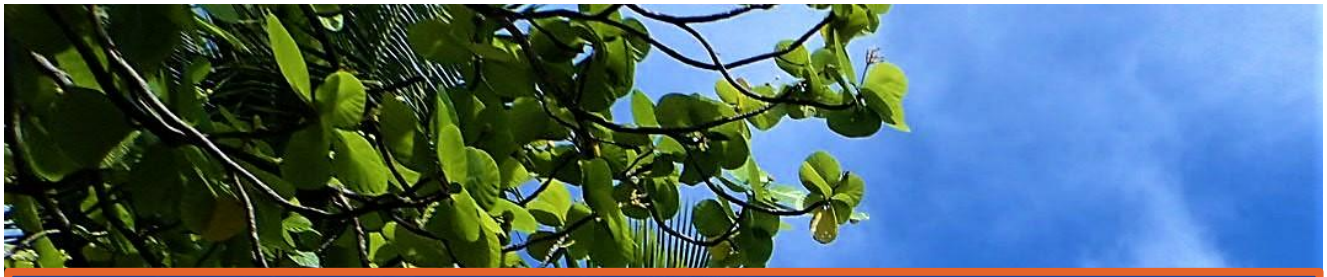

REPUBLIC OF THE MARSHALL ISLANDS

FOREST ACTION PLAN

2020-2030

Ministry of Natural Resources and Commerce

ACKNOWLEDGMENTS

The Republic of the Marshall Islands' Forest Action Plan was revised and updated for 2020-2030 under the direction of the Ministry of Natural Resources and Commerce (NRC), which is responsible for its development and implementation. NRC extends appreciation to the many individuals, groups and organizations who assisted.

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This plan retains much of the information laid out in the original version, known as the 2010 RMI Statewide Assessment and Resource Strategy (SWARS), and therefore once again acknowledges the following:

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Kwajalein Atoll Local Government
Majuro Atoll Local Government
RMI Environmental Protection Authority
Marshall Islands Marine Resources Authority
Ministry of Resources & Development
SWARS Working Group

CONTENTS

ACRONYMS

CE	Conservation Education (USFS)
CFAA	Cooperative Forestry Assistance Act
CMAC	Coastal Management Advisory Council
CMI	College of the Marshall Islands
CWPP	Community Wildfire Protection Plans
CROP	Council of Regional Organizations of the Pacific
F&AM	Fire & Aviation Management (USFS)
FAO	United Nations Food & Agriculture Organization
FSP	Forest Stewardship Program (USFS)
GEF	United Nations Global Environmental Fund
GIS	Geographic Information System
IUCN	International Union for the Conservation of Nature
JNJIE	*Jorikrik Nan Jorikrik Ilo Ejmour* (Youth to Youth in Health)
KALGOV	Kwajalein Atoll Local Government
NIPF	Non-Industrial Private Forest Land (all forest land in the Marshall Islands)
NRCS	USDA Natural Resources Conservation Service
MALGOV	Majuro Atoll Local Government
MC	Micronesia Challenge
MICS	Marshall Islands Conservation Society
MIIST	Marshall Islands Invasive Species Taskforce
MIMRA	Marshall Islands Marine Resources Authority
MIVA	Marshall Islands Visitors Authority
MOE	Ministry of Education
MNRC	Ministry of Natural Resources and Commerce
NTC	National Training Council
OEPPC	Office of Environmental Planning and Policy Coordination
PAN	Protected Areas Network
PII	Pacific Invasive Initiative
RISC	Regional Invasive Species Council (Micronesia)
RMIEPA	Republic of the Marshall Islands Environmental Protection Authority
RNGR	FSP Reforestation, Nurseries & Genetic Resources
S&PF	State & Private Forestry
SLM	Sustainable Land Management
SPC	The Pacific Community
SPREP	Secretariat of the Pacific Regional Environmental Programme
STC	State Technical Committee = TAC (NRCS)
SWARS	State-Wide Assessment and Resource Strategy
TAC	Technical Advisory Committee = STC (NRCS)
TTM	Taiwan Technical Mission
U&CF	Urban & Community Forestry (USFS)
USDA	United States Department of Agriculture
USFS	United States (Department of Agriculture) Forest Service
USP	University of the South Pacific
WUTMI	Women United Together Marshall Islands

January 2021 FAP layout and photos by Rachael Nash, unless otherwise credited. Cover photo by Mikhail Aleksandrovich Yatskovov.

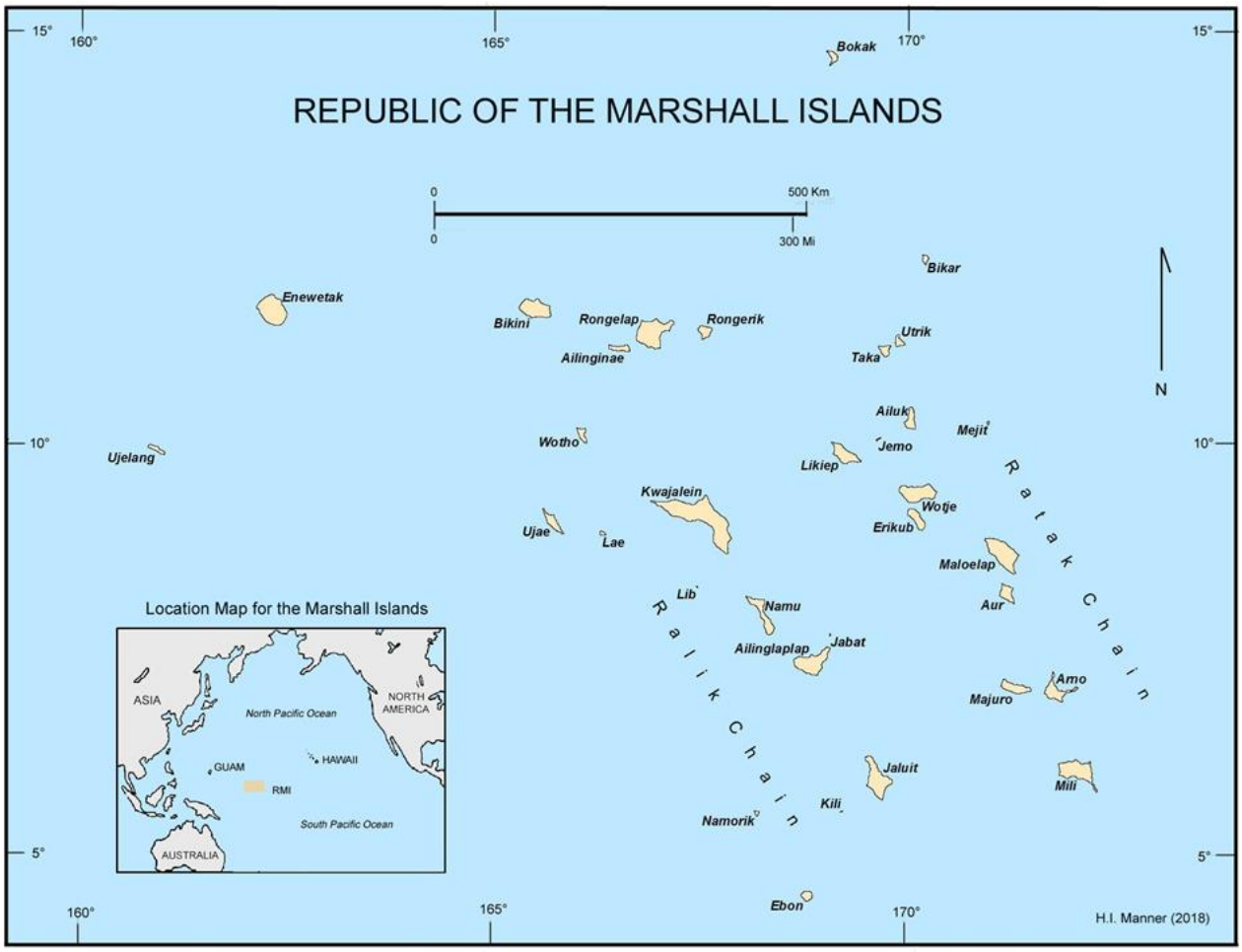


Figure 1 Map of the Republic of the Marshall Islands (H.I. Manner)

The Republic of the Marshall Islands (RMI) is a former U.S. Trust Territory, now a sovereign nation in a "Compact of Free Association" with the U.S. As a result of its U.S. affiliation, it is eligible for all USDA Forest Service State & Private Forestry programs.

