Liske-Clarke 2015).

“Current Management Plan” key: **P** – prevention/education (not yet here); **E** – eradication (just arrived or just discovered); **S** – small populations; **C** – control (management to contain or reduce but not eliminate; **N** – no management at this time (lack of resources, or too extensive).

Scientific Name Common Name	Common Name English	Common Name Chamorro	Habitat	Current Management Plan
<i>Coccinia grandis</i>	Scarlet gourd / Ivy Gourd	Pipi'non maka	Vine	C
<i>Mikania scandens</i>	Mile a minute	Mala'it	Vine	N
<i>Lantana camara</i>	Lantana	Lantana	Shrub	C
<i>Mucuna pruriens</i>	Sea bean	Akang'kang dan'kulu	Vine	N
<i>Antigonon leptopus</i>	Mexican creeper / Chain of love	Ka'dena	Vine	N
<i>Spathodea campanulata</i>	African tulip	Flores guafi	Tree	C
<i>Mimosa diplotricha</i>	Giant mimosa / wit-a-bit	Subet'biun chosa	Shrub	N
<i>Chromolaena odorata</i>	Bitter bush	Masigsig	Shrub	C
<i>Operculina ventricosa</i>	Paper rose / Wood rose	Ala'lag	Vine	N
<i>Biden pilosa</i>	Beggars tick / Guam daisy	Flores Guahan	Shrub	N

Scientific Name Common Name	Common Name English	Common Name Chamorro	Habitat	Current Management Plan
<i>Oryctes rhinoceros</i>	Coconut Rhino Beetle	Gaga Niyok	Insect	P
<i>Wasmannia auropunctata</i>	Little Fire Ant	Odot aga'ga (Di'kiki)	Insect	P
<i>Eleutherodactylus coqui</i>	Common coqui	Kai'ru	Frog	P
<i>Darna pallivitta</i>	Nettle caterpillar	Ulu gangochi	Caterpillar	N
<i>Solenopsis invicta</i>	Red imported Fire-ant	Odot aga'ga	Insect	N
<i>Puccinia psidii</i>	Eucalyptus rust	Ga'ga Tina'ke	Fungus	N
<i>Quadrastichus erythrinae</i>	Erythrina gall wasp	Sasa'tan Gaogao	Insect	N
<i>Aulacaspis yasumatsui</i>	Asian cycad scale	Ga'ga fading	Insect	C
<i>Veronicella cubensis</i>	Cuban slug	Ta'gula	Slug	C
<i>Phellinus noxious</i>	Black sock / Brown root rot	Chot'nut atbot	Fungus	N

Information more recently collected via Forest Inventory & Analysis (FIA) plots found that 29 invasive plants/trees occurred within the plots; over 90% of the plots had some level of invasive plants/trees and the average % cover by invasive plants/trees was 56% (Table 2).

Table 2: All invasive plant species, occurrence (# and % of subplots present), and average % cover in CNMI FIA invasive subplots.

Scientific Name	# of Subplots Present	% Occurrence	Average % Cover
Leucaena leucocephala	72	58%	41
Mikania micrantha	65	52%	8
Passiflora suberosa	46	37%	4
Lantana camara	36	29%	8
Chromolaena odorata	31	25%	3
Triphasia trifolia	27	22%	14
Centrosema molle	25	20%	12
Coccinia grandis	22	18%	11
Urochloa maxima	21	17%	29
Operculina turpethum var. ventricosa	19	15%	14
Mimosa diplotricha	15	12%	5
Achyranthes aspera	14	11%	3
Bidens alba	14	11%	16
Momordica charantia	14	11%	3
Pennisetum polystachion	7	6%	2
Amaranthus spinosus	5	4%	10
Antigonon leptopus	5	4%	22
Pithecellobium dulce	5	4%	14
Adenanthera pavonina	4	3%	24
Epipremnum pinnatum	4	3%	23
Spathodea campanulata	4	3%	33
Stachytarpheta jamaicensis	4	3%	1
Acacia confusa	3	2%	13
Syngonium angustatum	2	2%	21
Buddleja asiatica	1	1%	5
Euphorbia cyathophora	1	1%	1
Mucuna pruriens	1	1%	10
Thunbergia grandiflora	1	1%	70
Tradescantia spathacea	1	1%	2

The FIA protocol records disturbances (from animals, weather, vegetation, fires, & general human activity) of 1 acre in size or larger, or that affect 25% or more of all trees or 50% or more of a single tree species on each forest condition sampled per plot. Up to three disturbances and three treatments can be recorded per forest condition.

Also recorded on the plots was all types of disturbances including that from animals, weather, vegetation, fires, humans, insects and diseases and disturbance from unknown sources (Table 3). Disturbance by tree diseases was highest in terms of percent forest area followed by that caused by vegetation suppression and livestock. In general disturbances were highest in the lowland tropical forest when compared to those in strand forests and agroforests (also note CNMI forest types are dominated by lowland tropical rainforest =93%) however disturbances caused by humans was highest in agroforests.

Table 3: Estimated area (acres) and % of total forest area affected by disturbance type (CNMI FIA plots).

Disturbance Description	Estimated Area	% of Forest Area
Tree Disease	24125	40%
Vegetation Suppression	15368	26%
Livestock	6700	11%
Human Disturbance	3973	7%
Insect Damage	1847	3%
Crown Fire Damage	1618	3%
Unknown Disturbance	471	1%
Undisturbed	19473	32%

In addition to current invasive species occurrences, observed changes in climate are having far-reaching effects upon ecosystems that favor the spread of invasive species. Changing climatic conditions influence three fundamental elements of invasion mechanisms on land: the source location, the pathway and the destination. While all species are challenged by climate change, invasive species are by nature highly flexible adapters to new and changing environments, which gives them an edge over competing species at source locations and destinations. Climatic changes will create new invasive species pathways because of physical changes to terrestrial and marine environments that allow movement, and the appearance of vectors that aid invasive species movement.

Specific Invasive Species of Concern

As described above, since completing our last Forest Action Plan (previously SWARS) a coconut rhinoceros beetle infestation was detected on Rota in 2017 at the Tweksberry Beach Coconut Grove, a popular tourist attraction adjacent to the west harbor and marina. The CRB larvae were later confirmed to be the same destructive strain of CRB found on Guam – CRB-G. Because of the severity and destructiveness of this pest the Government of the CNMI continues to receive funding from the U.S. Department of Interior, Office of Insular Affairs. They have also received tremendous support – training, supplies & materials, etc. – from partner agencies, including the US Forest Service. Since the original find, CRB has spread to other parts of Rota but has not been detected on other CNMI islands. Eradication efforts are ongoing in hopes of removing the CRB population on Rota and reducing the threat to other islands (Figure 1). The coconut palm resource on Rota will continue to decline and die at increasing rates if the eradication project is not successful.



Figure 1: Destruction of coconut rhinoceros beetle host material on Rota, 2019. (Photo source: James Manglona, CNMI DLNR)

Another of Guam's most devastating invasive species, the Asian cycad scale (*Aulacaspis yasumatsui*), invaded Rota in 2007 and continues to cause cycad decline. Plots were established on Rota to monitor cycad (*Cycas micronesica*) health after the infestation (T. Marler, U of G). Initially the plots contained 10,631 plants per hectare in 2008. This declined to 500 plants per hectare in 2018 indicating about 100 trees dying per hectare per year. An overall plant health index rating completed in 2017 revealed the health of the Rota plant population had reached an all-time low. Known biological control on Rota is the predator *Rhyzobius lophanthae*, but it is not effective on smaller plants thus cycad extirpation is likely without further intervention. All empirical and observational evidence indicates the most urgent need to conserve the Rota cycad populations are to introduce an effective consortium of organisms that can control the scale on all sizes of plants thus enabling successful establishment and growth of young plants.

Current efforts are underway to reduce and/or eradicate the dangerous and harmful impact of an invasive species in the CNMI, the *Macuna pruriens*. It is known worldwide to be widely cultivated for nutritional and medicinal values; however, it is a non-native plant to the Marianas. This invasive species vine was introduced to Saipan in the early 1990s and is now widespread on that island, growing in small patches and are 5 to 10 acres apart.

It is locally known as the Papago vine. In its fruit ripening stage, the vine has loose spicules attached to the seed pods, which causes severe itching, triggering allergies when in contact with the plant. When the

wind speed picks up, the spicules become airborne and can travel long distances. It will penetrate cars, residential homes, warehouses, offices, and outdoor recreational facilities. Its spicules will stick to any surface, including other plants, concrete walls, heavy equipment, and picnic tables.



Figure 2: Mucuna pruriens is a non-native plant to the Marianas.

The public needs to know that physical contact with *Mucuna pruriens* is exceptionally harmful to children and adults, especially those with skin allergies. Anyone who comes in contact with the spicules will experience itching so severe that it renders the individual helpless for at least two hours or more. Persons with chronic skin disorders such as psoriasis or eczema do end up in the hospital when they encounter the

plant's spicules. Most vulnerable are infants, toddlers, senior citizens, and anyone who lives close to an established forest.

The best option for adequate control and eradication of *Macuna pruriens* will be the use of herbicides. Slash and burn technique and uprooting of the vine are not only challenging or harmful to any eradication crew but are not effective prove as it is a stubborn plant and grows back quickly from broken roots left in the ground.

Current Management

Invasive species management in the CNMI is conducted by multiple governmental agencies acting independently according to organizational mandates and objectives. Within DLNR are DFW, DOA, CNMI Forestry, and the brown tree snake (BTS) Program, all of which are involved in invasive species management. Both U.S. Customs and Border Protection and the CNMI Department of Finance Division of Customs Services actively screen arriving passengers for potential invasive species.

CNMI Forestry's Cooperative Forest Health Protection Five-Year Plan 2015-2020 aims to "protect, promote, and maintain indigenous trees, and to educate CNMI's land managers and landowners [on] the value of a healthy forest. The plan was reviewed by the CNMI Forestry 2009 Advisory Council and the DLNR Secretary's representative for Natural Resources.

The BTS Program is focused on the CNMI's highest priority invasive threat and warrants its own program with dedicated staffing and funding. BTS works closely with the US Geological Survey (USGS) Brown Tree Snake Project to prevent the establishment of the brown tree snake in the CNMI. The BTS Program maintains snake traps at high-risk entry points, inspects arriving air and sea cargo, and conducts rapid-response searches for sighted snakes within the CNMI.

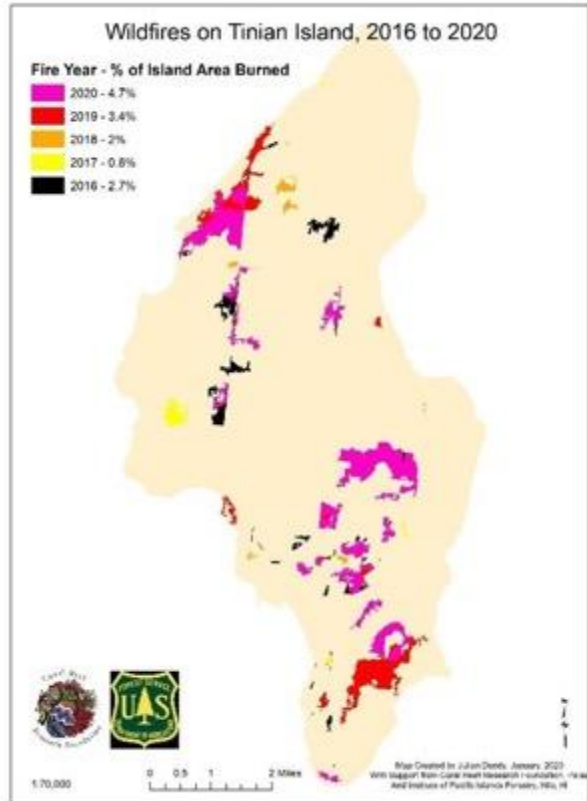
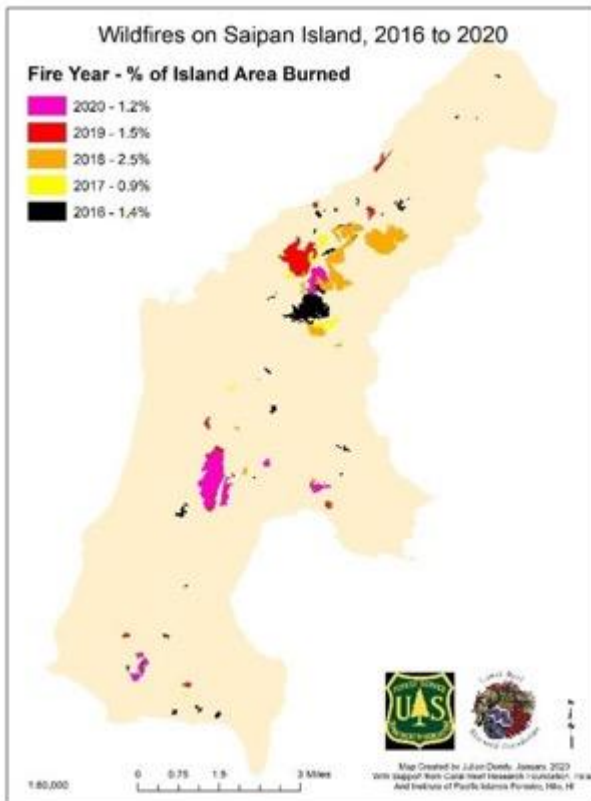
DFW addresses the impact of invasive species on marine and terrestrial species and their habitats in the Wildlife Action Plan for the CNMI 2015-2025. The plan, which was developed with broad community input and reviewed by the U.S. Fish and Wildlife Service, provides specific strategies and goals to manage invasive plants and animals that threaten species of greatest conservation need.

Wildfire

Wildfires are a reoccurring problem within the CNMI that pose a threat to both wildlife and people. Fire can burn habitat for the various species of the island, strip vegetation that holds soil facilitating erosion and damage private property while endangering people's lives. Almost all wildfires in the CNMI stem from human activities such as unattended fires, trash burning, cigarette littering or the intentional burning from hunters. Because of these events native habitat is lost, natural patterns of succession are broken and erosion is increased. Socially, homeowners face a greater risk of disruption due to the lack of defensible spaces around buildings, inadequate water supply system, lack of rural road access for emergency services. Management of fires will work to reduce the number and scale of wildfires through education, research and response preparation.

Table 4: The Number of fires By Island and Year (CNMI State Wildland Fire Plan 2014-2019)

Jurisdiction	Year	Number of Fires	Percent of Island Area Burned
Saipan	2016	41	1.4
Saipan	2017	10	0.9
Saipan	2018	14	2.5
Saipan	2019	10	1.5
Saipan	2020	8	1.2
Rota	2016	120	5.6
Rota	2017	6	0.3
Rota	2018	35	1.3
Rota	2019	60	8.1
Rota	2020	19	1.5
Tinian	2016	47	2.7
Tinian	2017	10	0.8
Tinian	2018	41	2
Tinian	2019	11	3.4
Tinian	2020	28	4.7



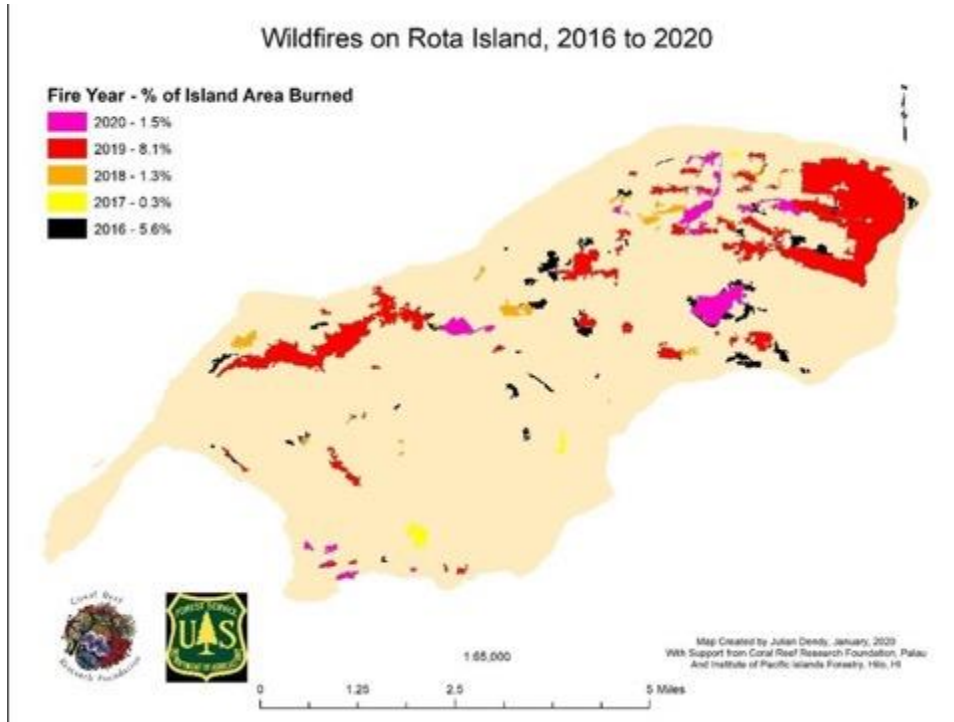


Figure 3: Wildfire prevalence on the islands of Saipan, Tinian, and Rota from 2016-2020 (Julian Dendy)

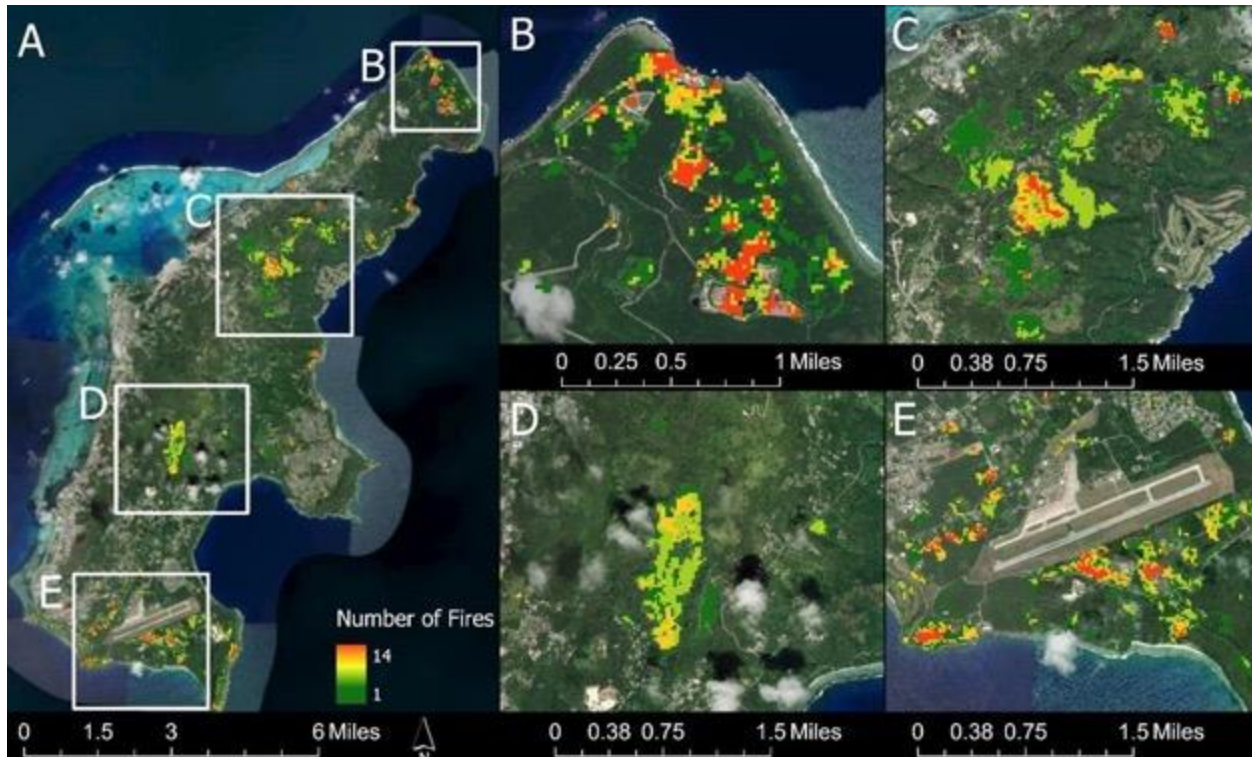


Figure 4: Fires identified on Saipan with pixel color indicating the total number times pixel was identified as burnt from 2013-2020. (A) Fires identified in Marpi (B) Wireless Ridge (C) Mt. Tapochau (D) and Naftan (E). (Bubb and Williams 2020, submitted for publication).

Causes

Fire is most likely not a natural part of the ecosystem in the CNMI. Core samples taken in the Susupe Wetland Complex indicate that charcoal particles were not present until 4860 years ago indicating that prior to human colonization there were no/very few natural fires on Saipan (Athens and Ward 2005). As such it is thought that the vast majority of fires that occur on the islands are now a direct result of human actions. Interagency discussions and unpublished data suggest that unattended cookouts, trash burning, cigarette littering and intentional burning by hunting are the dominate causes of wildfire island wide. The commonality of fires near public spaces including parks, parking lots, palapalas and picnic areas are evidence of the source (DCRM Watershed Website). Furthermore, the intentional fires set by hunters are done to clear vast amounts of grass temporarily, allowing for new shoots to grow. This fresh vegetation is a favorite food for deer allowing for easy take by local hunters. This practice is a common source of wildfire within the grasslands surrounding Wireless Ridge and on the southern slope of Mt. Tapachao (2010 FAP). These grassland areas are largely dominated by native sword grass, *Miscanthus floridulus*.

Wildfire Ecology

Fire has adverse effects on the land by exposing bare soil to the effects of water erosion. Soil aggregates can be easily detached and moved by flowing rainwater after the vegetation has been stripped by fire. The steep slopes present on the islands aids in erosion by allowing water to build speed as it runs downward to the ocean. Erosion reduces soil fertility as it primarily impacts the topsoil that contains the majority of nutrients used by vegetation. Additionally, erosion impacts the coral reefs downslope as the resultant sediment egresses downslope and settles over the coral smothering them and blocking out sunlight (DCRM Watershed Website).

Fires also are thought to break the natural pattern of vegetation succession in the CNMI. New studies (Bubb, unpublished) are showing that grasslands will naturally transition into shrub land and eventually into forests as the grasses are outcompeted by native trees for shade and nutrients. When fire is introduced however it creates a more unstable landscape that only fast growing, hardy vegetation is able to survive. Grasses, with their quick growth and reproduction cycles, are perfectly suited to grow in a frequently disturbed area. Fires usually start in grasslands with the vegetation carrying flames until it reaches the grassland-forest border that acts as a fire break. When the flames reach this edge there is usually not enough vegetation to carry the fire farther, but it is typical for the edges of forests to burn this way. There is mounting evidence suggesting that when these forest edges are burned, grasses readily replace the more fire-resistant trees that were formally there. Over time repeat burns will then result in ever expanding grasslands and degrading forests. In the bigger grasslands such as on Wireless Ridge and Mt. Tapochau, many of the individual grasslands are separated by thin boundaries of forests. As these forests are burned away connections between the grasslands might form allowing for bigger and more expansive fires that were previously impossible due to the forest breaks (Bubb, unpublished). As such fires result in a cycle that reduces the amount of new forests and replaces them with expanding grasslands. Promoting the natural pattern of succession will result in fire suppression as reducing the dominance of grasses removes a vector for fire to spread and larger woody trees have a lower potential to ignite.

Recent field and remote sensing work have elucidated fires patterns on the lower three islands. Fire vulnerability modeling has shown that fires occur in grasslands at a much higher rate than other ecosystems. Remote sensing studies quantifying the number of acres burnt per year indicate that fires are occurring more often and at larger spatial scales. Seasons with more fire correlate to seasons that had overall less precipitation and more days between precipitation events. This suggest that small periodic

rainfall during the dry season is a major source of wildfire suppression. As droughts become more common due to climate change it is reasonable to assume that fires will also become larger and more expansive.

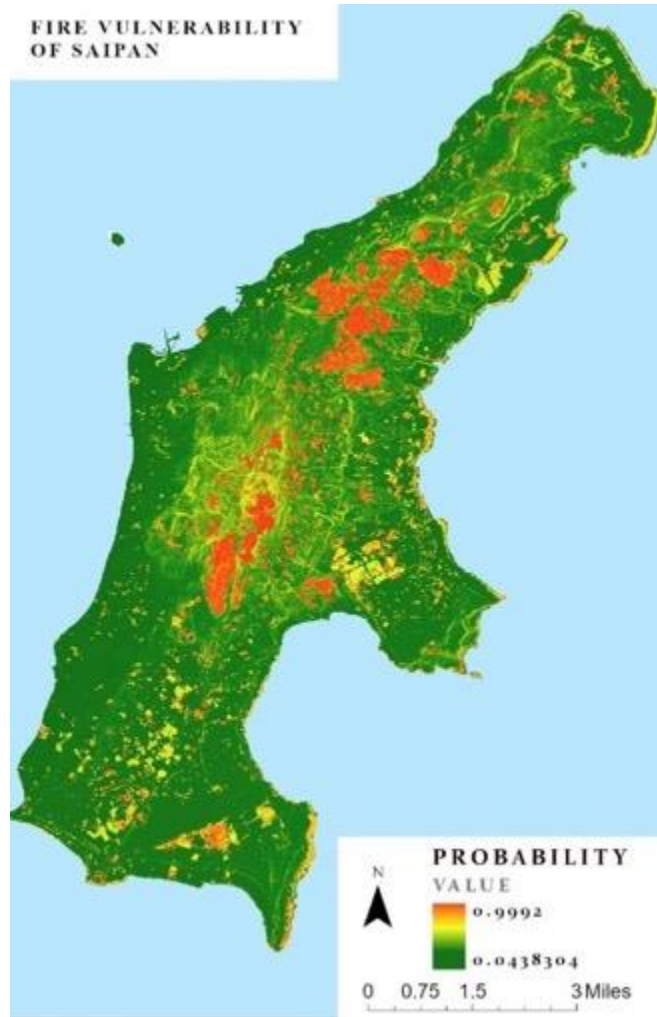


Figure 5: Fire vulnerability probability on Saipan. (Bubb, unpublished). Methodology for developing this map can be found at: https://dcrm.gov.mp/wp-content/uploads/crm/fire_writeup-1.pdf.

Current Management

Management is handled through multiple different agencies. DFEMS and CNMI Forestry have the responsibility for preventing and suppressing fires within the CNMI. DFEMS is tasked in managing federal grants addressing wildland fire risk. Under these grants forestry-fire programs are tasked to develop and implement an effective fire information, education and prevention for outreach into the general public, to implement fire protection and suppression activities, and to establish a fire incident reporting system (2006 Fire Grant Proposal). The Cooperative Fire Assistance Plan of 2006 was the initial plan drafted to enable the funding continuation. However, these documents are working documents, thus updates and further improvements will be incorporated for all available federal financial assistance under the State Fire Assistance Grant Program. The Forestry Section cooperates by participating in revegetation efforts and promoting fire prevention while providing technical assistance for forest restoration. BECQ manages watersheds and participates in revegetation efforts both of which

facilitate wildfire suppression. Federal financial assistance has been availed by the USFS to support the CNMI under the National Fire Capacity program, formerly known as the State Fire Assistance Program.

Under these different agencies, management takes two distinct forms. Short term management is the primary responsibility of DFEMS who are the first responders to control and put out wildfires that threaten people and property. Often though, due to the limited equipment, work force available, and the lack of road access to remote areas, wildfires are often left to burn. Long term management is evident in various management plans including the Watershed Management Plans under the Bureau of Environmental and Coastal Quality (BECQ). These plans call for revegetation of grasslands, the implementation of Best Management Practices and long-term education and outreach programs. BECQ's recent campaign 'Real Hunters Don't Burn' has been successful at reducing the spread of wildfires on Rota.

Revegetation of grasslands and badlands has been a component of CNMI Forestry's strategy in combating wildfires on Saipan and BECQ's strategy in Rota. Grasslands, as explained above, are areas that are dominated by grass and other perennials that are highly vulnerable to fire. Badlands are areas that due to soil chemistry and repeated burning are slow to become vegetated naturally and are especially prone to erosion due to lack of soil holding vegetation. Both the Talakhaya and Laolao watershed have undergone extensive revegetation efforts curbing the number of fires that have occurred in the area. Species selected for afforestation are fast growing and fire resistant and have the ability to grow deep roots preventing erosion. They can also provide additional benefits such as wildlife habitat or attractive flowers to improve scenery and honey production.

Existing Plans Related to Forest Resources in CNMI

Wildlife Action Plan for the CNMI 2015-2025

In order to be eligible for State and Tribal Wildlife Grants (SWG) through the USFWS, the CNMI DFW is required to review and revise the CNMI Wildlife Action Plan every ten years. The latest Wildlife Action Plan (Liske-Clarke 2015) was completed in 2015 and outlines species-specific ten-year objectives, including research and monitoring needs. Most of the strategies and objectives in the current WAP will complement activities implemented under this Forest Action Plan but are not directly related. One exception to this is the Strategies listed under “Invasive Species Prevention” (p. 7-1), including:

- Develop and implement a comprehensive biosecurity program...focusing on other invasive species present on Guam but not yet in the CNMI, such as little fire ant and coconut rhinoceros beetle.*
- Develop new regulations and enforce biosecurity measures for all expeditions to the northern islands.
- Educate boat owners about specific invasive species that could be spread among islands, and measures to take to prevent spread.
- Establish an invasive vine management program on Saipan to conserve ecological structure and function of important forest areas for SGCN.
- Develop protocols and capacity for early detection/rapid response to new invasive species arrivals.
- Develop program to allow for perpetration of nightingale reed-warbler in Kagman/other agricultural plot and by providing corridors and island of useable habitat within farm plots
- Improve habitat wetland metlars (moorhen) and swiftlet caves areas to assist in maintaining high quality habitat for these federally listed species.
- Rota Sabana - revegetate islands of fruit trees for bat foraging.