> ...the Marshall Islands encompass 29 atolls and 5 solitary islands, and is comprised of approximately 1,225 individual islands and islets. These are situated from 160 degrees to 173 degrees longitude East, and between 4 degrees and 14 degrees latitude North. Total dry land area is only about 70 square miles. All the Marshall Islands are low in elevation; the average height of land above sea level being 7 feet. The air is warm and moist, with a humidity of about 80%, with considerable salt spray as well. The air temperature averages around 82 degrees Fahrenheit, ranging between about 76 and 90 degrees. Rainfall tends to be seasonal. It can range from as much as 160 inches in the south to as little as 25 inches a year in the north – or even less during the extremely dry years when there may be no precipitation whatsoever on some of the drier atolls. Tropical storms (typhoons) are fortunately relatively rare, but when they do hit, can be devastating. (RMI: Living Atolls, 2000)

This Forest Action Plan identifies the RMI's highest priorities for forest resource management and needs for assistance from the United States Department of Agriculture (USDA) Forest Service (USFS). State assessments and resource strategies are integral to the Forest Service's State and Private Forestry (S&PF) redesign and required as an amendment to the Cooperative Forestry Assistance Act (CFAA), as enacted in the 2008 Farm Bill. Each "State" was required to complete a State-Wide Assessment and Resource Strategy (SWARS) within two years after enactment of the 2008 Farm Bill (June 18, 2008) to receive funds under CFAA. The 2008 Farm Bill also made the Republic of the Marshall Islands eligible for CFAA programs that are available to states, territories and commonwealths of the USA. The SWARS developed in 2010 for the RMI required updating in 2020, and is now known as the Forest Action Plan (FAP).

The RMI FAP includes two components of the assessment and planning required by the S&PF Redesign approach to identify priority forest landscape areas and highlight work needed to address national, regional, and state forest management priorities:

Statewide Forest Resource Assessment —provides an analysis of forest conditions and trends in the state and delineates priority rural and urban forest landscape areas.

Statewide Forest Resource Strategy—provides long-term strategies for investing state, federal, and other resources to manage priority landscapes identified in the assessment, focusing where federal investment can most effectively stimulate or leverage desired action and engage multiple partners.

The RMI FAP summarizes information from **other existing assessments and strategic plans**; details may be found in those existing documents.

The FAP provides a basis for subsequent annual grant proposals, as authorized under several CFAA programs. The redesign deemphasized program-by-program planning and emphasized program integration to meet island priorities. The original 2010 RMI SWARS was thus organized around the Marshalls' own priority issues with respect to forests. Issues were defined by the advisory group to the "state" forester of the Marshall Islands as a way of organizing the goals and strategies most relevant to the forest resources of the RMI. "Cross-cutting considerations" were also recognized by the advisory group, as threats, constraints and limitations that affected more than one issue.

These priority issues and cross-cutting considerations (**Table 1**) were revisited and revised for the 2020 update of the Forest Action Plan by relevant **stakeholder groups detailed in Section III** through a process that involved a desktop review, workshop, and individual consultations. One cross-cutting consideration described in the original plan, 'capacity-building', was replaced with 'data collection, management, and analysis' in 2020 as being critical to carrying out RMI's objectives. Capacity building is still important, required for all issues, and mentioned throughout the assessment and strategies.

Table 1 Marshall Islands Priority Issues and Cross-cutting considerations

Priority Issues	Cross-cutting considerations
Conservation of Biodiversity	Climate change
Food security and sustainable livelihoods	Freshwater Resources
Coastal reinforcement	Data collection, management, and analysis
Urbanization	Invasive plant species, insects & diseases

The FAP then cross-references USDA Forest Service themes and objectives (**Table 2**) and specific funding programs and their requirements.

Table 2 USDA Forest Service National Themes and Objectives

1. Conserve Working Forest Landscapes

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

2. Protect Forests from Harm

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

3. Enhance Public Benefits from Trees and Forests

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

Forest Service programs and program guidelines often refer to "private landowners". To apply such guidelines to the RMI requires consideration of the activity and its purpose. Programs such as Forest Stewardship authorize providing technical and educational assistance to landowners, and supporting them with tree seedlings and other in-kind assistance with forest management; in this case, "landowner" may refer to whoever in the RMI has the right to plant, care for or harvest from trees. All forest land is privately owned under complex forms of land tenure:

> *Given the scarcity of land in the Marshalls, land is the most highly prized possession and "control of the land is the central theme of Marshallese culture." Land is divided into* weto *held under a matrilineal line. Land rights are shared between different levels of society: the* iroij*, or chief holds title over entire islands or atolls. The* alap *manages one or more* weto *and the* ri-jerbal*, or workers, cultivate the land, harvest marine resources and pay tribute to the iroij in return for the rights to live on the land and use the resources. The* iroij *establishes rules and manages the land and resources in a way that provides for all the people. (Reimaanlok, pg. 55)*

I. STATEWIDE FOREST RESOURCE ASSESSMENT

The 2016 RMI State of the Environment Report (SOE) report, prepared with support from SPREP, provides a summary of natural resource and environmental conditions in the Marshall Islands. Three of the themes are particularly relevant to this Forest Action Plan: Atmosphere and Climate (including climate change), Land (includes forests and agroforests), and Biodiversity (including protected areas and invasive species).

GENERAL FOREST CONDITIONS AND TRENDS

FOREST SPECIES AND ECOSYSTEMS

The Marshall Islands are naturally tropical forested ecosystems, mostly converted to agroforest over the millennia since settlement by the Marshallese people. Marshallese agroforest is a mix of trees, woody shrubs and herbaceous species, managed for food and other forest products, notably breadfruit, coconut, pandanus, and bananas. Since Western contact, many areas have been managed as coconut plantations (often with other species intercropped, a simpler form of agroforestry) and additional species have been introduced and integrated into the agroforest (especially fruit trees).

"The Marshall Islands – Living Atolls Amidst the Living Sea: The National Biodiversity Report of the Republic of the Marshall Islands" (called "Living Atolls" throughout this document) provides a non-quantitative, unmapped assessment of the Marshalls' biodiversity of flora and fauna, including comprehensive species lists and species status as of 2000. Atoll-by-atoll overviews (pp. 45-51) provide very brief assessments of

environmental conditions. The Plants and Environments of the Marshall Islands webpage also provides descriptions and links to additional resources.

FOREST INVENTORY AND ANALYSIS

Mapping and forest inventory conducted using the Forest Inventory and Analysis (FIA) for the first time in 2008 showed that forest, including agroforest and coconut plantations, covered about 70% of the Marshalls' land area. 12% of the landscape was classified as urban land. Species diversity was low; a total of 17 tree species and 45 understory species were measured on the FIA plots, with an average of four tree species per sixth-acre plot. Additional results of the assessment are included in the Republic of the Marshall Islands' Forest Resources, 2008.

The FIA was conducted for the second time in 2018, with additional plots added in order to establish measures toward meeting the goals of the Micronesia Challenge (MC). Information on the MC monitoring and data summaries are available via a MC terrestrial web-viewer.

While the 2018 survey report from the USFS is not yet available, the FIA database is available online. Supplemental summaries were created from the FIA Pacific Island database using data from base plots from the first and most recent inventories and the change between them, as well as newly established Micronesia Challenge plots. The information was gathered to support the update of this FAP, especially priority areas of coastal stabilization, food security, and species biodiversity. The category of forest community used by the FIA was useful for organizing these priority areas, since strand and mangrove forests are both critical for coastal stabilization, agroforest is important for food security, and lowland and montane rainforest both shelter many native and endemic plant species. As such the summaries were focused on the trends and characteristics of forest communities, since the formal FIA reports generally provide a broad overview of all forests per jurisdiction and were unpublished and unavailable to reference at the time of writing. This supplemental information for RMI is attached to this FAP (Appendix 1).

OTHER ASSESSMENTS

Agroforest inventory utilizing small Unmanned Aircraft Systems (UAS), was piloted on Arno atoll. Software development, training in methodology to measure and map coconut trees from drone imagery, and implementation was carried out through collaboration with the USFS, University of Hawaii, MNRC, Marshall Islands Conservation Society (MICS) and GEF-5 Ridge to Reef Project. 20,498 coconut trees were detected across 375 acres, along with information on tree/vegetation height. There is potential to use the technology to inventory breadfruit and pandanus.