*It should be noted that the strategies under this WAP were developed in 2015, before the discovery of the coconut rhinoceros beetle on Rota in 2017. The CRB Action Plan is discussed in more detail below.

The Wildlife Action Plan also includes a call for increased inter-agency collaboration with the goal to “Enhance the capability of CNMI conservation agencies and organization to coordinate on proactive conservation efforts” (p. 7-4).

The full document can be access through USFWS website at:

<https://www.fws.gov/pacific/images/feature/2017/highlights/CNMI%20SWAP%202015%20FINAL%20secured.pdf>

Watershed Management Plans: Garapan, Laolao, Achugao, Talakhaya

The CNMI has four priority watersheds: Garapan, Laolao, and Achugao on the island of Saipan, and Talakhaya on Rota (Figure 6).

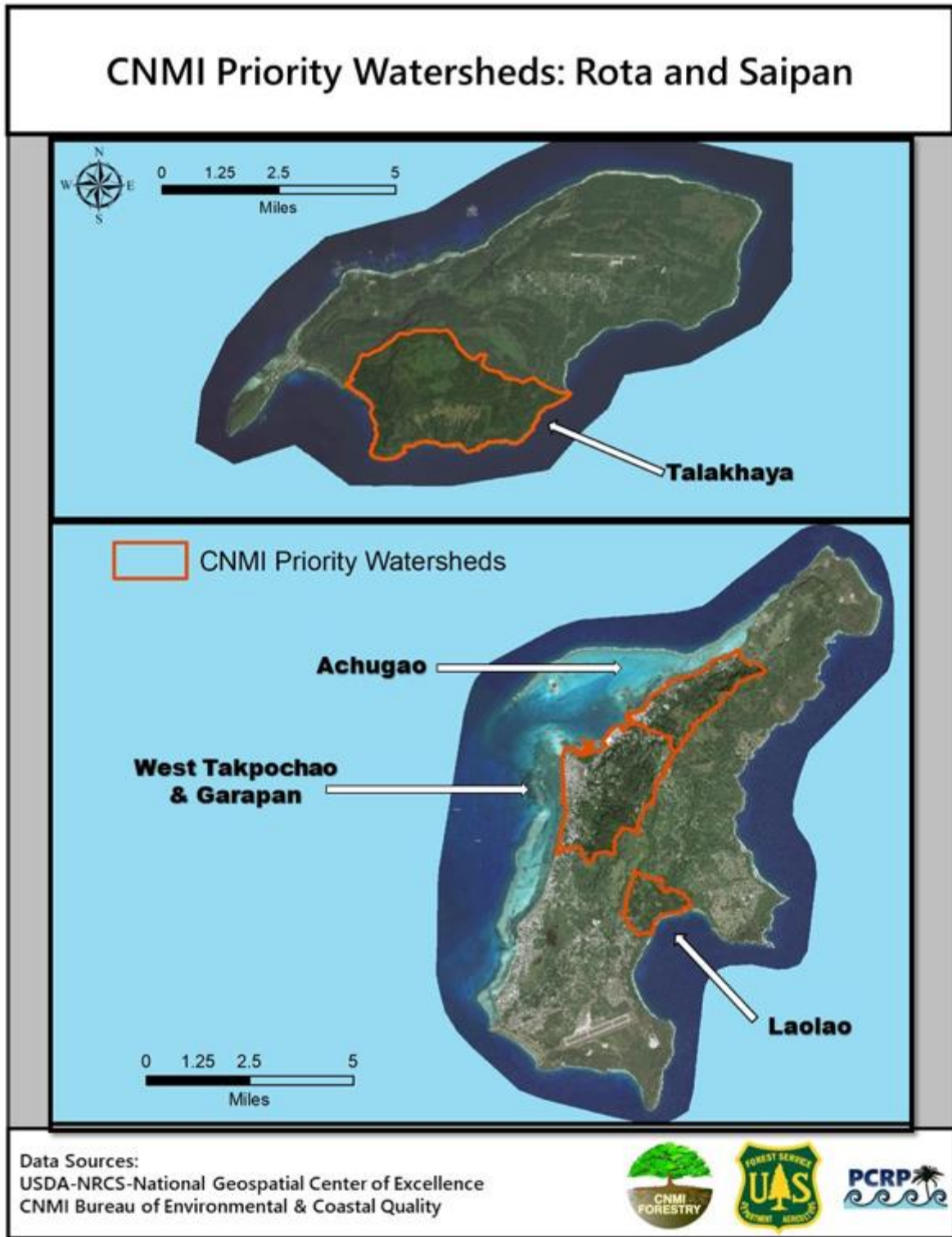
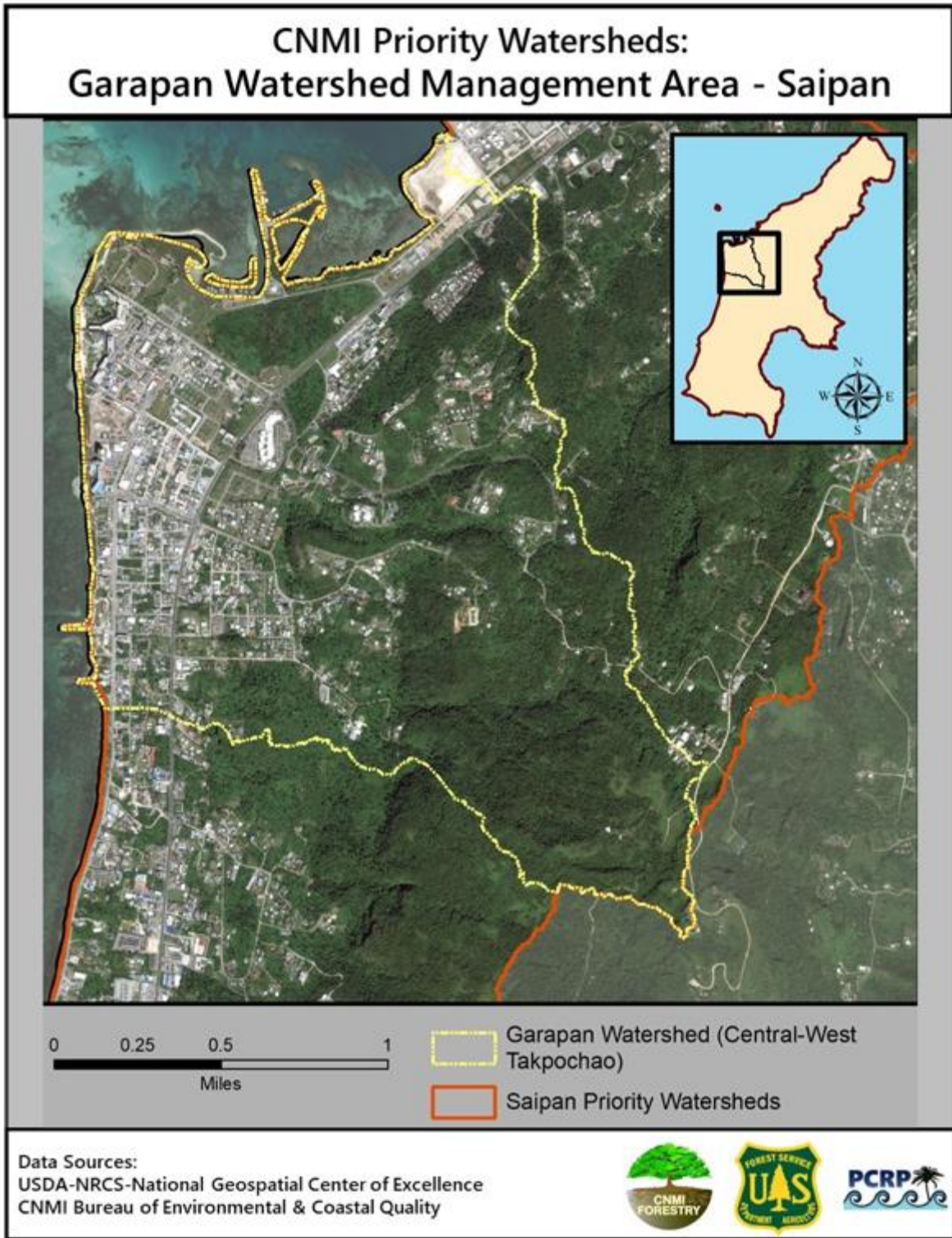
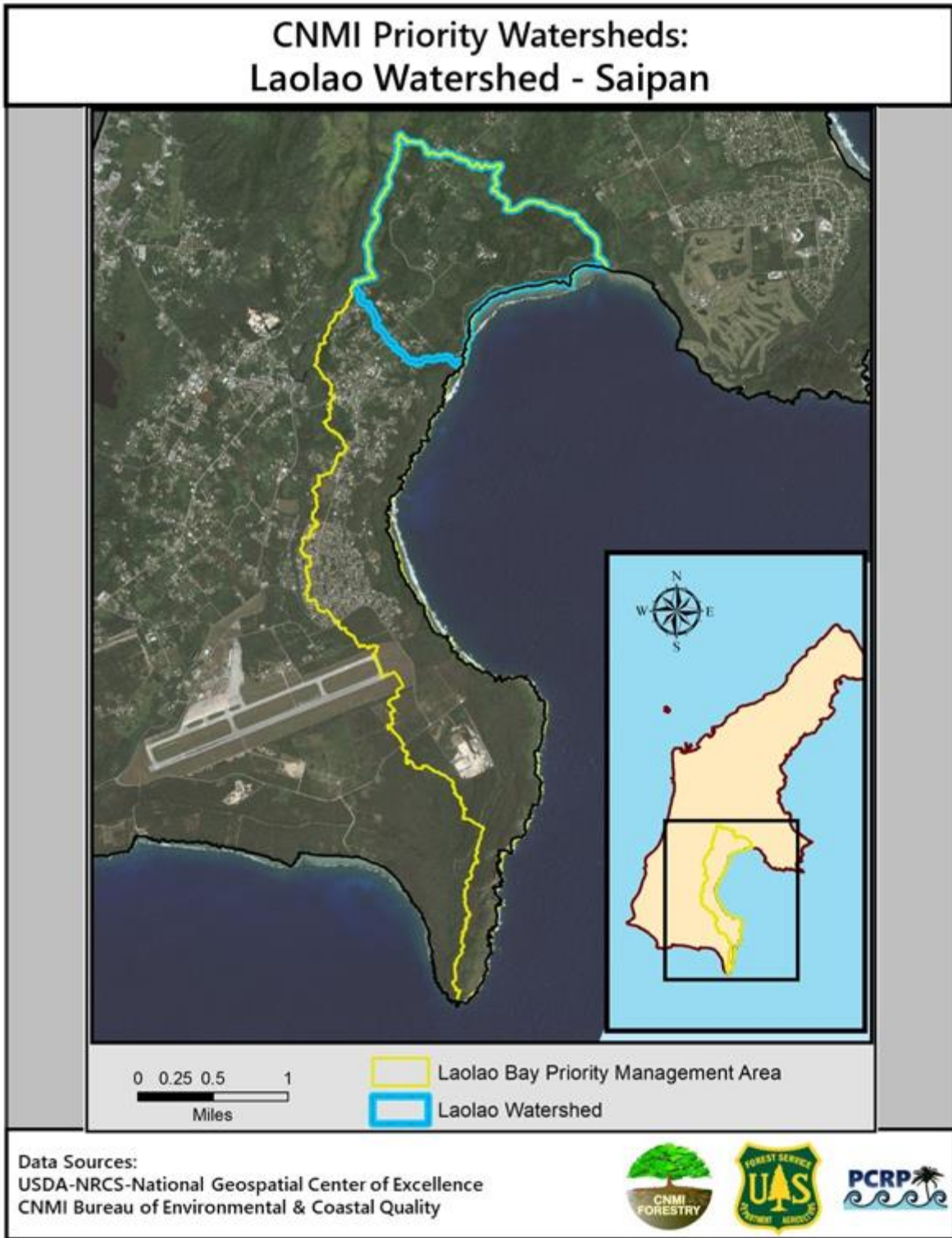


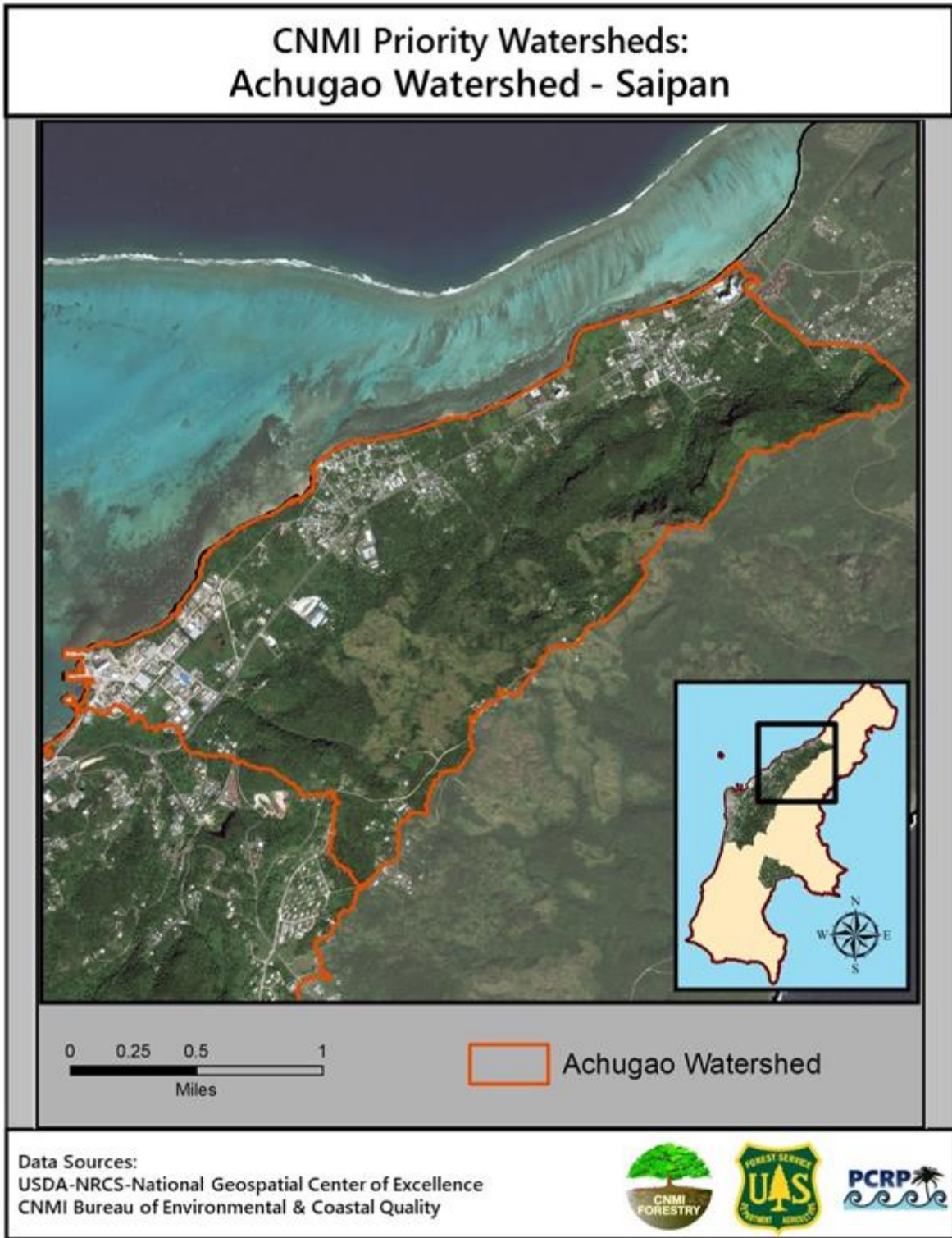
Figure 6: Priority watersheds in the CNMI.

Garapan, Laolao, and Talakhaya each have existing Conservation Action Plans (CAPs) that were developed and have been periodically updated over the last ten years. Achugao is a new priority watershed and therefore does not have an existing CAP. The BECQ Division of Coastal Resources

Management (DCRM), through funding from National Oceanic and Atmospheric Administration (NOAA) Coral Reef Conservation Program (CRCP) and assistance from The Nature Conservancy (TNC), is currently going through the process of developing comprehensive Watershed Management Plans (WMPs) following Environmental Protection Agency guidance for each of these four watersheds.







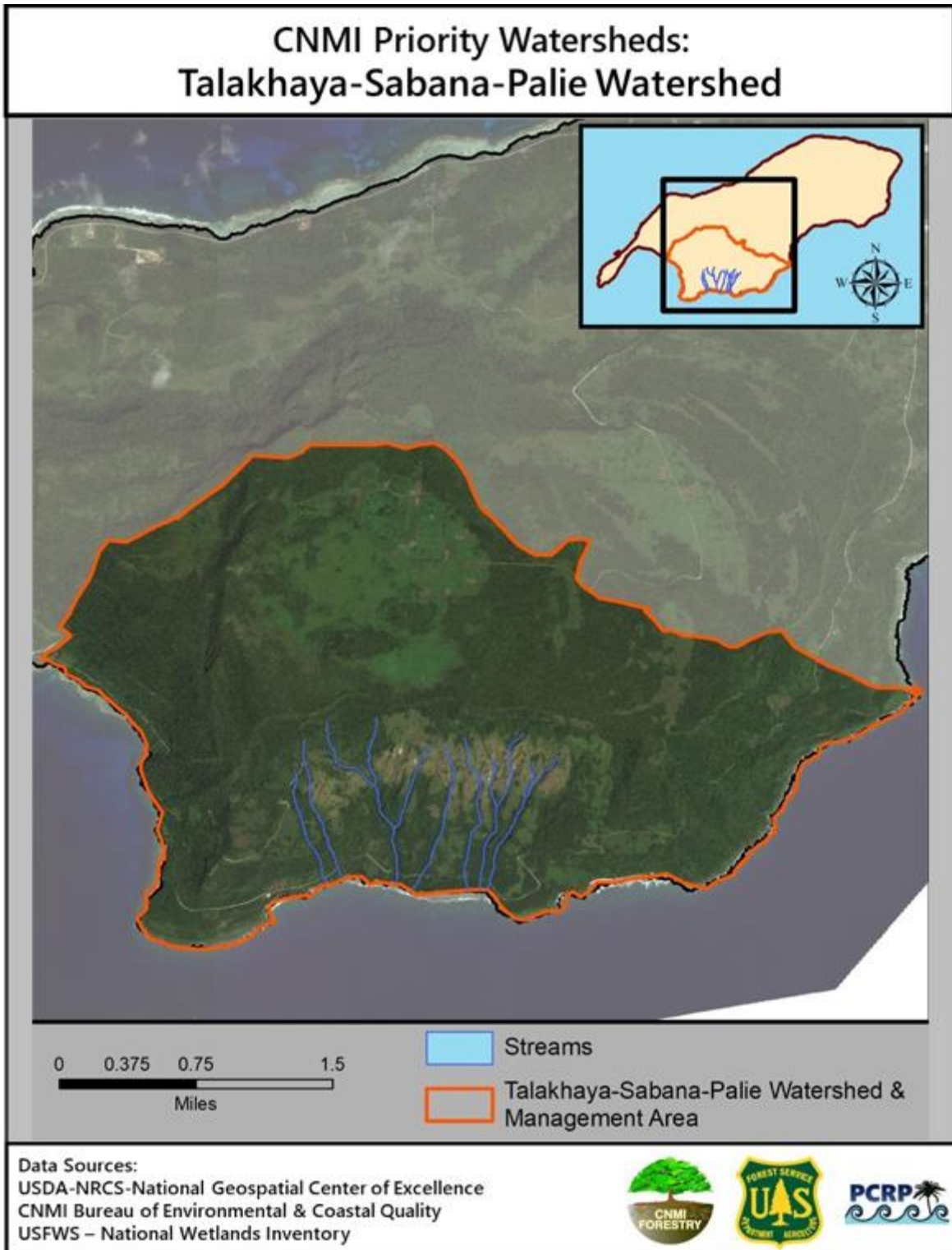


Figure 7: CNMI Priority watersheds (clockwise from upper left): Garapan/West Takpochao; Laolao; Achugao; and Talakhaya.

The final drafts of the Talakhaya and Garapan WMPs have been completed and submitted for approval by government authorities; Laolao and Achugao WMPs are still in development and are expected to be completed by the end of 2021. Once these WMPs are finalized and approved they will be available on the

BECQ-DCRM watershed management website <https://dcrm.gov.mp/our-programs/water-quality-and-watershed-management/>

Forest Health Plan

Forestry's vision with the CFHP is to have a thriving healthy sustainable island ecosystem for the well-being of its citizens and visitors. With such healthy ecosystem, comes the promotion and regeneration of native plant species, supporting a balanced synergy amongst all living organism while sustaining its multi-cultural value. For more information, please see the full strategy laid out in Appendix A.

Most of the discovered and recorded forest health issues are invasive weeds that out-compete forest plants species throughout the Marianas archipelagos and the more recent infestation by CRB on Rota. Invasive weeds have found means to adapt at an alarming rate thus capable to multiplying with minimal limitation due to the absence of its natural enemies. Disturbed areas become vulnerable at most places, whereas the removal of tree canopies allows other faster weed species to overcome.

Another issue is the introduction of exotic species for landscaping or agricultural purposes. These introduced species vary from a shrubby plant to climbing vines, brought by island residents or reoccurring visitors. Although interjected by our Quarantine inspectors, such plant species were not listed in the database to be noxious or threat to the island's ecosystem, thus were released and tagged as agricultural goods. This deficiency opens the ability for many plant species to be introduced from neighboring countries without difficulties.

Strategies:

1. Building and maintaining capacity:
 - a. Strengthen national and regional level by establishing good communication, participation and action towards dealing with non-native invasive species.
 - b. Maintain and be informed with current events and application of approved scientific approach towards dealing with invasive pest or pest of concerns.
 - c. Designed and Establish a Rapid Response Mechanism when detection of invasive non-native species are present or as soon as they appear.
 - d. Design or build educational and informational programs on a local and community level.
 - e. Use appropriate projects that relates to the control of invasive pests with high priority or visibility, as model of scientific base practice.
 - f. Support the establishment of an entomologist or pathologist position within the Departmental or collaborating agency level.
 - g. To include all Quarantine and businesses that imports agricultural good following acceptable protocol in the developed Biosecurity Plan.
2. Promote sharing of Information:
 - a. Develop an early warning system that would include notification of new and predicted occurrences of invasive species.
 - b. Establish database of failure and success of different eradication and control methods for invasive species to ensure that all can be learn from the experience.
3. Develop Economic Policies and Tools for addressing problems of Invasive alien Species:
 - a. User pays: make those responsible for the introduction of economically harmful invasive species liable for the costs they impose.

- b. Full social cost pricing: ensure that the prices of goods and services whose production or consumption worsens the damage of invasive reflect their true cost to society.
 - c. Precautionary principle: because of the potentially irreversible and high costs of invasive intrusion, base management and policy on the precautionary principle.
 - d. Protection of the public interest: since the control of harmful invasive species yields benefits that are a public good, it requires public investment in prevention, eradication, control, mitigation and adaptation.
 - e. Subsidiarity: operate policies and management at the lowest level of government that can effectively deal with the problem.
4. Institute a system of Environmental Risk Analysis (if feasible):
 - a. Reviewing the WTO and IPPC risk analysis criteria to implement and ensure compatibility of national law with international criteria.
 - b. Building on work undertaken by the plant and animal protection community to develop a rigorous process of risk analysis in relation to any deliberate introduction of species (not just between countries, but within a country or region as well), including detailed analysis of the balance between benefits and costs.
 - c. Developing criteria to measure and classify impacts of alien species on natural ecosystems, including detailed protocols for assessing the likelihood of invasion in specific habitats or ecosystems.
 - d. Developing tools to factor invasive species into the decision-making processes regarding land use planning and development.
 - e. Investigating ways in which strategic and project-specific EIA can be applied to unintentional introductions.
 5. Build Public Awareness and Engagement:
 - a. Developing public awareness campaigns to support invasive species management, including sharing information and coordinating messages as appropriate to avoid contradiction and maximize efficiency.
 - b. Engaging key stakeholders, communities and neighbors in invasive species solutions by linking invasive species strategies wherever, particularly when integrating and developing programs or other established societal priorities.
 - c. Building the capacity of local communities and groups to implement invasive species management measures where they live.
 - d. Prepare acceptable national Strategies and Plans
 - e. Sharing experience in this strategy with other states and organizations through documentation, staff exchanges, and other means of engagements.

Action Plan for *Oryctes rhinoceros* 2018-2023

As described above, the coconut rhinoceros beetle (*Oryctes rhinoceros*; *CRB*) was detected on Rota in October 2017 at the Tweksberry Beach Coconut Grove, a popular tourist attraction adjacent to the west harbor and marina. In response, CNMI DLNR developed an Action Plan to address this highly invasive species, which includes conducting surveys and eradication treatments, primarily with local and Office of Insular Affairs funding.

The CNMI strategy as laid out in the plan to combat the CRB includes the following strategies (for more information please see the full strategy laid out in Appendix A):

1. **Building and maintaining capacity**, including building local technical capacity, building and maintaining relationships between local and federal resources managers, and acquiring adequate funding to address and contain the CRB infestation.
2. **Promote sharing of information**, specifically linking to federal and international available databases on invasive species, facilitate the sharing of data, and establish an early warning detection system.
3. **Develop Economic Policies and Tools for addressing problems of Invasive alien Species:** Encourages legislature to incorporate economic principles into their national or state strategies for addressing Invasive Species, these should be built on five main principles: user pays; full social cost pricing; precautionary principle; protection of the public interest; and subsidiarity.
4. **Institute a system of Environmental Risk Analysis (if feasible):** Risk analysis measures should be used to identify and evaluate the relevant risks of a proposed activity regarding alien species and determine the appropriate measures that should be adopted. EIA plays an important role in the decisions to undertake specific processes or activities. Decision-makers should ensure the use of strategic and/or project specific EIA in assessing the impact, long-term and short-term, of species introductions.
5. **Build Public Awareness and Engagement**, including the development of a public awareness campaign, engaging key public and private stakeholders, building community capacity, and information sharing with other states and organization.

CNMI State Wildland Fire Plan 2014-2024

As described above, wildfires are a reoccurring problem within the CNMI that pose a threat to both wildlife and people. Almost all wildfires in the CNMI stem from human activities such as unattended fires, trash burning, cigarette littering or the intentional burning from hunters. The CNMI State Wildland Fire Plan for 2014-2024 outlines Objectives and Initiatives that will govern the Cooperative Fire Agreement between CNMI Forestry and the CNMI DFEMS.

In addition, DFEMS intends to identify priority communities to collaborative community wildfire protection plan (CWPP) development.

The Objectives and Initiatives found in the plan are outlined below. The full plan can be accessed at: <https://opd.gov.mp/library/plans/2014-2024-state-wildland-fire-plan-draft/>

The objectives of the state fire assistance in the CNMI:

1. Provide the community with an increased awareness on rural fire protection and safe burning practices.
2. Maintain and improve fire protection effectiveness and efficiency on federal and nonfederal lands.
3. Provide a consistent information and education campaign on an annual basis to homeowners relating to fire prevention.
4. Maintain and update the Commonwealth of the Northern Mariana Islands Fire Prevention Assessment Plan.
5. Enhance communication capabilities with other State Cooperators relating to program needs.
6. Provide homeowner assistance relating to hazard fuel reduction and implementation of defensible spaces around structures.

7. Provide adequate rural fire protection and suppression services to interface and intermix settings.
8. Establish a working relation with the general community such as fanners, ranchers, and outdoor users on the importance of safeguarding our natural resources specifically forested areas.
9. Achieve higher funding benefits that exceed regular funding level earmarked for the Commonwealth of the Northern Mariana Islands (CNMI).

The following are general areas of concern for the Commonwealth of the Northern Mariana Islands State Fire Program:

1. **Reduce losses with respect to Wildland Urban Interface (WUI)**
 - a. Expand public awareness activities regarding hazards and risks associated with unmanaged fuel mitigation practices to homeowners, developers, and outdoor goers.
 - b. Implement an effective management technique, development of strategies, and method when dealing with wildland fire emergencies.
 - c. Increase or enhance training capabilities of wildland fire personnel in areas of WUI settings.
 - d. Update of modern firefighting resources and technology relating to wildland urban interface.
 - e. Establish an effective understanding between urban and rural fire protection services.
 - f. Delineation of jurisdiction of fire agencies involved at fire incidents.
 - g. Emphasis to individual communities of their responsibilities as a citizen in safeguarding our resources and forested areas.
 - h. Work toward the introduction of legislation to enact laws or ordinances at all level of government with respect to conservation and protection of our forest.
2. **Training:** Building professional development and skills, particularly through training opportunities outside of the CNMI in jurisdictions such as California, Florida, and elsewhere.
3. **Vegetation Management:** Creating a healthy forest, reduce fuel accumulation and exposures, and create effective fuel breaks and fire protection measures in high-risk areas.
4. **Firefighting Asset Acquisition:** Continue the acquisition of firefighting equipment and fire apparatus to provide an effective and efficient fire protection and fire suppression services on the islands.
5. **Information and Education:** Conduct presentations relating to fire safety to residents, business establishments, fanners, and outdoor goers, with the goal of developing fire safety awareness among the public.
6. **Cost Effective through Analysis and Planning:** Identifying issues affecting rural and wildland fire protection and suppression programs as well as delineating areas for program improvement and effectiveness

CNMI Invasive Species Strategy and Action Plan

DOA's Invasive Species Strategy and Action Plan (ISSAP) 2015-2020 focuses on pests of Agriculture and includes specific management strategies and a formal action plan. The plan was developed under the direction of the Agricultural Advisory Committee (AAC) that is made up of resource professionals, state and federal agency, program managers, private landowners, and commercial businesses. The plan aims to identify "acceptable practices towards protection, promotion, and sustainability while maintain acceptable

cultural farming and ranching practices, promotion of economic development, and to edify land managers and landowners the value of farming”. The final plan was reviewed by the AAC and by the DLNR Secretary’s representative for Natural Resources. DOA also manages the import of animals into the CNMI including quarantine through its Animal Health and Industry Section.