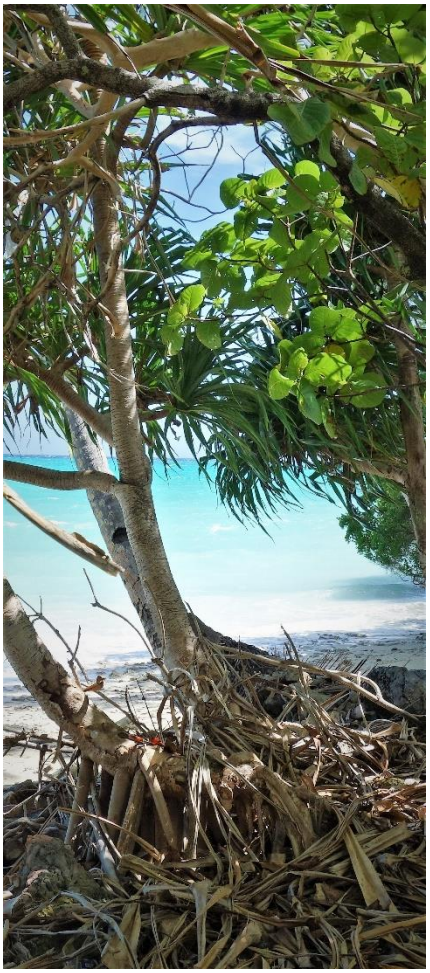
PRIORITY AREAS

Priority landscape areas for RMI's priority issues are described in each section. Updated detailed maps for each issue and general vegetation types for the Marshall Islands were not available at the time this Forest Action Plan was completed. Maps created for the 2010 plan have been retained, but may be replaced in the future if new spatial information becomes available. The 2010 maps and a description of how they were created are attached (Appendix 2).

CROSS-CUTTING CONSIDERATIONS (INCLUDING THREATS)

The following cross-cutting considerations (primarily threats) impact all priority issues and areas related to forest resources in the Republic of the Marshall Islands, and should be addressed in order to develop effective strategies.

A. CLIMATE CHANGE



Global projections of sea level rise over the long term are potentially devastating to the low-elevation atolls of the Marshalls. Regional information about climate change effects over a planning horizon measured in decades is critical to planning for adaptation strategies, but is still not precise. RMI is in the process of preparing a Pacific Islands Regional Climate Assessment (PIRCA) as of the end of 2020.

Rainfall, drought and sea level are strongly affected by ENSO (El Nino Southern Oscillation) processes, but climate models do not agree on how ENSO patterns will change with continued global warming (Fletcher et al, 2010). There have been several strong ENSO cycles in recent decades, so measured changes in rainfall and sea level rise in recent decades cannot necessarily be projected into the future.

Storms and extraordinarily high tides occur with natural variability and are also amplified by climate change and sea level rise. Atolls, with their characteristic beach berms and depressed interiors, are sensitive to the frequency of surges overtopping those shoreline barriers. Increased frequency of overtopping events, exceeding required recovery times, will alter terrestrial ecosystems and agroforests, and will leave islands uninhabitable well before sea level rise permanently inundates the island.

The movement of people between outlying and urban atolls, and between Majuro and the U.S., is increasing, as people seek jobs, better education, health care and other aspects of modern lifestyles that they perceive as available outside of the RMI. This movement is exacerbated by climate change, and assessments of its impact on communities and migration are needed to inform strategies concerning agroforestry extension and natural resource management. One such case study was recently conducted (Van der Geest et al, 2019).

A Marshall Islands Climate Outlook webpage is available to provide a dashboard for seasonal information related to climate. This is an important consideration since between 2020-2030, the effects of the ENSO cycle are expected to outweigh the effects of climate change.

Additional information can be found at the Marshall Island's Climate Change website detailing RMI's implementation of the United Nations Framework Convention on Climate Change (UNFCCC).

B. FRESHWATER RESOURCES

Native forest ecosystems and traditional agroforest management are both dependent upon and necessary for the protection of the freshwater lens underlying atoll soils. The maintenance of coastal forest windbreaks (to reduce salt spray and desiccation), the conservation of native and traditional tree species adapted to atoll conditions, the avoidance of irrigation and chemical fertilizers, and the maintenance of organic soil matter through vegetative cover and composting techniques, all protect the quality of existing freshwater resources and assist continued productivity where freshwater resources are limited or dwindling. Declines in freshwater quantity or quality due to droughts or inundation events pose threats to forest and agroforest health. RMI has two declared Ramsar sites in Namdrik and Jaluit atolls which have been managed by the local governments with support from the RMI EPA (Environmental Protection Authority). However, there is little data available to determine their current status (RMI SOE 2016).

C. DATA COLLECTION, MANAGEMENT AND ANALYSIS

The *Reimaanlok* process outlines methodologies for assessing the status of RMI's socioeconomic and marine landscape. However, it still lacks an endorsed method for practitioners to assess the status of our terrestrial environment and resources. It is a priority to establish a standardized method to establish terrestrial baselines for all atolls in the RMI. This baseline is essential for both developing meaningful management activities, but also for monitoring their impact. The FIA provides an overall assessment of RMI's forest resources, but is not intended to provide statistically valid information at the atoll level. Supplemental methodology should be reviewed, including the use of drones (recently piloted), or participatory rural appraisal.

Data storage and sharing is also a key priority among practitioners. Guidelines and process on regular data storage, backup, and organization should be developed within each agency or as a collective. Partners should identify and frequently utilize data sharing/collaboration tools to streamline workflows, reduce duplication, and strengthen interventions. This will be key to enabling meaningful monitoring of projects and their impacts.

Currently, the Climate Change Directorate alongside SPREP have established a Republic of the Marshall Islands Data Portal that has nearly unlimited cloud storage and is available for all partners to upload and share data and reports. However, at this time the portal is not being regularly utilized by partners. One challenge is the time required to organize and upload all past collected data, maps, and reports to the portal. Additionally, frequently updating and organizing data as is collected to the portal does not seem established in partner workflows.

Implementers and partners should be trained in analyzing information collected locally to draw conclusions from data to develop better management actions. There should be consistent analysis techniques utilized by partners and standard key questions answered when reporting on the status of terrestrial resources for each atoll.

D. INVASIVE PLANT SPECIES, PESTS & DISEASES

Pests and diseases are threats to the health of native forests, agroforests, coastal and urban forests, and therefore forest health management is a cross-cutting consideration. The 2008 forest Inventory data showed that approximately 37% of trees had some form of damage, most often damage by unspecified insects, and next most often damage by other vegetation, including vines. The Global Register has a comprehensive list of introduced and invasive species for the RMI: 435 species, of which 394 are plants. Target species are addressed in RMI's National Invasive Species Strategy and Action Plan (NISSAP) 2016-2022.

Coconut Rhinoceros Beetles (CRB) are of utmost concern, with RMI's dependence on coconuts for food security and sustainable livelihoods. CRB traps have been installed near port of entries, such as the RMI International Airport on Majuro. No CRBs have been found since the traps were set, but constant surveillance is needed. There is a plan to extend the CRB traps into the airport on Kwajalein, which is a US military base and will require collaboration with Foreign Affairs and appropriate authorities. Rat eradication projects are ongoing. Four surveys were completed on Majuro to identify species present. Training for biological control measures planned for 2020 was put on hold due to COVID-19 travel restrictions.

RMI also participates in the Regional Invasive Species Council (RISC).

PRIORITY ISSUES

A. CONSERVATION OF BIODIVERSITY

Conservation of biodiversity in the Marshalls concerns terrestrial native species (especially endemic species and migratory birds) and traditional cultivars. It also emphasizes sustainable land management (SLM) to protect the biodiversity and productivity of the species-rich marine environment (i.e., through reduction of water pollution and providing alternative livelihoods). Addressing this issue is rooted in efforts to reconnect with traditional culture; interest of external scientists; and national, regional and international commitments such as the Micronesian Challenge.

Benefits and services

- Ecological services
- Rare and endemic species
- Sustainable livelihoods
- Traditional medicinal plants
- Food security (nutrition from Marshallese cultivars of pandanus and other crops)
- Terrestrial/ecosystem health

Values and targets

Figure 2 Reimaanlok steps

Terrestrial biodiversity values in the Marshall Islands include pan-Pacific species that are uniquely manifest as atoll ecosystems. Forest-associated wildlife includes a subspecies of the Imperial Micronesian Pigeon endemic to the Ratak chain of the Marshall Islands, a species of shrimp, the Arno skink, and about 25 insects often endemic not only to the Marshall Islands but to a specific island or wetland. The Marshall Islands' terrestrial plant species include about 80 native vascular plant species, of which only one (a grass) is endemic; however, biodiversity values include agrobiodiversity, a rich heritage of local cultivars of traditional species, especially pandanus and breadfruit. The need to document and preserve varieties of local crops was emphasized by stakeholders during FAP consultations in 2020. They also identified traditional forest management, including techniques for planting critical coastal species. Sustainable land and urban management practices also avoid adverse impacts on near shore marine biodiversity, which includes many endemic fish species.