The plan describes both established invasive species as well as potential pathways of introduction for other invasive species (such as the brown tree snake) that are well established in nearby jurisdictions but have not yet gained traction in the CNMI. The document also describes some ways forward for better management of invasive species, including active management and restoration of native forests. An expanded description of this Strategy and Action Plan can be found in Appendix A.

Strategies (in part from 2017 ISSAP):

- **Coordinate Regional Efforts**, specifically between CNMI, Guam, and Hawaii which all have Invasive Species Councils (ISC) with the same basic objectives, yet have historically acted independently from one another.
- **Be Knowledgeable**: To know which invasive species we should focus on, we need to understand their potential to cause damage, the cost in terms of both time and money to target them, and our potential for success.
- **Be Prepared and Proactive**: Plan and implement defensive actions early and in advance in order to respond to invasive species detections quickly and prevent an invasive species’ ability to establish itself.
- **Plan for long-term invasive species management**: Extending short-term management plans into long-term and permanent management responses.
- **Build Resistance and Resilience**: Foster resistance and resilience in native environments through monitoring and encouraging native biological diversity.
- **Restore and Recover Damaged Forests**: Restore and recover forests where and to the extent possible, and remove or reduce the invasive species within them.
- **Involve the Community**: Educate the public to change behaviors and encourage the prevention and further spread of invasive species and to enlist their help is critical to our success.
- **Limit the U.S. Military’s Environmental Damage in the Marianas**: Work with the US Military to reduce damage to the CNMI environment.

Actions:

- Identify, authorize and enable a lead agency to coordinate regional efforts. The CNMI ISC was formed in 2016. Continue to participate in the Regional Invasive Species Committee (RISC).
- Expand inspection and interception efforts to include all interisland travel in the CNMI
- Create an invasive species database committee under CISC
- Analyze Threats by Individual Invasive Species
- Inventory and survey the Northern Islands
- Establish Working Relationships with Guam and Hawaii
- Coordinate Local Agency/Stakeholder Activities
- Create a Funding Committee
- Create a Community Outreach Program

Forest Inventory Assessment

The forests of Rota, Tinian, and Saipan were systematically inventoried in 2004 and 2015 by the USDA Forest Service Forest Inventory and Analysis Program (FIA).

Fieldwork for this project was primarily conducted by foresters from the CNMI Forestry program with training and program management assistance from FIA foresters, the University of Guam, and the University of Hawaii. The data collected on these long-term research plots can be used to help meet the goals of the Micronesia Challenge.

In 2015, 37 FIA field plots were visited in a variety of forest types. High-resolution satellite imagery also was used to map five broad classes of land cover: forest, nonforest vegetation, urban, barren, and inland water.

CNMI is expanding the frequency and intensity of monitoring plots in identified conservation priority areas to further meet the goals laid out by the Micronesia Challenge Terrestrial Measures Working Group.

Commonwealth of the Northern Mariana Islands 2015 Data Summary

- Forest area: 60,206 acres
- Unreserved forest land: 45,371 acres; protected forest land 13,217 acres; mangrove forests 1,617 acres
- Number of live trees: 83,813,945
- 46 tree species recorded
- Net live tree volume: 32,616,103 cubic feet
- Live tree aboveground biomass: 1,645,957 tons
- Live tree aboveground carbon: 822,978 ton

Critical Forestry Issues Identified by Stakeholders

CNMI Forestry consulted with local experts, stakeholders and partners to identify critical issues related to CNMI's forests. These issues include: sustainability of urban forests, conservation of native flora and fauna, erosion control/protection of coral reefs, conservation of wetlands, and maintaining fresh water quality.



PROTECTION OF CORAL REEFS



CONSERVATION OF WETLANDS



**CONSERVATION OF NATIVE
FLORA AND FAUNA**



Issue 1 – Sustainability of Urban Forests

CNMI's urban forests are comprised of native and non-native species planted and managed around commercial (including restaurants, hotels, entertainment, recreational businesses), residential (single-family and apartments) and public areas (including churches, government services, hospitals, schools, and social halls). The FIA program conducted a systematic inventory of the forests of Rota, Tinian, and Saipan in 2004 and in 2015 and reported that based on 75,407 acres on the three main islands, about twelve percent of the landscape were classified as urban land (Donnegan et al., 2004). Saipan has the largest urban forest area, which makes up 21 percent of total forest area. Majority of urban land in Saipan is concentrated in and around villages in the West Takpochao watershed. West Takpochao watershed, which covers 6.62 square miles (17.14km²), contains the villages of Chalan Laulau, I Liyang, Gualo Rai, As Falipe, Takpochao, Garapan, China Town, Fananganam, Maturana Hill, Chalan Galaide, American Memorial Park, As Palacios, Navy Hill, As Rabagau, Puerto Rico, Lower Base, Sadog Tasi and Capitol Hill. The development within the area is also the heaviest scattered with family compounds, houses, apartment buildings, small farms, businesses, roads and parking infrastructure and major public institutions such as the Northern Marianas Housing Corporation, and the Commonwealth Healthcare Center.

CNMI's urban forested areas not only provide eye-catching aesthetics, they also provide social, ecological, cultural and economic services for residents, visitors, schools and businesses. These benefits including reduced energy costs through shading; improved water quality by removing pollutants; slowed storm runoff and costal stabilization; enhanced wildlife habitat, and increased human health and well-being.

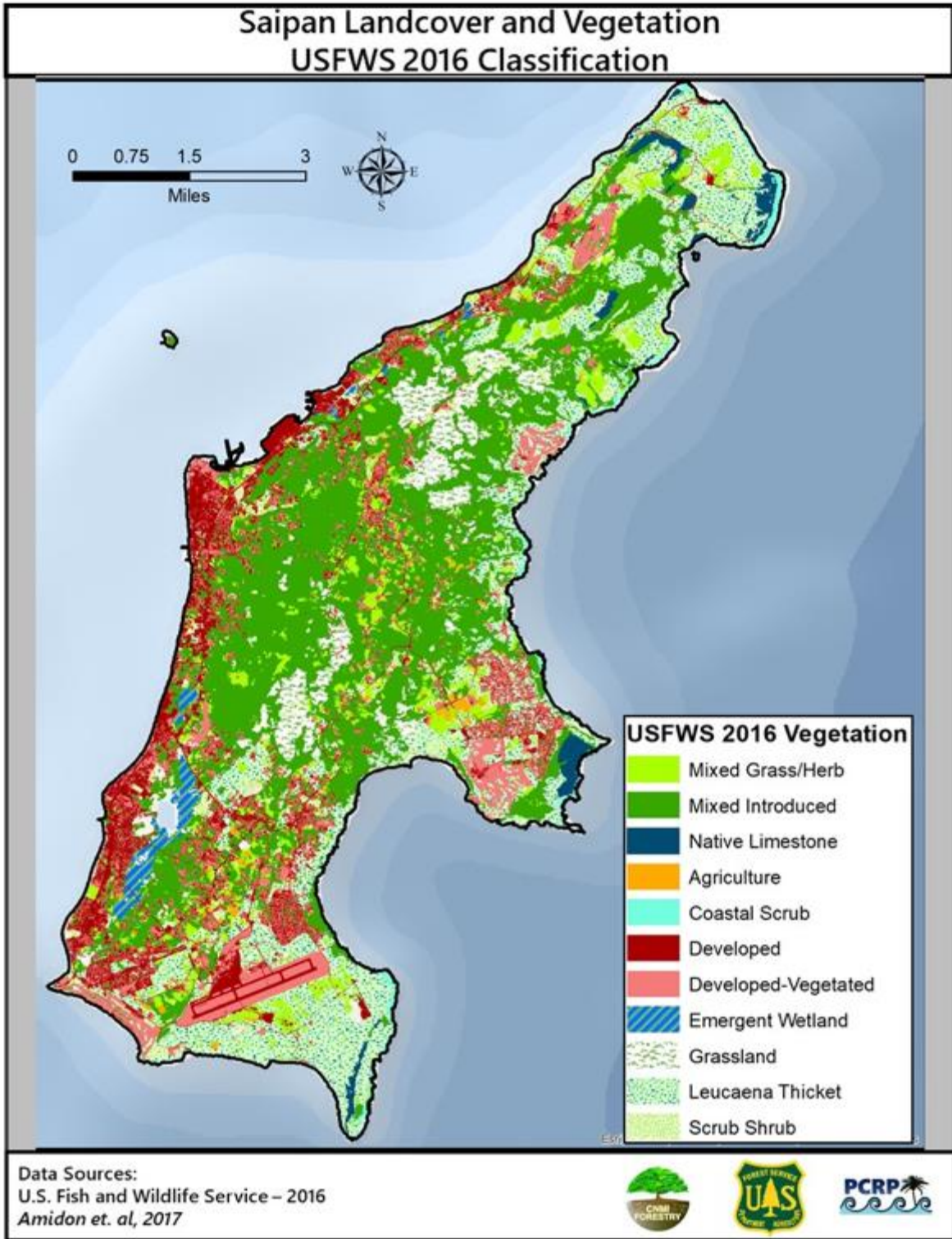
The focus must be to increase urban greenspace while at the same time enhancing public benefits derived from this critical ecosystem service. Engaging the public and educating them about the benefits of urban forests could help improve public understanding of decisions related to the development of green infrastructure and minimize conflicts on the use and functions of urban forests. Increasing knowledge and fostering dialogue empowers local communities, not only in planting trees and fostering greater respect for CNMI's urban forests but in community collaboration, environmental education and public policies that will lead to a more beautiful, healthy and sustainable island.

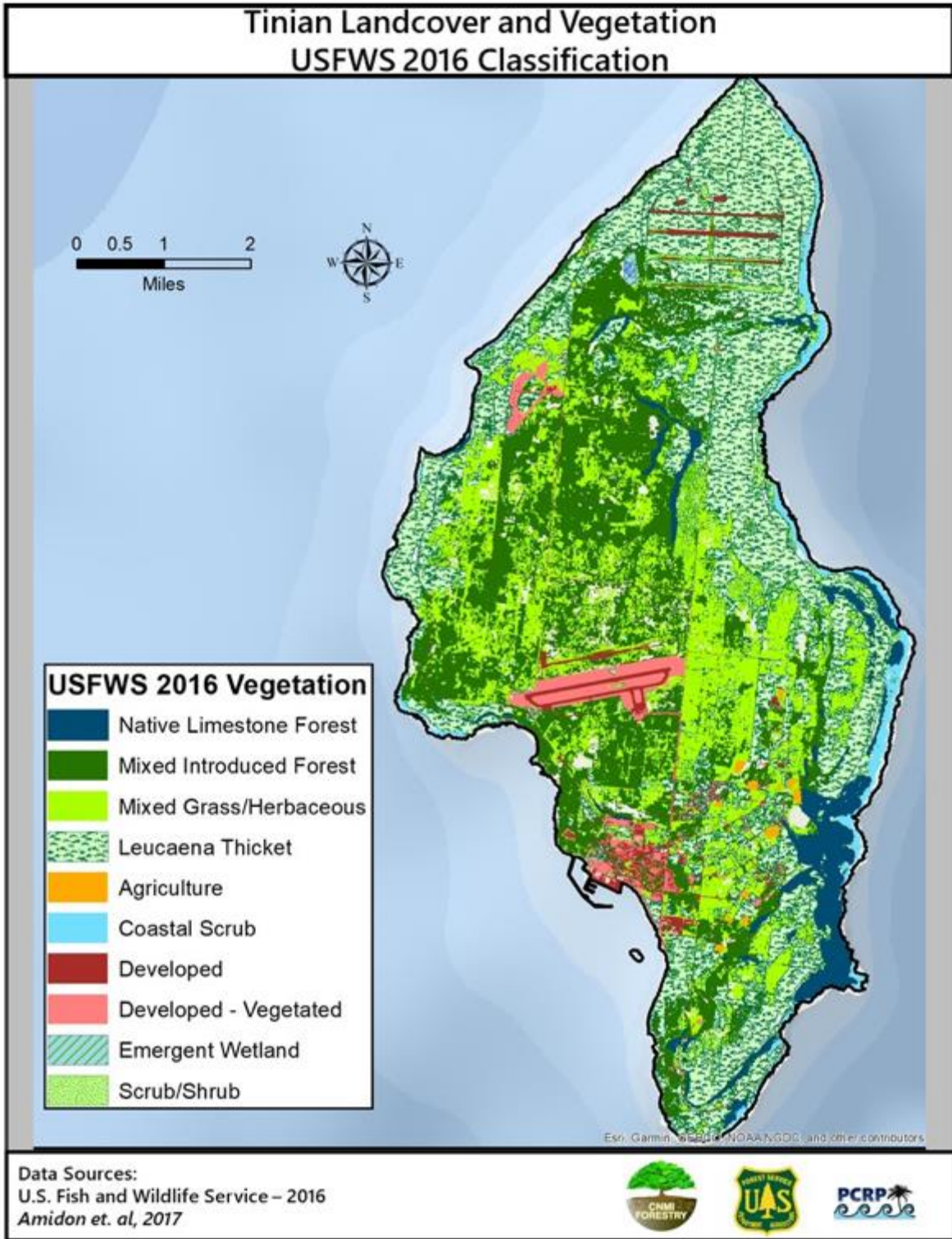
Threats to Urban Forests

The care and management of CNMI's urban forests can be complicated by natural and social factors. As urban expansion continues, such challenges are likely to increase and new ones might emerge. The unprecedented rate of development and increase in population threatens CNMI's urban forests has resulted in urban forest areas being replaced with development projects such as hotels and condominiums. Urban greenspace requirements are not incorporated into any DPL leases, as well as all DEQ, DCRM, and zoning permits and regulations, or Qualifying Certificate requirements. This increase in impervious surfaces due to development make it difficult to promote green infrastructure and protect CNMI's urban forests. CNMI needs to proactively include green infrastructure and trees in the planning phase of project development. Important concerns include providing adequate space for trees, connecting green areas to the flow of water, and designing and maintaining plantings to maximize net benefits over the long term. Plants and mulch imported for the urban landscape can become invasive threats themselves as well as serving as pathways for the introduction of invasive pests and plant pathogens. Education and awareness

on these pests and diseases and tree damages from human and/or natural disturbances is critically needed both from government inspectors and the local public.

According to the publication entitled Catastrophic Storms and the Urban Forests, a storm's impact on the urban forest is a growing threat and its consequences affect our urban forests and all communities. The percentage of population living in coastal areas and the rising number of predicted high-intensity storms and typhoons has created highly vulnerable coastal areas. Planting the right tree in the right place and encouraged shoreline vegetation can help mitigate not only the effects of storm surge, flooding, but also mitigate larger impacts of climate change.





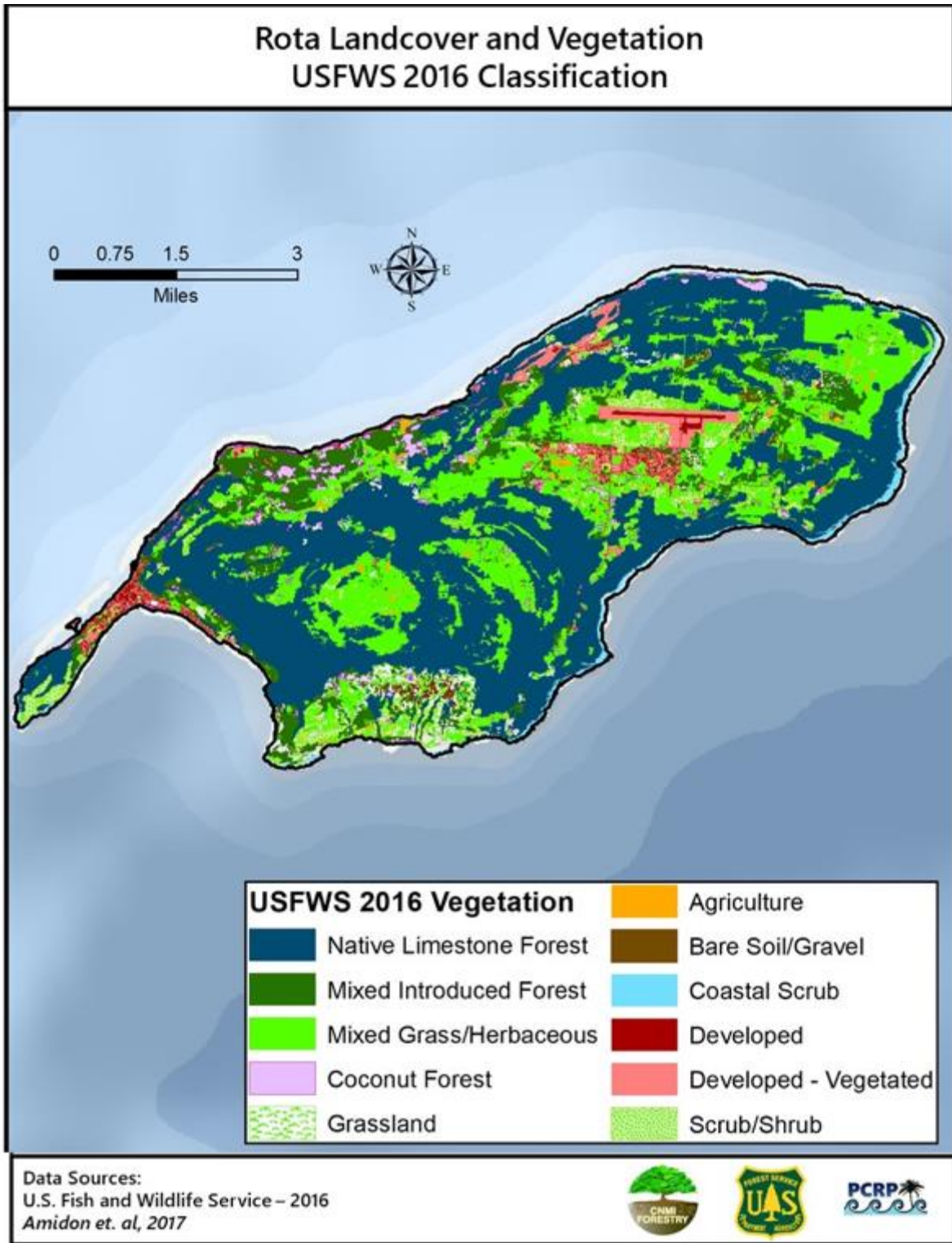


Figure 8: Landcover and vegetation classifications for the islands of Saipan, Tinian, and Rota, as of 2016.

Native Limestone Forest

The following maps highlight the coverage of native limestone forest among Saipan, Tinian, and Rota, and are based on the most recent, comprehensive vegetation mapping effort for the Marianas Archipelago. This effort was led by the U.S. Fish and Wildlife Service, and included a primary objective to improve the delineation of native dominated forest. While other land cover maps have been previously developed for the Marianas, they have either aggregated distinct vegetation types into a single classification, such as “Evergreen Forest” to describe all forest types (NOAA 2016) or, if they are detailed, have not been completed for all islands or been updated within the last ten years (USFS, Liu and Fischer 2006). A breakdown of the USFWS land cover classes (23 in total), source data, remote-sensing, and field assessment methodology is detailed in Amidon, et. al 2017.

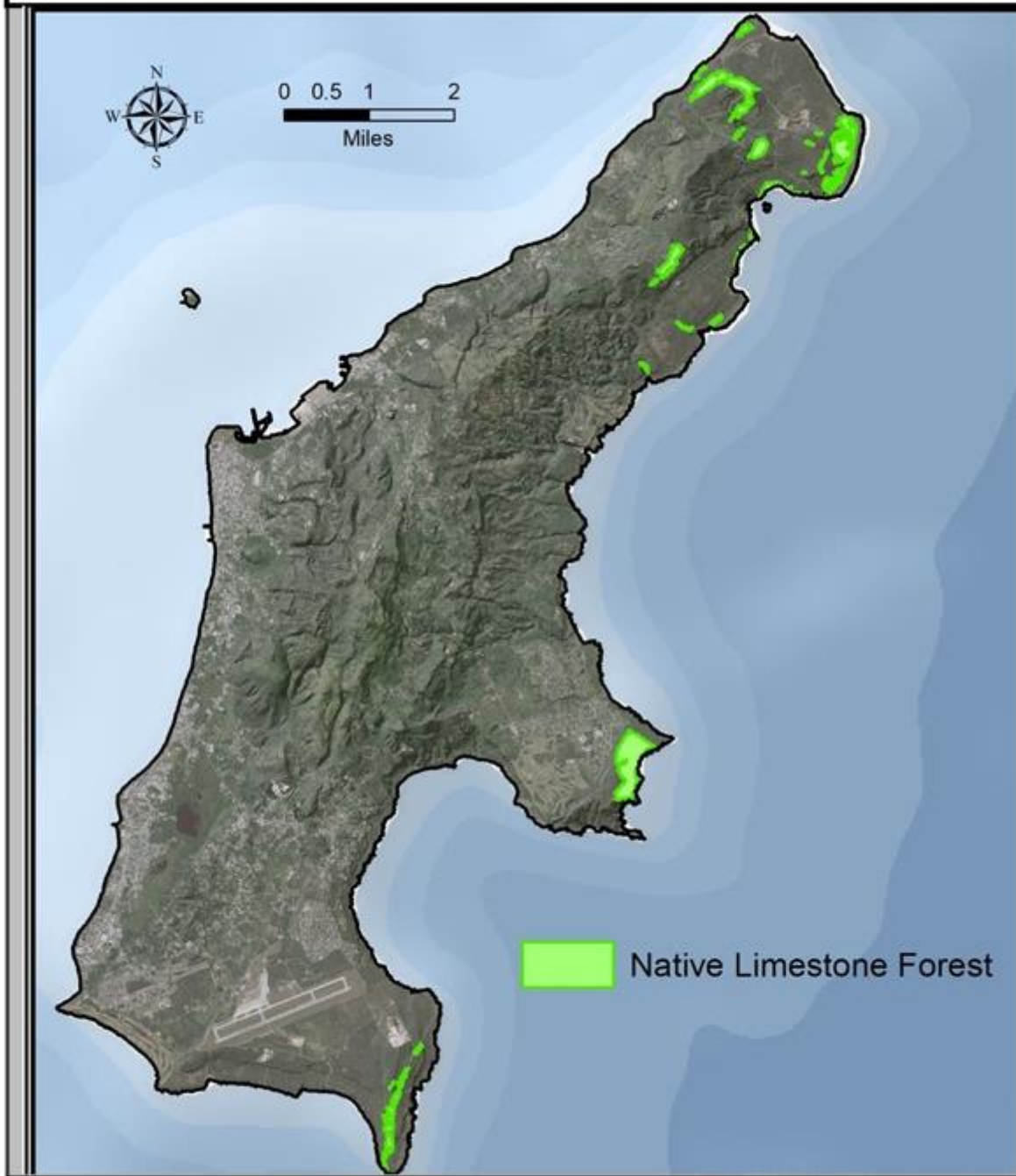
In the updated USFWS forest classification, “native limestone forest” is defined by forests of varying ages present on a limestone substrate, with a canopy dominated by native tree species. The dominant canopy species for this class in CNMI include *Elaeocarpus joga* (joga), *Pisonia grandis* (*umumu* or *umomo*), *Hernandia labyrinthica* (oschal), *Hernandia Sonora* (nonak or nonag), *Ficus prolixa* (nunu), *Macaranga thompsonii* (pengua), and *Intsia bijuga* (ifit). Dominant canopy species vary by each island, and in some cases by region of an island. Species composition for the forest classes in the following maps builds on a multi-decade lineage of vegetation classification work in the Marianas, with seminal efforts by Falanruw et. al (1989) and Raulerson and Rinehart (1991).

Urban Areas and Urban Forest

The following maps highlight the coverage of developed areas and “urban forest” coverage among Saipan, Tinian, and Rota, and are based on the most recent, comprehensive vegetation mapping effort for the Marianas Archipelago. This effort was led by the U.S. Fish and Wildlife Service, and a detailed breakdown of the USFWS land cover classes (23 in total), source data, remote-sensing, and field assessment methodology is detailed in Amidon, et. al 2017.

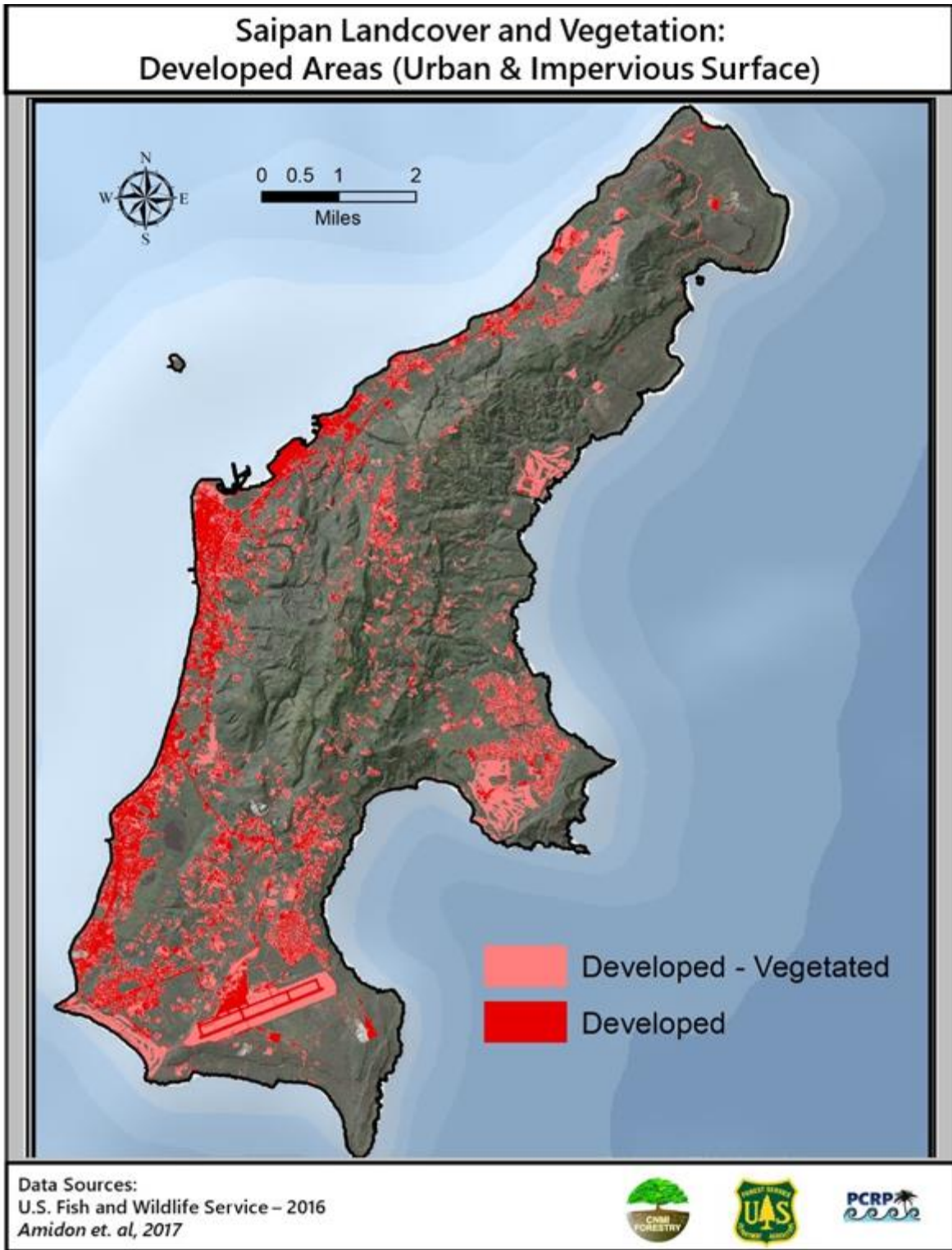
In the following maps, urban areas and urban forest landcover are defined by two specific classes: “Developed” and “Developed Vegetation”. Developed vegetation includes lawns and mowed areas, as well as ornamental and shade trees and shrubs. Parks, golf courses, and residential open spaces are included in this category. The residential villages of Saipan, Tinian, and Rota are comprised largely of the Developed Vegetation type, while more densely populated villages with infrastructure, street grids, and higher concentrations of buildings are represented as “Developed”. This class includes all buildings (concrete and other materials), paved surfaces, and roads. Gravel and unpaved roads are generally included in this category as well, as this landcover class is often used in conjunction with analytical tools to determine stormwater runoff and groundwater filtration potential. Given the interest in community stewardship of urban forest resources, it may be worthwhile for the CNMI to create a more nuanced delineation of “urban forest” in the future, to include not just the developed landscape, but also peripheral forest types and vegetated land fringing the urban space.