Specific locations with high biodiversity values (populations of valued species, rare assemblages or species, and relevant cultural sites) are still being identified and mapped using published literature, personal observations of experts, and local knowledge. Assessment is proceeding atoll- by-atoll as part of community-based assessment and planning work, relying heavily on local informants. "*Reimaanlok*: Looking to the Future; National Conservation Area Plan for the Marshall Islands" (called *Reimaanlok* throughout this document) describes this assessment process (**Figure 2**) in detail, along with maps for sample atolls.

The team's work is ongoing, and terrestrial data as tentatively identified in 2010 is shown in the atoll maps attached to this FAP, with the exception of values such as turtle nesting sites and *mo* (traditional

conservation areas) which are kept confidential (unpublished) to protect them from poachers. *Reimaanlok* calls these "fine-scale" (localized) "conservation targets" (biodiversity values targeted for conservation).

Table 3 Fine-Scale Terrestrial Conservation Targets identified in *Reimaanlok (pp. 68-70)*

Marshallese	*English*
Mo	Bird Island (traditional reserve) *(confidential)*
Bwebwenato	[mistranslated in *Reimaanlok* as Traditional special purpose area]
Ma	Breadfruit forest
Kanal, kojbar	Climax forest (*Pisonia grandis, Neisosperma oppositifolium*)
Jon, bulabol, kimeme	Mangrove forest
Kone	*Pemphis acidula* forest
Pat	Pond
[not translated]	Native shrubs and grassland
[not translated]	Crab population
[not translated]	Turtle nesting beach *(confidential)*
Janar	Windward forest

Stakeholders also highlighted medicinal plants as an important value in 2020, including *konnat (Scaevola taccada), kiden (Tournefortia argentea*), and *utilomar (Guettarda speciosa*).

CONDITIONS AND TRENDS

Information and Data

Data is not available or has not been located. The FIA has only been conducted twice (and was not designed to detect rare species and populations) and community-based assessment and mapping is still underway.

Strengths

- Micronesia Challenge
- Protected Area Network (PAN) Act (2015)
- Pest control regarding breadfruit
- Preserving pandanus varieties (revive *Bob* Festival)
- Increased population of *mule* (pigeon)
- Protected turtle nesting areas defined
- Increased coastal replanting (awareness improved on methods of coastal protection using traditional plants and techniques)
- More community-based management (CBM) and designation of priority areas
- Increased number of staff in the Agriculture Division

Weaknesses and Critical information gaps

- Not all species are known/inventoried (or information not readily available)

- Lack of baseline studies, especially on remote atolls
- Lack of continued monitoring
- Insufficient capacity/number of implementing agencies/partners for strategies
- No data storage and sharing of information/knowledge management (KM)
- Lack of awareness in the communities on forest management
- No follow up plans (implementation progress/no progress)
- Lack of SMART targets in plans
- Decreased number of plants species (*Ma Mejwaan*, swamp taro (on Ebon atoll), *Ma Joklap* (Likiep), Pandanus, *Kaanol, Kiden*)
- No mechanism/platform for biodiversity specific issues (intertwined with current climate change and adaptation focus)
- Community-based mapping and designation of priority areas is still ongoing on most atolls (see Table 4).
- "Coarse-scale terrestrial conservation targets" (ecosystem types of interest) listed in *Reimaanlok* ("agroforests," "indigenous broadleaf forests", and "wetlands") are thus far mapped only as "land," while the Forest Service vegetation type maps thus far only map "forest" and non-forest types (range, urban, barren, water). Actual vegetation type mapping is therefore an information gap at both the Republic and project level.
- Quantitative information about projected sea level rise and projected changes in local climate (both of which will affect terrestrial biodiversity) have a great deal of uncertainty. Predictions will become more accurate with (a) local direct monitoring of relative sea level rise, (b) improved world and regional modeling, and (c) commitments by larger nations concerning their carbon emissions.

Opportunities

- USFS Partnership, U&CF program and updated FAP
- The Micronesian Challenge
- Establishment of Protected Areas Network (PAN) Office
- More conservation areas
- *Reimaanlok* process (management plans for conservation areas), incorporating more terrestrial components
- 6th National Report on Biodiversity
- Biodiversity included in the NSP
- MICS updated on terrestrial methods
- Reinvigorate terrestrial working group
- SGP Funding
- Nursery at NRC has been renovated
- NRC replanting traditional plants
- Awareness for students
- NRC training opportunities/TTM/CMI Land Grant
- Need to update the NBSAP
- Partnerships/donor opportunities with GCF, GEF, EU, GIZ
- US FS Forest Health funding to combat invasive species; technical assistance to better understand the root disease issues (particularly in lowland tropical rainforest (per FIA report).

THREATS

- Development resulting in habitat loss
- Loss of keystone species

- Unsustainable farming practices
- Loss of traditional conservation practices
- Invasive species introductions and effects continue at a steady pace despite some efforts at quarantine and eradication (especially rats and root disease according to FIA results)
- Urban development and pollution
- Climate change and sea-level rise
- Still unknown long-term effects from nuclear testing
- Conflicting cultural perceptions. For example, *janar* (windward forest) is removed to provide "clean" (tidy) landscaping, views, and breezes.
- Obstacles in processes to obtain funding (no list of priority atolls focusing on biodiversity activities)
- Modern/introduced farming practices through MNRC, TTM, CMI Land Grant, WUTMI, Wellness Center, LFA and MIOFA if they are not sustainable.

PRIORITY AREAS

The *Reimaanlok* plan describes a community-based process of designating conservation areas. Most conservation areas encompass both near-shore marine resources and terrestrial resources; designations as "subsistence only" or "special reserve" primarily reflect intentions for the marine resources, so both types are simply shown as "conservation areas" in this terrestrial FAP. The enclosed atoll-by-atoll maps show all conservation areas designated to date which do include terrestrial resources. The "priority area" for the biodiversity issue of the RMI FAP includes these areas and any conservation areas that might subsequently be identified through a community-based process. **Table 4** shows, for any given atoll, whether the conservation area designation process has taken place or not.

Table 4 Status of Atolls in *Reimaanlok* (provided by MIMRA)

Overall Status of Reimaanlok Community-based Resource Management Planning by Site - October 2020

Pending	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
Kwajalein			Majuro - Buruon	Majuro - Ajeltake	Ailinglaplap	Majuro - Bikirin	Ailuk	
Rongerik				Likiep (R2R)	Jabat	Majuro - Drenmeo	Namdrik	
Rongelap				Aur (R2R)	Maloelap	Majuro - Bokan Botin	Jaluit**	
Ailinginae				Mejit (R2R)	Wotje	Majuro - Ene Kalamur		
Bikini				Lib (Ramsar Site)*	Namu	Majuro - Woja		
Enewetak					Arno	Utrik		
Ujelang					Mili	Ujae		
Erikub					Bikar	Lae		
Jemo					Bokak	Ebon (R2R)		
Taka					Wotho (R2R)			
Nadrikdrik					Ailinglaplap - Bouj			
Kili								

*Lib marine survey yet to be conducted

**Jaluit Atoll Conservation Area Plan from 1999 needs to be revisited

Additional priority biodiversity areas identified in 2020:

- Ailinglaplap, Namdrik, Jaluit, Mejit, Kwajalein and Arno (Mangroves)
- All other areas that have not gone through the *Reimaanlok* Process (Include Bikar and Bokaak)

B. FOOD SECURITY AND SUSTAINABLE LIVELIHOODS

Photo by Mikhail Aleksandrovich Yatskov

Agroforests are a source of subsistence goods and commercial products. Many Marshallese suffer from malnutrition and diabetes that could partially be addressed with increased agroforest production. Marshallese family incomes are low; agroforest production can reduce the need for purchases and bring in cash income.

Values, Benefits and Services

- Food security. Breadfruit, pandanus (tree crops) and taro (a component of the agroforest) are traditional staple starches.
- Nutrition. Fresh tree fruits avoid malnutrition and diabetes from unhealthy imported foods. Many traditional species and varieties have higher nutritional values than varieties bred for large-scale production, and certainly higher than refined and junk foods.
- Import substitution.
- Coconut and pandanus fiber for handicrafts, an important source of income, especially for women.
- Copra (dried coconut) for cash income
- High value market crops: some rare pandanus cultivars could prove to be useful specialty crops

- Sustainability. Traditional agroforest practices maximize soil organic material (compost), essential for water retention in sandy soils. Traditional practices do not add chemical fertilizers and pesticides to aquifers.
- Appropriate for the environment. The chemical composition of atoll soil does not allow the production of many crops that are grown on high islands or other tropical areas.

CONDITIONS AND TRENDS

While there has not been a formal comprehensive survey of agroforests in the Marshall Islands in recent years, partial surveys indicate that agroforests in the country are generally becoming less managed. In the last three to five years, however, there seems to be a growing interest among the general public on improving management and preservation of the country's agroforests. This is due in a large part to better awareness by the general public of the importance of agroforests.

Forest inventory data confirms that the national coconut resource is mostly in a cohort of mature plantation trees, indicating that sustained future copra production may require replacement of older senescing trees.

In terms of local food production and consumption, the trend is mixed. While there has been increased interest in local production in the urban center of Majuro, the results are mixed in terms of consumption. In the urban centers, it is clear that younger Marshallese have an affinity for imported processed foods over local foods. A sustained awareness campaign on the health benefits of local food consumption must be prioritized if this trend is to be reversed.

In the outer islands, local food production has declined in recent decades due to drought and urban migration; with a dwindling population base, many communities no longer have the human resources to tend to the land.

Strengths

- Agriculture Sector Plan
- Food Security Policy
- Climate Change Policy
- Increased capacity in conducting terrestrial surveys
- Improved functionality of the NRC Agriculture division
- Invasive Species Coordinator based at MNRC through SPREP Office
- Better access to partnerships and donors to implement activities
- Sawmill project: 13 sawmills placed in atolls to process senile coconut trees and plant new ones
- Increased conservation designations and awareness for marine and terrestrial resources
- Establishment of the Agriculture Course at CMI
- Targeted coconut replanting (mentioned as a target in national plans)
- Increased home, community and school gardens
- 'Be Marshallese, Buy Marshallese' program to promote trade and sale of handicrafts and products (i.e., pandanus baskets and coconut oil)

Weaknesses and information gaps

- Imbalanced access to local foods
- Easier access to imported goods even though can be more expensive
- Not enough awareness on measures on food security
- Sawmills project: lack of program to compensate operators/boom trucks
- Transportation schedules remain inconsistent, affecting supplies and assistance reaching atolls, and forest products and produce from reaching urban areas

- Coconut is more of an economic focus than it is for food security and nutrition
- Lack of enforcement and monitoring of conservation areas
- Composting of organic materials is very limited
- Maps needed of the most important underground water lenses (freshwater resources)
- Quantitative information needed about projected sea level rise and projected changes in local climate
- Baseline studies needed, especially of remote atolls, to compare trends

Opportunities

- Improve on replanting efforts for coconut trees not just for economic but for food security and increased nutritional value (i.e., local *kanauwe* variety)
- CC mitigation efforts (i.e., coastal protection of agroforestry)
- Work more closely with Traditional Leaders to reestablish *mo* sites (traditional conservation areas)
- Improve segregation and composting organic materials
- Increase education and awareness activities (i.e., nutrition and agricultural practices)
- Access to funding opportunities
- Update biosecurity legislation
- Update Biosafety Plan
- CCH Climate change and Health Action plan in process
- Capitalize on NRC's nursery projects to distribute seedlings to the outer islands for staple food crops and traditional methods for storage
- Develop workplans/business plans for the sawmill project (i.e., better planning for replantation)
- Preserve distinct varieties of local crops

THREATS

- Loss of traditional agroforestry practices
- Lack of awareness of nutritional values
- Invasive species, including those introduced as food crops or as ornamentals
- Clearing of forest in order to plant market crops, which are often unsustainable in the atoll environment
- Climate change (drought) and sea-level rise (salt water intrusion) resulting in disappearance of certain crops, trees, and medicinal herbs
- Conflicting cultural perceptions such as the above mention of clearing land vs. shoreline protection, also gathering gravel for use around homes
- Insects and diseases (i.e., root disease, coconut rhinoceros beetle)
- Excessive land clearing, mowing, burning etc. which removes protection and organic material inputs to the uppermost layers of soil, potentially rendering the soil less fertile
- Overuse of water for crops threatens the sustainability of underlying aquifers
- Lack of urban planning
- Increased clearing of forestry in urban centers for homes and businesses
- Increased pollution and solid waste management
- Land tenure
- Change in governments administration and priorities
- Epidemics and pandemics (i.e., COVID-19 in 2020)

PRIORITY AREAS

The priority area for this issue is considered all areas of mapped "forest" in the enclosed maps, since this class is mostly agroforest and no more detailed maps are available. Inhabited atolls (some atolls such as Rongerik, Ailinginae, Bikar and Bokak are uninhabited) are served by MNRC agriculture extension and are considered part of the priority area. The most productive areas are generally the inner lands of an islet, especially the widest islets with the richest soil and deepest freshwater lenses. Priorities are placed generally according to the following relative weights (although data is not available in GIS format and therefore has not been mapped):

- Breadfruit - 80%
- Coconut - 90%
- Climax forest - 70%
- Mangrove area - 50%
- Shrubland and Grassland - 40%
- Windward forest - - 60%
- Traditional reserves - 40%
- Traditional special purpose areas - 40%

The USFS, in collaboration with the University of Hawaii and support from USGS, provided technical assistance to create a Agroforestry in the Climate of the Marshall Islands web dashboard.

The RMI Food Security Policy (2013) provided preliminary guidance, followed by the RMI Agriculture Sector Plan (2021-2031) completed in 2020 that identifies key guiding principles, roles, and actions. The latter will serve as the primary guiding document for Agriculture outputs.

C. COASTAL REINFORCEMENT

Coastal forests are those on the beach crest above high tide mark. Their root systems reinforce the beach "berm" or crest. To an extent, they can therefore resist coastal erosion, maintain berm height, and therefore minimize the occurrence of "overtopping" (surge of high seawater into depressed interior areas). However, extreme events can always wash away forest, berms and even entire sections of sandy islands. Coastal forests have been thinned and removed in many urban and rural areas, so their restoration and maintenance in their natural state is a "no-regrets strategy" and a first line of defense against the effects of sea level rise.

Values, benefits and services

- Stabilize beach crest and avoid coastal erosion
- Windbreak protecting inner agroforests from wind, desiccation and salt spray.
- Protection for rare, endangered and/or endemic species, subspecies and cultivars
- The species of this coastal reinforcement are often pioneer species which are ecologically needed before secondary species can become established

CONDITIONS AND TRENDS

Data is not available, but continued clearing can be observed, with removal of large trees/forest areas on Majuro and Kwajalein for development purposes noted during the 2020 FAP workshop.

RMI is especially vulnerable to shoreline erosion, and has a number of projects that seek to mitigate this. In 2020, implementation of the Pacific Resilience Project – Phase II (PREP II), an agreement with the World Bank, was ongoing, with the objective to strengthen early warning systems and climate resilient investments in shoreline protection, including construction of seawalls.

Strengths

- Awareness increased on the importance of planting and protecting these species for coastal protection through various avenues (CMAC/*Reimaanlok* partners)
- More stringent monitoring of coastal projects by the RMIEPA
- Land Use Regulations
- Zoning and Building Regulations
- PAN Regulations
- Increased awareness of traditional coastal stabilization methods through CMI Land Grant
- More partners involved in National Resource Management
- Increased technologies and capacities to conduct surveys and forecast modeling for mitigation (GIS and other relevant technologies)
- Increased knowledge/awareness about the importance of coastal reinforcement
- Increased community engagement for coastal reinforcement (i.e., Ajeltake shoreline replanting efforts with communities)

Weaknesses and Critical information gaps:

- Capacity to address and analyze accelerated erosion processes and to identify mitigation opportunities.
- Scientific/baseline studies, especially atolls
- Not all tree and plant species in the RMI are known (or information regarding them is not readily available)
- Being diverse ecosystems, there are expected to be differences in species etc. between the southern wetter atolls and the northern drier ones
- Lack of data (i.e., baseline, collection, storage/accessibility)
- Limited capacity in the NRC Agriculture Division of Forestry
- Lack out outreach activities, materials and sharing of information

Opportunities:

- Development of the RMI National Adaptation Plan (in progress in 2020)
- More grants/opportunities available – need to have good proposal and project submissions
- Application (app) for Green Dashboard
- Strategies in place to replant resilient trees for coastal protection under the Agriculture Sector Plan and FAP
- *Reimaanlok* process for all outer islands for production of Coastal Management Plans (and corresponding Marine Protected Areas)
- Projects implemented through regional partner organizations (i.e., CROP) on water resource management in coastal areas (aquifers, etc.)