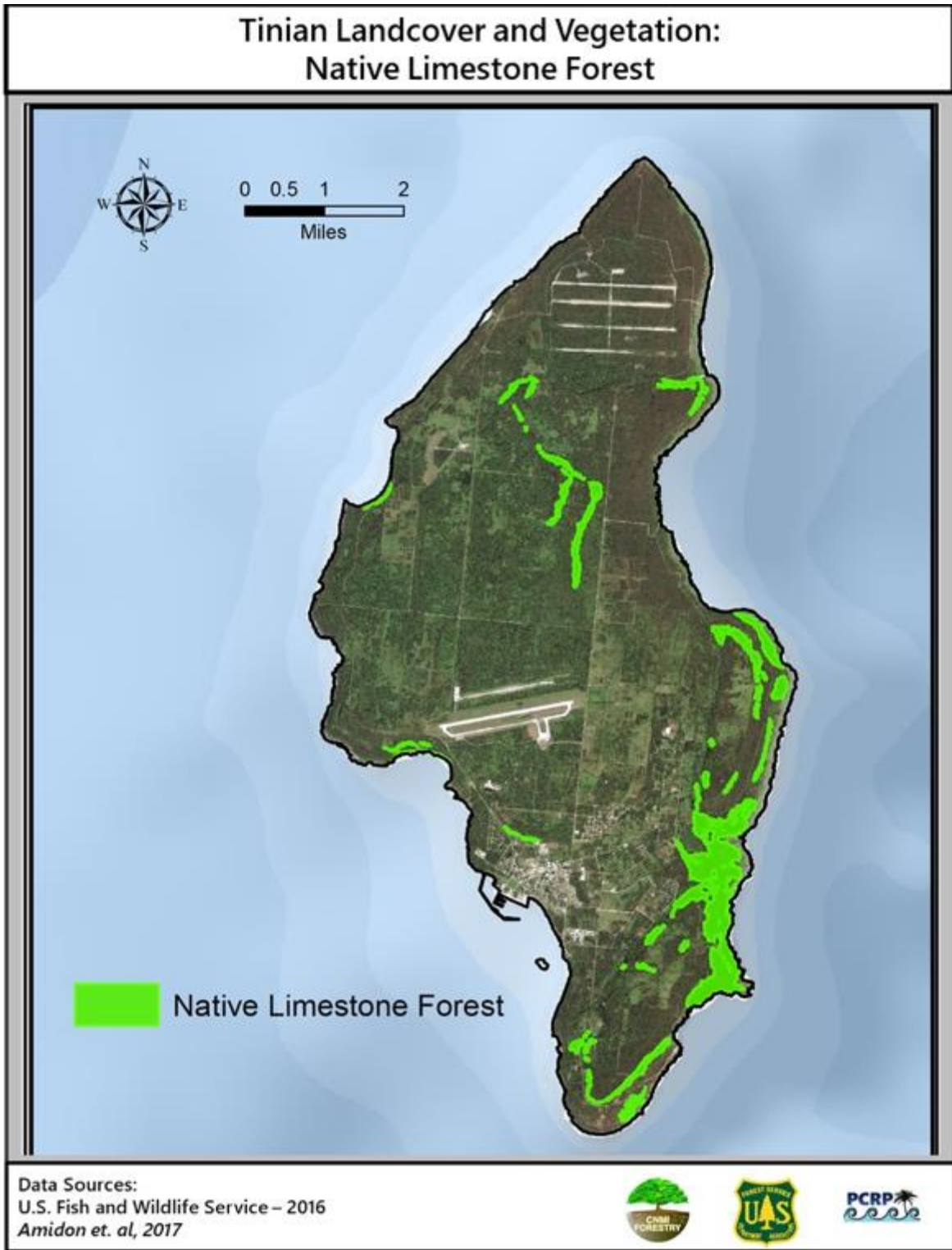
Native Limestone Forest



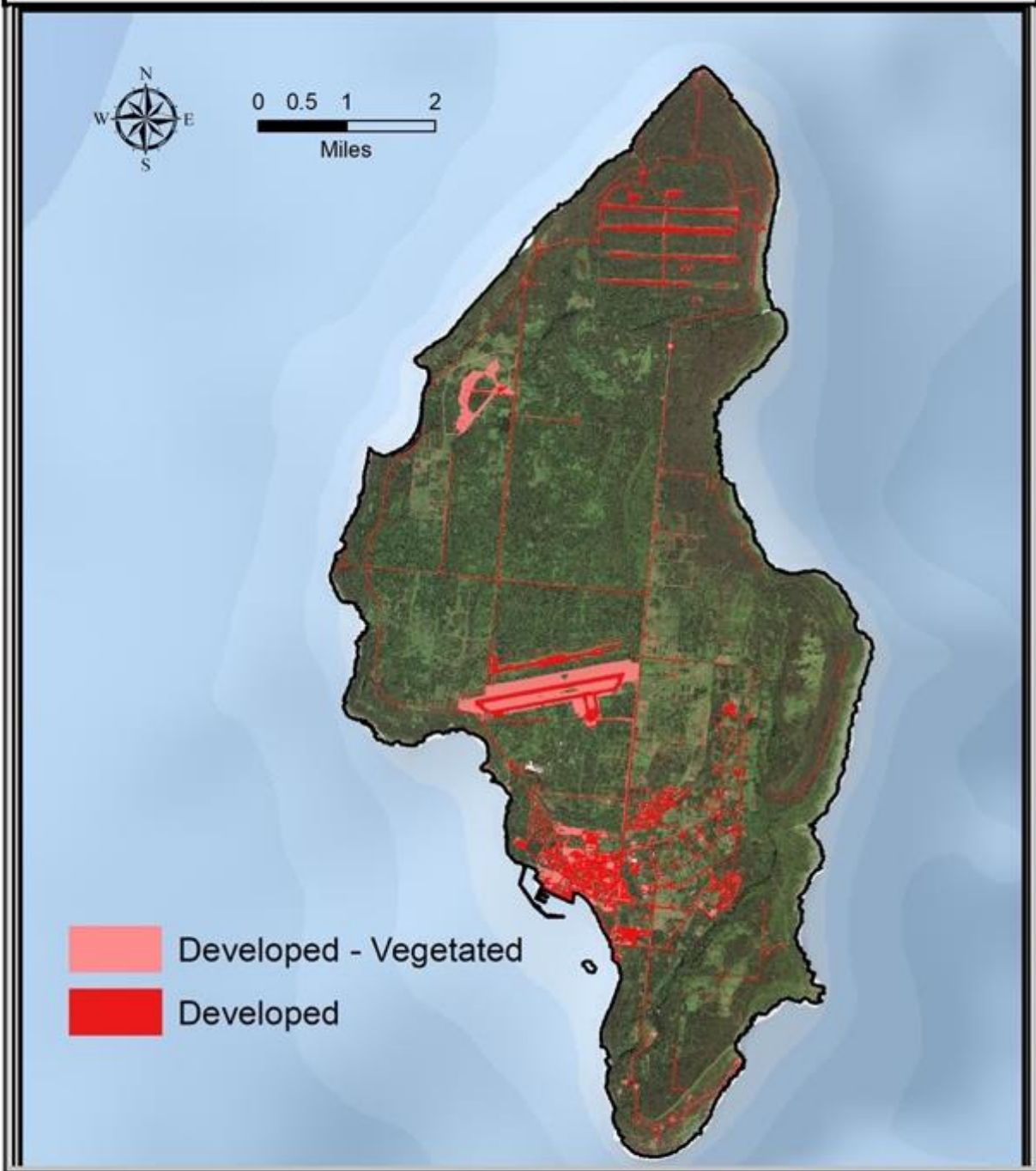
Data Sources:
U.S. Fish and Wildlife Service – 2016
Amidon et. al, 2017







Developed Areas (Urban & Impervious Surface)



Data Sources:
U.S. Fish and Wildlife Service – 2016
Amidon et. al, 2017



Rota Landcover and Vegetation: Native Limestone Forest



Data Sources:
U.S. Fish and Wildlife Service – 2016
Amidon et. al, 2017





Figure 9: Landcover and vegetation maps for Saipan, Tinian, and Rota, specific to Native Limestone Forest and Developed Spaces.

Priority Landscapes for Urban Forest Sustainability



Figure 10: Da'ok tree serves as a shade tree at the entrance of Marianas High School (Native Plant Guide, DCRM 2014).

The focus must be to increase urban greenspace in urban areas like the West Takpochao watershed while at the same time enhancing public benefits derived from this critical ecosystem service. Engaging the public and educating them about the benefits of urban forests improves public understanding of decisions related to the development of green infrastructure and minimize conflicts on the use and functions of urban forests. Increasing knowledge and fostering dialogue empowers local communities, not only in planting trees and fostering greater respect for CNMI's urban forests but in community collaboration, environmental education and public policies that will lead to a more beautiful, healthy and sustainable island.

These issue priorities overlap federal goals to:

- Mitigate and adapt to climate change;
- Protect and improve air and water quality;
- Conserve energy;
- Reduce the impacts of land use change, fragmentation, and urbanization on forest landscapes;
- Improve community health and well-being;
- Build urban forest resilience and mitigate the impacts of invasive pests and catastrophic events

Issue 2 - Protection of Coral Reefs

The people of the CNMI value coral reefs and are dedicated to their conservation. These diverse reef ecosystems provide traditional and subsistence uses, production of commercial food products, recreational opportunities for a healthy tourist economy, physical protection of the coastal zone from storms, unique educational opportunities, and novel research applications. Coral reefs are also integral to the CNMI's cultural heritage. The CNMI has some of the most beautiful and diverse marine ecosystems in the world. The CNMI is home to more than 1,000+ fish species and 256 coral species. Coral reefs are important to our islands because they provide us with food, protect our shorelines from typhoon damage and erosion, support our economy, and help maintain the environmental integrity of our oceans. Ancient Chamorros and Carolinians were expert fishermen with inherent knowledge of harvesting reef fish species such as tåtaga (unicornfish), mafute' (emperor), and palakse' (parrotfish). Traditional fishing methods such as spearfishing and talaya (throw-net) help preserve the cultural identity of the islands. The CNMI has seven Marine Protected Areas (MPAs), which are No-Take areas that prohibits fishing or harvesting of any marine species of plant or animal, prohibit take of coral (dead or alive), and prohibit all explosive or destructive activities to marine life. In Saipan, there are several marine protected areas such as Mañagaha Marine Conservation Area, Forbidden Island Marine Sanctuary, Bird Island Marine Sanctuary, Laolao Bay Sea Cucumber Sanctuary and Lighthouse Reef Trochus Sanctuary. In Rota, Sasanhaya Fish Reserve is adjacent to the Sabana Conservation area. The Tinian MPA is bounded from the Southwest Carolinas Point to Puntalan Diablo. Threatened coral species listed on the Endangered Species Act include the *Acropora globiceps*, *Acropora robusta*, and *Seriatopora aculeata*. Coral reefs are important to the people of CNMI because they provide traditional and subsistence uses, production of commercial food products, recreational opportunities for a healthy tourist economy, and physical protection from storms.

Threats to Coral Reef

Increased population and development over the past decade in the CNMI have exacerbated a number of threats to CNMI's coral reef ecosystems and has led to the destruction and reduced health of coral reefs and coral reef associated habitats. These effects are most noticeable on the island of Saipan, where approximately 90 percent of CNMI's population resides. Therefore, most coral reef management efforts have focused on Saipan. However, the other southern populated islands do have important coral reef ecosystems that are threatened by human impacts. From a long-term perspective, the decline in coral reef coverage and marine health threatens the CNMI's cultural heritage, traditional ways of life, and physical protection from storms. Additionally, this decline immediately impacts the CNMI's tourism and fisheries industries, and thus its economy. The CNMI government considers coral reef ecosystem conservation and management a high-priority concern.

Priority Landscapes for Coral Reef Protection



Figure 11: View of the Talakhaya watershed, Rota, CNMI.

Four local “priority” watersheds have been identified as the central focus of the CNMI Coral Reef Initiative’s land-based coral conservation efforts: Garapan, Laolao, and most recently Achugao on Saipan, and Talakhaya on Rota (Figure 6 and Figure 7). These watersheds were selected for their economic, biological, and social significance because they are high-use areas with vital natural resources. They continue to be the highest priority areas in the CNMI due to having the most degraded coastal water quality. Integrated Watershed Management Plans for these watersheds and their recommendations for best management practices should be closely followed and prioritized. On Tinian, erosion control efforts in Carolinas and surrounding areas continue to be a priority. Sedimentation from unpaved roads, land clearing and development have destroyed roads and continue to harm nearshore marine environments.

Issue 3 - Conservation of Wetlands

Wetlands are extremely important ecosystems found throughout the CNMI. Wetlands in the CNMI include lakes, ponds, estuaries, marshes, swamps, streams, and mangrove forests that provide many essential services that contribute to the well-being of the local community. They help to control pollution and flooding, contain unique plant and animal species, provide habitat for wildlife, and offer recreational and educational opportunities for locals and tourists. In addition, wetlands provide nitrogen fixation and carbon sequestration. Wetlands have the ability to help control the amount of carbon dioxide in

our atmosphere. The plants and soils found in wetlands store carbon, preventing it from being released into the atmosphere as additional carbon dioxide. In Saipan, Tinian, and Rota, wetland ecosystem services are valued at \$10.7 million each year. From land to sea, wetlands also play a critical role in filtering pollutants that may reach coral reefs, an ecosystem service valued at nearly \$5 million (Wolfs Company 2019). At the federal level, Section 404 of the Clean Water Act helps to prevent individuals from unlawfully harming wetlands and regulates the discharge of dredged or fill material into waters of the United States unless the Army Corps of Engineers grants special permission. Wetlands in the CNMI have overlapping jurisdiction and are regulated and managed by local and federal agencies. Recognizing the importance of wetlands to the community, the DCRM classifies wetlands and mangrove areas as an “Area of Particular Concern” (APC). Development proposals within wetlands and mangrove areas must obtain APC permits to ensure that these areas are preserved or enhanced. Protecting and enhancing these critical ecosystems is crucial to preserving the health of CNMI residents and environment.

Threats to Wetlands

Wetlands in the CNMI continue to remain threatened by development, pollution, and invasive species. Increased pressure from development (landclearing and backfilling) and invasive species are the most common causes of wetland loss in the CNMI. Unpermitted fill of wetlands persists as an ongoing violation issue while development has the potential to encroach on wetland areas. Storm water runoff caused by heavy rainfall events make their way to wetland areas and reduce their water quality. MIHA and American Memorial Park (AMP) wetlands are impacted by the invasive pond apple (*Annona glabra*) and Indian fleabane (*Pluchea indica*) which not only outcompetes native wetland species but also changes their hydrological functions. Thus, wetland regulation and management are crucial to preserving these areas and ecosystem services for the future (DCRM 2019).