THREATS

- Land clearing including coastal forests, especially in urban areas.
- Urbanization
- Invasive species, especially *Casuarina* which is often inappropriately promoted as a wind break but is instead destructive in the atoll environment
- Construction of seawalls
- Indiscriminate beach "clean-up" efforts
- Tourism, removing the vegetation for better view of the sea, planting of "prettier" species. Coastal forests are usually not understood or appreciated for their ecological values.
- Climate change
- Pollution, locally generated and distant through drift
- Erosion and salt water inundation and excessive salt spray
- Lack of education and awareness and sharing of information on coastal erosion, protection, stabilization
- Increased dredging activities on Majuro and Kwajalein; dock development in some outer atolls
- Increased pollution for land and ocean-based sources

PRIORITY AREAS

Photo by Mikhail Aleksandrovich Yatskov

The priority area for this issue has been identified as a 100-foot strip around the coasts of each island in the Marshalls. At the project level, education takes place where the strip is intact, and restoration takes place where this strip has been de-vegetated.

Additional coastal stabilization priorities can be found in the RMI Joint National Action Plan for Climate Change Adaptation & Disaster Risk Management 2014-2018.

D. URBANIZATION

Urbanization is a result of migration and the adoption of modern patterns of living. A large proportion of the Marshalls' population is now concentrated on a few urban islands, with resulting reductions in forest cover and separation of people from the tangible and cultural benefits of forests.

Values, benefits and services of urban forests:

- Food (home gardens)
- Beauty and esthetics
- Cultural awareness
- Shade trees
- Larger number of people can benefit and learn about local species than in the more rural areas
- Medicinal value
- Economic value (copra and timber production)
- Coastal erosion control
- Ecosystem services

CONDITIONS AND TRENDS

No direct data available, though some factors are captured in the aforementioned study on climate change and migration (Van der Geest et all, 2019). Although some tree planting continues, it likely cannot keep pace with the increase of number of trees being cut down to allow for more houses, other buildings, and parking lots.

More areas in the rural sections of Majuro are being cleared for housing and parks development (no data available).

The aforementioned PREP II Project that includes building a seawall on Ebeye is a potential replanting area for larger trees (shading, wind barrier, etc.)

There is an increased number of personal gardens (banana, breadfruit, lime, plumeria) on two islands on Kwajalein.

Strengths

- RMI Joint National Action Plan for Climate Change Adaptation & Disaster Risk Management 2014-2018
- Reimaanlok/Outer Islands Coastal Management Plans/Ordinances
- Protected Areas Network (PAN)
- RMIEPA
- Increase in home, school and community gardens
- More planting of bob and ma trees
- EPA conditions on permitting for construction of buildings
- Nursery set up on Santo/Carlos Islands, Kwajalein
- Awareness improved through CMI Land Grant and NRC

THREATS

- Overcrowding, ultra-urbanization, as has occurred on Ebeye, Kwajalein and in parts of downtown Majuro, where trees are cut down to allow for more homes and concrete
- Invasive species, such as insect pests which can destroy trees.
- Changed sense of aesthetics (i.e., plain concrete is viewed as better than “messy” plants)
- More vehicles, need for more roads, parking lots, etc.
- Climate change resulting in reduction of available appropriate building areas, hence putting more pressure to cut down trees.
- Marshallese are often too busy with their jobs and other responsibilities to tend to gardens and trees
- Overcrowding, ultra-urbanization on Ebeye, Kwajalein and Majuro, where trees are cut down to allow for more homes and concrete
- Lack of Awareness of negative impacts from urbanization
- Increased dredging activities on both Majuro and Ebeye leading to more erosion and loss of coastal trees
- Pollution and Solid Waste Management

Weaknesses and Information gaps:

- Further information should be found as to which trees and other forest plants are appropriate for the urban setting (i.e., trees that tend to grow too large and break up house foundations should be discouraged, ones that are slower growing and do not drop excesses litter would likely be preferred).
- Lack of projects (i.e., forest stewardship, tree planting) on Ebeye/not as consistent as in the past
- Lack of monitoring and evaluation
- Lack of interest, maintenance and commitment from communities
- No regulations/guidelines on removal of trees
- Lack of opportunities/access to programs, information (i.e., which trees/plant species most appropriate for tropical, urban settings) and funding (especially for Ebeye Communities)

Opportunities:

- Conservation education (CE) and awareness programs for communities, youth and schools (note: as people generally do appreciate having trees and other plants around, more emphasis could be placed as to their value, not only for food, but also for their esthetics and value in stress reduction)
- Revamp replanting work in Ebeye for replanting, compost production, extend to other communities
- Community farming promotion on Ebeye (Taiwan Mission)
- Develop guidelines, ordinances on removing trees
- Improved capacity of *Reimaanlok* methodologies to include terrestrial surveys and analysis
- Establishment of the PAN and PAN Office
- USFS Replanting Project in the Ajeltake Community (MICS)
- Extensions/Outreach programs under Land Grant and the Wellness Center for replanting
- PSS collaboration with NRC for replanting of breadfruit and ma
- Establishing extensions and offices to ensure Ebeye Community (including Wotje and Jaluit) have better access to programs, information and funds.
- MOA between KalGov and CMI Land Grant
- Use of Community Accomplishments Reporting System (CARS) recommended by USFS

PRIORITY AREAS

The priority area for this issue has been mapped as all "urban" areas on the landcover type map.

II. STATEWIDE FOREST RESOURCE STRATEGY

CONTRIBUTING PROGRAMS AND RESOURCES

RMI MINISTRY OF NATURAL RESOURCES AND COMMERCE

The Ministry of Natural Resources and Commerce (MNRC), formerly the Ministry of Resources and Development (MRD), was originally established in 1979 under the Constitution of the Republic of the Marshall Islands (RMI). It consists of many Divisions and programs. The Division of Agriculture has three main functions: 1) Agriculture Production Services, 2) Plant and Animal Protection Services and 3) Agricultural Policy and Planning. This, along with housing the 'State' Forester, makes NRC the primary agency responsible for developing and implementing this Forest Action Plan. An identified long-term Strategy of this FAP is to create a Division of Forestry.

The Ministry's Annual Budget Portfolio identifies its key activities, many of which are carried over from the Five Year MRD Strategy and Action Plan (2005-2010). As the activities are still relevant and underscore the importance of sustainable development in all sectors under NRC, it is cross-referenced in the Strategy component of this FAP.

EXISTING RMI PROGRAMS, PLANS AND STRATEGIES RELATED TO FOREST RESOURCES

The Micronesia Challenge, RMI Protected Area Network, and Reimaanlok

The Micronesia Challenge (MC) is a shared commitment made by the FSM, Guam, Palau, CNMI, and the RMI 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. As was mentioned under the Forest Resource Monitoring section above, with USFS support, a long-term terrestrial monitoring program was established to track progress towards these goals, and data made available on a Terrestrial Web-viewer accessible online.

Contributing to the MC goals, is working to establish a Protected Area Network (PAN), and has passed related legislation: RMI PAN Act (2015) and RMI PAN Act Amendment (2018). The current process for developing conservation areas is following the Reimaanlok, process described in the Conservation of Biodiversity section and in detail in Reimaanlok: National Conservation Area Plan for the Marshall. Islands 2007-2012., which builds on The Republic of the Marshall Islands Biodiversity Strategy and Action Plan (2000).

Climate Change

RMI has prioritized planning for and mitigating climate change impacts over the years, through key documents that include, but aren't limited to:

- Vision 2018: Strategic Development Plan Framework (2003-2018)
- The National Climate Change Policy Framework (2011)
- National Climate Change and Health Action Plan (NCCHAP) 2012
- RMI Joint National Action Plan for Climate Change Adaptation & Disaster Risk Management 2014-2018

In 2020, RMI finalized its new National Strategic Plan for 2020-2030, and includes the following related to climate change:

> ***GOAL: Holistic Response to Climate Change for Sustainable Social, Economic Development and Well-Being of RMI and its People***
>
> *Policy Objectives*
> *1) Adaptation and resilience actions to current and future impacts of climate change*
> *2) Mitigation of Green House Gas (GHG) emissions in pursuance of RMI's NDC targets and pathway to net zero emissions by 2050*
> *3) Strong advocacy, diplomacy and regional/global leadership to enhance urgent global climate action*
> *4) Strengthened security and survival of RMI to the existential threats of climate change*
> *5) Continued national advocacy, awareness and education on climate change and resilience building.*
> *6) Increased climate finances to enable necessary response to climate change impacts on RMI's socio-economic development*

The *Tile Til Eo* 2050 CLIMATE STRATEGY, "Lighting the Way", provides recommendations to achieve zero emissions and 100% renewable energy within the Marshalls by 2050. In addition, it calls for the development of a National Adaptation Plan (NAP) in order to adapt to the impacts of climate change and achieve resilience. The NAP was in progress as of December 2020.