Priority Landscapes for Wetland Conservation

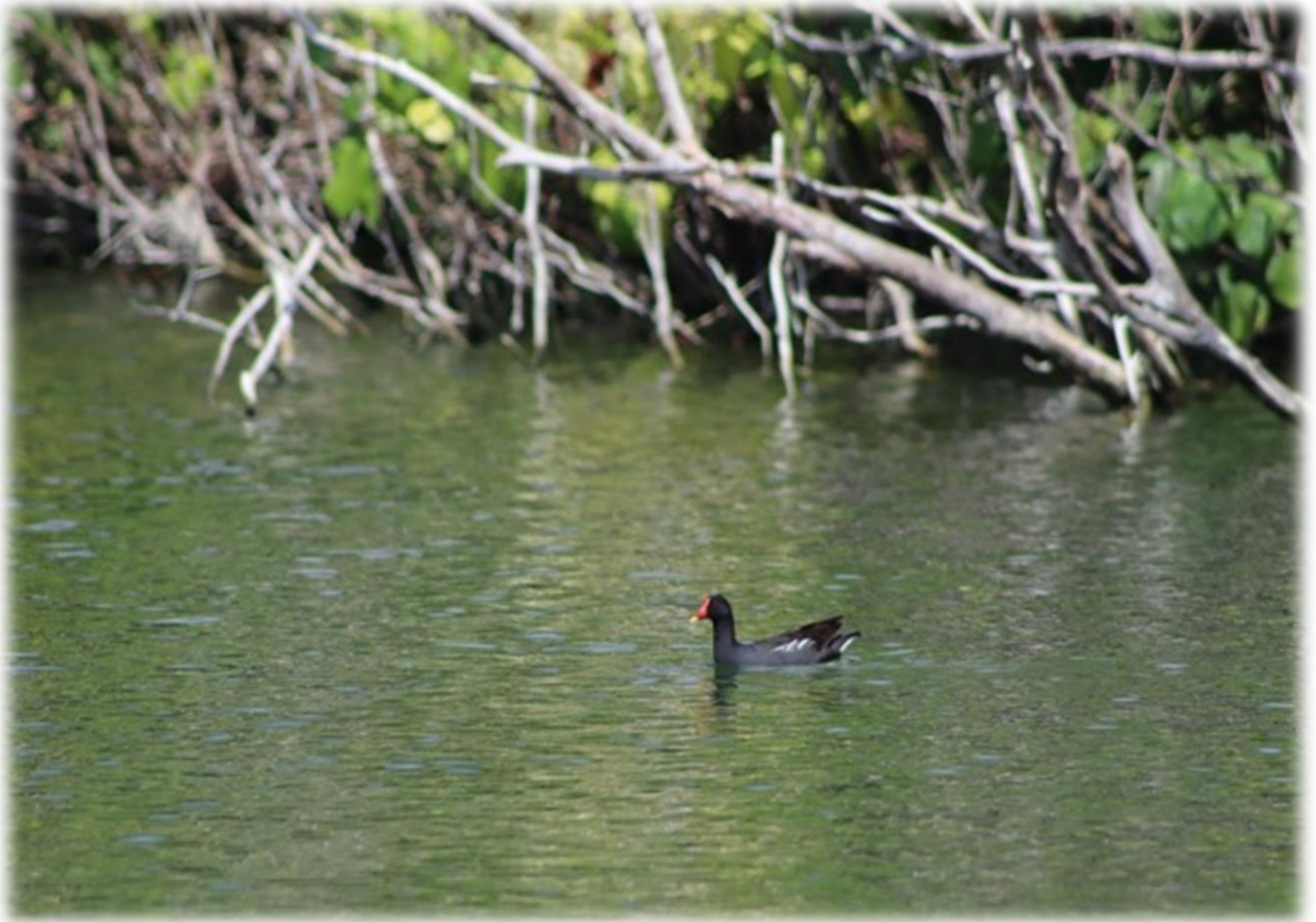


Figure 12: Kagman wetland serves as an important habitat for the endangered Marianas moorhen.

Wetland habitat includes lakes, natural and man-made ponds, estuaries, marshes, and swamps and are all priority landscapes for wetland protection and enhancement. In the CNMI, 642 acres of wetlands occur on the islands of Saipan, Tinian, and Pagan, with Rota having streams and associated riparian areas (BECQ 2018). Saipan has the most wetlands with Lake Susupe being the largest brackish-water lake. The 40-acre lake and 350 acres of palustrine emergent and forested freshwater wetland surrounding the lake comprise about 75 percent of Saipan's freshwater wetlands. Other wetlands include Lake Hagoi in Tinian, a freshwater lake that sits above an impervious surface or a perched water table surrounded by extensive marshes, and Marpo swamp. In the Northern Islands, there are two lakes on Pagan: Laguna Sanhiyon (Upper or Inner Lake) at 43 acres and Laguna Sanhalom (Lower or Outer Lake) at 40 acres. Perennial streams also occur on Saipan, such as the Talofoto Stream that feeds Jeffrey's Beach Estuary. Rota boasts a series of intermittent freshwater streams within the Talakhaya watershed. The only mangroves in the CNMI are found on Saipan. Mangroves in Sadog Tasi, American Memorial Park, Smiling Cove and stream mouths between Lower Base and Tanapag. There are extensive freshwater marshes on Saipan surrounding Lake Susupe, and extending north to Oleai and south to Chalan Kanoa and San Antonio. The most common ponds are found on golf courses provide important habitat for the endangered Mariana common moorhen (Figure 12). Wetlands purify and recharge groundwater and provide important wildlife

habitat. The Mariana common moorhen is completely dependent on wetland habitat, and wetlands are an important habitat for the nightingale reed-warbler.

Of particular concern for the CNMI are the few remaining mangrove forest habitats. Saipan hosts the only mangroves in the CNMI, most of which are located in the 30 acre American Memorial Park, the CNMI's only National Park, and are primarily comprised of the mangrove species *Bruguiera gymnorrhiza* (Greene et al 2019; Figure 13). As summarized in the 2019 National Resource Condition Assessment (NRCA) for the Park (Greene et al 2019), significant areas of Saipan's mangroves were cleared for sugarcane production during the Japanese administration (1919-1945). While most of the remaining mangrove habitat on Saipan was spared damage from wartime bombing (Perreault 2007), areas of these wetland were further cleared and later used as a landfill through 1978 (Cogan et al. 2013, Raulerson and Rinehart 1989). Resource managers are now working to restore these habitats. Most notably the Puerto Rico dump closure plan included the planting and continuous monitoring of 200 mangrove seedlings in the AMP wetland as mitigation for removal of wetlands during the creation of the Governor Eloy S. Inos Peace Park above the former Puerto Rico dump site (Greene et al 2019).

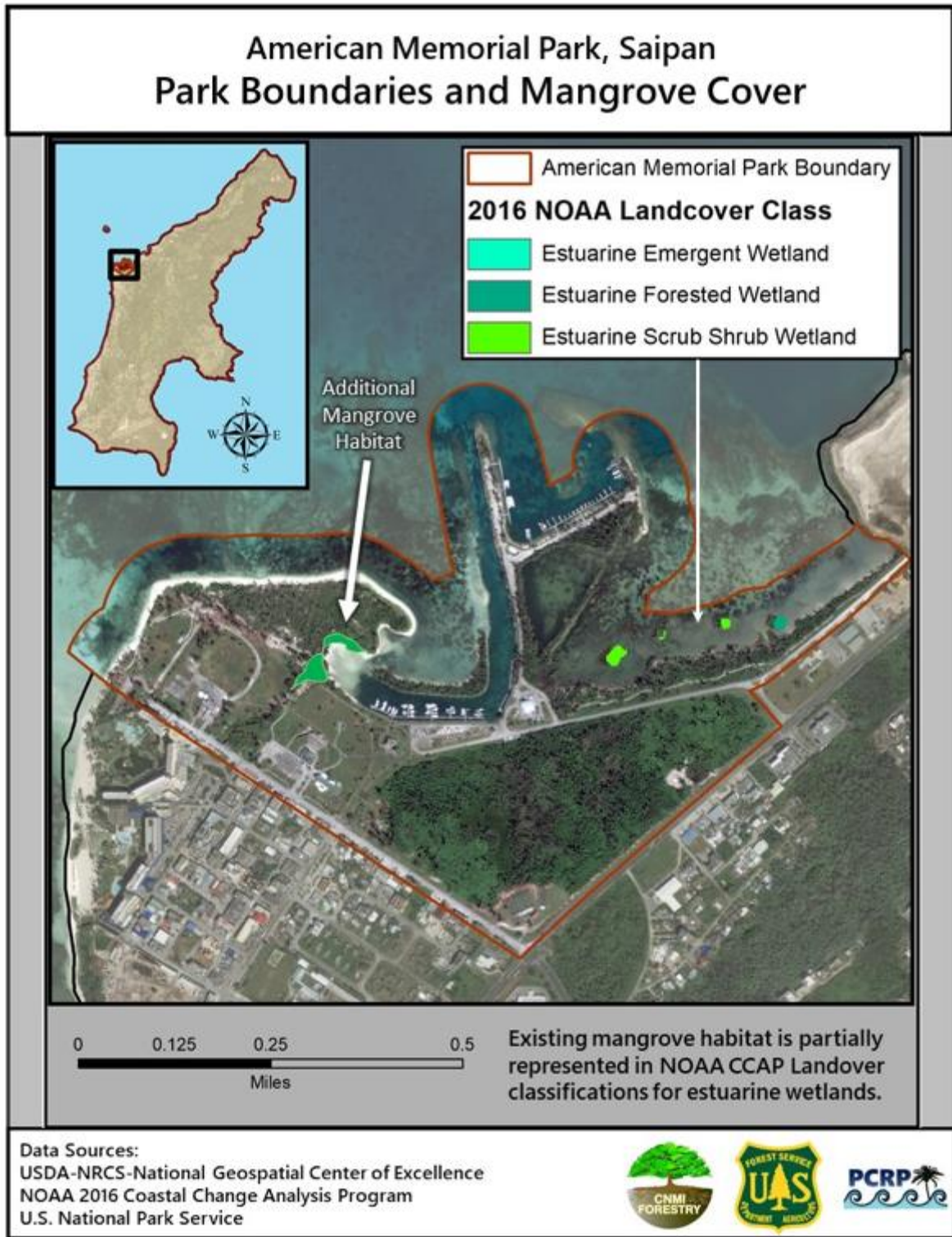


Figure 13: Mangrove cover in American Memorial Park.

Issue 4 - Maintaining Freshwater Quality

The main source of CNMI’s freshwater comes from groundwater. On Saipan and Tinian, wells are used to take advantage of the natural underground water system. The primary source of water for the island of Saipan comes from 135 groundwater wells, the Donni Spring, and two Maui-type wells (Carruth, 2003). On Tinian, the primary water source comes from one Maui-type well. On Rota, springs, streams, and natural water caves occur and the islands major water source comes from this surface water supply. Freshwater on Rota also occurs in the form of seeps along the northern beach areas.

Threats to Fresh Water Quality

Unsustainable development, improper sewage waste systems of residences and businesses may affect the potential for ground water contamination. During heavy rainfall events, freshwater risks becoming contaminated with land-based sources of pollutants released from piggeries, agricultural fertilizers and pesticides from farms, and lack of maintenance of sewage waste systems.

Priority Landscapes for Maintaining Fresh Water Quality



Figure 14: Okgok freshwater stream within the Talakhaya Watershed, Rota.

High priority watersheds identified from the analysis include Laolao, Garapan, Achugao and Talakhaya. Within these watersheds, landscapes that pose the greatest threat of sediment and nutrient deposition into freshwater systems were delineated as high priority areas. These areas include landscapes with high

population growth, rapid development, steep slopes, stream corridors, and agriculture. Native forests were deemed important because of their role in absorbing excess nutrients and sediment, recharging aquifers, stabilizing soil, and moderating water flow.

Issue 5 - Conservation of Native Flora and Fauna

The CNMI is rich in diversity, both marine and terrestrial. CNMI's forests are home to many bird and plant species. Humans have inhabited the Mariana Islands for around 2,000 years, although the majority of change to CNMI's environment came in the last century with conversion to agriculture. The majority of remaining native forest is found on the northern uninhabited islands, although Rota and Aguigan have large stands of native old growth limestone forest. The variety of islands and habitats in CNMI has allowed for a high level of endemism to develop. CNMI's lush forest makes it a home for our native birds to nest and feed establishing their territories there. The CNMI has 150 species of birds, 12 of which are endemic to the CNMI. CNMI's forest is also home to a wide variety of plant species. Of over 220 native plant species, almost 40% are endemic. In addition to patches of native limestone forest, most of CNMI is covered by a mix of non-native forests, grasslands, plantations, and urban areas. Medicinal plants can also be found in native limestone forest areas. The leaves and bark of *Erythrina variegata*, known as Gaogao in the native tongue, are used medicinally for diabetes and other ailments, naturally occurring in native forests. *Morinda citrifolia* is a widely used medicinal plant. It is generally used as a cure all and to increase strength. The leaves are used to make tea or juice, commonly known as Noni juice. Preserving these diverse habitats, and the livelihoods and cultures of the people who depend on them, has required the collaboration between diverse collection of partners. The preservation and protection of CNMI's forests is imperative for conservation of endangered local flora and fauna and our indigenous heritage.

Threats to Native Flora and Fauna

The majority of forests on Rota, Tinian and Saipan have been disturbed continuously over time. Natural and human-caused disturbances, unsustainable development encroaching native forests, and invasive species are the biggest threats to CNMI's native flora and fauna. Effective management of our forestry programs can help to restore these habitats. The forests of the CNMI have been strongly influenced by a long history of disturbance, both human-caused and climatic disturbance. Deliberate forest fires set by hunters have been a challenge and over time have diminished critical forest habitats, endangering rare plant and animal species, and freshwater resources. Human populations and land use on the CNMI have changed, resulting in differing influences on forest vegetation. Land degradation and uncontrolled agricultural for economic development have been a common practice with private landowners and the government. Within the last century, the most important land use changes have involved the conversion of forests to agriculture and urban uses. The changes have been rapid. In addition to loss of forest to urbanization, invasive weeds have also become a threat to forests in the CNMI. Smothering invasive vines have been widespread throughout the CNMI. Continued development and implementation of strong invasive species programs to educate the public, assess threats and current status, and to eradicate or control several pests threatening forest sustainability are needed over the life of this FAP and beyond.

Priority Landscapes for Conservation of Native Flora and Fauna



Figure 15: Native limestone forest in the Laolao Watershed, Saipan.

All areas of CNMI's native limestone forests and undisturbed areas are considered priority landscapes including CNMI's terrestrial conservation areas. High priority landscapes determined from their native vegetation include priority watershed areas like Laolao, West Takpochau, and Achugao on Saipan and Talakhaya on Rota. All of CNMI's wetlands are important priority landscapes. West Carolinas native limestone forests in Tinian, Kastiyu and the east side of the island are also considered to be high priority landscape areas. All forested areas, including agroforests and urban trees across all islands are considered high priority areas for invasive species detection, eradication, control and management.