Invasive Species

MNRC's Division of Quarantine is the foremost responsible agency for addressing Invasive Alien Species (IAS). Some key strategies related to RMI's FAP themes are presented in the strategy matrix. The RMI National Invasive Species Strategy and Action Plan 2016-2022 (NISSAP), also identifies priority species for management, coordination, and actions. Numerous actions were highlighted during the FAP update:

Actions

- Strengthening institutional frameworks and capacity for IAS management
- Implementing Programs for IAS risk reduction, Early detection
- Determine level of invasive species (IS) awareness for all sectors
- Raise awareness and carry out outreach on the impacts of IS on biodiversity, economy, health and cultural values
- Design and implement community workshops to counter IAS threats
- Problem Definition, Prioritization and Decision Making
- Development of community-focused education and awareness resources
- Mechanisms are established to prevent the spread of invasive species across international borders, between states and within states
- Improve techniques for monitoring the spread of invasive species within the country.
- Determination of priority species for the country to address
- Improve understanding of priority Invasive species taxa, including species biology and associated impacts, and develop effective management techniques for these priority taxa
- Develop and implement improved inspection, treatment, packing and transportation procedures and methods, for goods and transport vectors
- Establish, maintain and utilize risk assessment procedures for the proposed importation of new species, varieties, etc. and for the internal movement of organisms from one island group/atoll to another
- Improved functionality of the Marshall Islands Invasive Species Taskforce (MIIST)
- Improve ability to prevent the incursion of non-native species

- Establish and maintain an effective IAS incursion detection and response system
- Create biosecurity protocols and response capacity for non-established priority species

Additionally, there is a Regional Biosecurity Plan for Micronesia and Hawaii, and a Regional Invasive Species Council (RISC), that includes representation from the NRC Quarantine Division.

National Environment Management Strategy

The RMI National Environment Management Strategy 2017–2022 was developed in order to address issues identified in the 2016 RMI State of the Environment (SOE) Report 2016. Implementation is coordinated and monitored by RMI OEPPC. Three of the themes strongly align with the FAP, and their focus areas are below. Refer to the NEMS for strategies for each.

Theme 1: Atmosphere And Climate. Strategic Focus Area:

4 Ensure RMI Commitment To Climate Change Adaptation.

Theme 2: Land. Strategic Focus Areas:

1 Ensure Protection Of Existing Vegetation, Coconuts, Breadfruit And Pandanus.

2 Promote Sustainable Agricultural Practices On Cultivated Land, With More Focus On Traditional Practices.

3 Committed To Protection Of Wetlands.

Theme 4. Biodiversity. Strategic Focus Areas

1 Protect Special Ecosystems, Sites, Tradition, Language And Species

2 Foster Long Term Protection And Maintenance Of Biodiversity in the RMI

RMI FOREST RESOURCE STRATEGY TABLES

The following strategies are organized by RMI's Priority Issues (Conservation of Biodiversity, Food Security and Sustainable Livelihoods, Coastal Reinforcement, and Urbanization). Priority areas for each issue are identified above in the Assessment section. The US Forest Service State and Private Forestry (S&PF) resource programs most likely required to help implement the strategies are the Forest Stewardship Program (FS), Urban and Community Forestry Program (U&CF), and Cooperative Health: Forest Health Management and Monitoring (FH). A description of these and other USFS programs can be found here: www.fs.usda.gov/naspf/sites/default/files/naspf/pdf/spf-authorities-final.pdf. For each strategy, resources required include both funding and technical support is needed, and will be sought from a variety of partners, which key potential contributors and implementors shown in the Tables.

Table 5 Biodiversity Strategies

RMI ISSUES	STRATEGIES	PROGRAMS AND PARTNERS THAT HELP IMPLEMENT	RESOURCES REQUIRED (Technical and Financial from USFS, RMI Gov, others)	USFS OBJECTIVE (Table 2)	PERFORMANCE MEASURE
BIODIVERSITY	Develop management plans through *Reimaanlok* process (include planting, growing, maintaining and sustainably harvesting food crops, medicinal plants, trees and target species)	Reimaanlok, NRC, CCD, Local partners, Traditional Leaders, CMAC, CMI Land Grant, MIOFA, MICS, FAO/USFS	FSP, RMI Government	Conserve, Protect, Enhance	Establish # of management plans in communities (biodiversity focus)
	Establish NRC Forestry Division (with dedicated forestry positions)	NRC, CCD, USFS	FSP, FH, U&CF, RMI Government	Conserve, Protect, Enhance	MNRC Forestry Division established by 2030 equipped with # of capable staff
	Expand educational outreach in regards to forest management (importance of conserving traditional trees, plants and crops), to include pest identification and management	NRC, PSS, PREL, CMI Land Grant, Jo Jikum, NGO's	FSP, FH, U&CF, RMI Government	Conserve, Protect, Enhance	Establish # of field agents, # workplans developed, development of curriculum.
	Develop and institutionalize RMI terrestrial data collection and analysis (baseline data, data collection methods and training on methods, monitoring)	NRC, MICS, CMAC, PAN,	FSP & FIA, RMI Government	Conserve, Enhance	By 2025 MNRC has developed a user-friendly database system for terrestrial information

Table 6 Food Security and Sustainable Livelihoods Strategies

RMI ISSUES	STRATEGIES	PROGRAMS THAT HELP IMPLEMENT	RESOURCES REQUIRED	USFS OBJECTIVE (Table 2)	PERFORMANCE MEASURE
FOOD SECURITY AND SUSTAINABLE LIVELIHOODS	**Promote and increase production of agroforestry** including high value market crops; community extension and education *(See MNRC Five Year Plan: Agriculture Production Services as applied to tree crops – pp22-23)*; including control of invasive plants	Reimaanlok, R2R, CMI Land Grant, Taiwan Technical Mission, MICS, MIOFA, LFA, Local Governments & Land Owners	FSP, U&CF, FH, FAO, RMI Government, Republic of China Taiwan (ROC), GEF 5&6,SPC, European Union (EU)	Conserve, Protect, Enhance	% of pop. Benefitting from sustainable livelihood thru: health, education and standard of living;
	Rejuvenate Traditional Crops - Promote drought tolerant variety of indigenous food crops - Educate community, as with "Bob" *festival (See MRD Five-Year Plan as applied to tree crops, pp. 22-25).*		FSP, U&CF,FAO, EU, RMI Government, GEF 5&6, SPC	Conserve, Enhance	Increase or change in # of household's access to traditional crops; #acres made more resilient
	Environmental Degradation Minimized 1. Planting of salt-tolerant traditional trees along coastal areas 2. Promote tree planting on farmlands including coconut replanting 3. Promotion and preservation of the diversity traditional and cultural plants 4. Support development of appropriate agroforestry systems 5. Promote urban forestry *(See RMI Agriculture Sector Plan 2021-31 pp 21)*		FSP, U&CF, FAO, EU, RMI Government, GEF 5&6, SPC	Conserve, Protect, Enhance	# Number of trees planted traditional and exotic, soil and water condition improved

RMI ISSUES	STRATEGIES	PROGRAMS THAT HELP IMPLEMENT	RESOURCES REQUIRED	USFS OBJECTIVE (Table 2)	PERFORMANCE MEASURE
FOOD SECURITY AND SUSTAINABLE LIVELIHOODS	**Sustainable crop production systems developed and promoted** 1. Improve soil conditions 2. Improve water use 3. Develop pests and diseases control methods 4. Crop diversity improved, conserved, and utilized 5. Develop appropriate agroforestry systems 6. Develop a package of practices for major crops *See RMI Agriculture Sector Plan 2021-31 pp 22-23)*	Reimaanlok, R2R, CMI Land Grant, Taiwan Technical Mission, MICS, MIOFA, LFA, Local Governments & Land Owners	FSP, U&CF, FH, FAO, GEF 5&6, RMI Government	Conserve, Protect, Enhance	soil quality water use # of crop varieties used in agriculture production The resilience of agroforestry systems
	Increased consumption of nutritious locally-produced foods 1. Promote home gardens (combination of starchy staples and nutritious traditional and exotic vegetables 2. Preservation of knowledge on traditional food preparation and preservation 3. Develop recipes, create a recipe book 4. Support schools in proper nutrition *See RMI Agriculture Sector Plan 2021-31 pp 23)*		FSP, U&CF, FAO, RMI Government, EU, GEF 5&6, (ROC)	Conserve, Enhance	# of home gardens # healthy recipes adopted by target households

RMI ISSUES	STRATEGIES	PROGRAMS THAT HELP IMPLEMENT	RESOURCES REQUIRED	USFS OBJECTIVE (Table 2)	PERFORMANCE MEASURE
FOOD SECURITY AND SUSTAINABLE LIVELIHOODS	**Coconut "Tree of Life" Development**: 1. rehabilitation & replantation 2. Sawmill program (locally funded project to utilize senile coconuts and replant coconuts) *(MND Five-year Plan, pp. 18-20)*	Reimaanlok, R2R, CMI Land Grant, Taiwan Technical Mission, MICS, MIOFA, LFA, Local Governments & Land Owners	FSP, U&CF, GEF 5, RMI Government, EU	Conserve, Enhance	Increased # of acres/ % community owned coconut rehab sites Identified sites of coconut replantation Established coconut plantation in top copra producing atolls. Increased # of pop. Benefitting from copra
	Forest/agroforest pests & diseases - Quarantine - Eradication and control programs; response plans - Develop animal and crop protection program - Biocontrol measures - Public education re quarantine - Monitoring & surveillance - Pest Prevention, early detection - Additional training for pest detection and pest management (i.e., pesticide application, etc) *(MRD Five-Year Plan, Plant and Animal Protection Services)*		FH, RMI Government, SPC, SPREP, GEF6	Conserve, Protect, Enhance	% of identified areas with pests & diseases controlled Plant and animal protection program operational

Table 7 Coastal Reinforcement Strategies

RMI ISSUES	STRATEGIES	PROGRAMS THAT CONTRIBUTE	RESOURCES REQUIRED	USFS OBJECTIVE (Table 2)	PERFORMANCE MEASURE
COASTAL REINFORCEMENT	*Data collection, monitoring and analysis*				
	-Support development of terrestrial baseline survey (TBS) (with focus on coastal changes and vegetation) methodology to be integrated into Reimaanlok *-Build capacity of partners to implement TBS on all atolls* *-Enable ongoing monitoring and analysis to inform management and replanting initiatives*	USFS, NRC, CMAC, MICS, MIOFA, CMI, RMIEPA, local govs	FSP, U&CF, GEF 6&7, EU, RMI Government,	Conserve, Enhance	-Practitioner guide developed for TBS, -TBS methodology formally adopted by CMAC #of partners trained on TBS methods, # of atolls with a TBS
	Protection of Coastal Areas				
	- Replanting of indigenous salt tolerant vegetations -Increase traditional method of coastal protection "jannar"	USFS, CMI-UH Sea and Land Grant, NRC, PAN Office, RMIEPA, MICS, SPREP, SOPAC, Local governments	FSP, U&CF, RMI government, GEF	Conserve, Protect, Enhance	Increase % of coastal vegetation grown in vulnerable sites. Increased cultural awareness. Acres of forest made more resilient. # of communities using traditional coastal protection. Miles of coastline protected with traditional methods
	-Establishment of protected areas focused on vulnerable coastlines	CMAC partners, PAN Office, Local governments			# of protected areas established with goal of coastline preservation
	-Establish and maintenance of seed bank and nursery for variety of salt tolerant, coastal fixing vegetation	MIOFA, NRC, CMAC, Local Governments, CMI Land Grant			# of seedlings distributed to communities

Table 8 Urbanization Strategies

RMI ISSUES	STRATEGIES	PROGRAMS THAT CONTRIBUTE	RESOURCES REQUIRED	USFS OBJECTIVE (Table 2)	PERFORMANCE MEASURE
URBANIZATION	Develop policy/ordinance to require/align tree planting activities on projects - Organize municipal advisory groups - Recruit volunteers - Develop tree ordinances (including conservation area designations) - Community assessments & plans - Conservation education - Pest detection and management	NRC and all agencies in Advisory Council	U&CF, FH, RMI Government	Conserve, Protect, Enhance	#communities developing/ managing forests #people in environmental literacy & stewardship # of ordinances passed (established through coastal management plans)
	Beautification & cultural awareness: - Pre and post assessments - Education and Awareness strategy	WUTMI, MICS, OCIT, NRC, traditional and community leaders, local govt	U&CF, RMI government	Enhance	Change in general attitude towards plants and forests. #People engaged in stewardship.
	- Promote School planting activities - Interest youth in careers in agriculture and agro-forestry - Pre and post assessments	MICS, NRC, FAO, PSS, OCIT, WUTMI, traditional and community leaders	FSP, U&CF, RMI Government, FAO, SPC	Enhance	#schools participating in planting activities #students enrolled in agroforestry certificate
	Organic Composting Education - Education and Awareness in communities and schools - Promote use of organic/ composting instead of burning waste	MAWC, NRC, Local Governments, PSS, MICS	FSP, U&CF, FAO, RMI Government	Enhance	#of awareness presentations/events held, # of households composting

RMI FOREST ACTION PLAN DEVELOPMENT PROCESS

As the primary agency responsible for forest resources and to the RMI 'State' Forester, RMI MNRC led the process to update this FAP. It utilized the expertise of the Micronesia Conservation Trust (MCT) and their consultants to assist with coordinating, reviewing, revising, and preparing the document. The USFS provided funding, technical support, review of draft documents and overall guidance. Stakeholder groups consulted are described in the following sections.

Discussion began in late 2019, with plans to start consultations in early 2020. Unfortunately, the global COVID-19 pandemic resulted in the need for the RMI to take extreme precautions and close its border incoming arrivals. As an internal precaution, social gatherings and large meetings were greatly limited. For this reason, this update was significantly delayed, and required a new strategy that resulted in much of the process to be conducted virtually over teleconference calls with remote input from the consultants.

Intensive preparation of the FAP took place over six months, from July -December 2020. After a thorough desktop review in July, the consultants provided guidance to a local organization, the Marshall Islands Conservation Society (MICS), who facilitated an in-person FAP workshop. Prior to the start of the workshop, MNRC reviewed the 'State' Forest Stewardship Coordinating Committee (SFSCC), and invited members and other relevant stakeholders. The workshop invitation and additional information is provided in Appendix 3.

The workshop was held on July 30th and 31st , 2020 in Majuro. During the workshop, the participants reviewed the original 2010 SWARS, and reconfirmed or adjusted RMI's priority and cross-cutting issues and threats. For each issue, they conducted a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis to serve as information needed to describe the current conditions and trends and threats. The group then discussed priority landscape areas for each issue. Following the workshop, the MICS and MCT consultants incorporated the notes into the revised draft FAP under MNRC's direction. The draft FAP was circulated among the

stakeholder groups for further consideration. It was submitted for review to the USFS on August 30, 2020. After comments were returned, MNRC continued to work with the consultants and USFS via email and conference calls from October to December, 2020. The final document incorporates the feedback received from many partners.

STATE FOREST STEWARDSHIP COORDINATING COMMITTEE

For the purpose of updating RMI's Forest Action Plan, the MNRC reached out to key agencies, organizations, interest groups, and other stakeholders during the process for consultations. Heads of agencies constituted an ad hoc 'State' RMI Forest Stewardship Coordinating Committee (SFSCC) for Forest Action Plan review.

Organization executives listed in the table above were all notified of the two-day RMI FAP Consultation Workshop that took place at the end of July, 2020, in Majuro. Some attended the workshop and some were represented through their proxies. All the organizations listed in the table are key stakeholders in the focus areas of biodiversity, food security and sustainable livelihoods, coastal reinforcement and urbanization; and their valuable advisory views and opinions are considered to be crucial to the discussion on the outcomes of the Forest Stewardship Committee.

The Coastal Management Advisory Council (CMAC) will play a key role in the coordination and assistance of the implementation of the FAP with communities across the Marshall Islands. Partnership amongst key member agencies and is key to the success of CMAC. CMAC will serve as an advisor, facilitator and reviewer of projects and proposals that address priority FAP strategies, especially those that can best be implemented by or with other agencies and communities.

Table 9 RMI State Forest Stewardship Coordinating Committee

RMI 'State' Forest Stewardship Coordinating Committee (SFSCC)		
Interest or agency required by law "if feasible" on the SFSCC	**Agency/Organization/ Group**	**Representative Name**
RMI "State Forester" (advised by the committee)	Ministry of Natural Resources and Commerce (NRC)	Iva Reimers – Roberto
US Forest Service	N/A	N/A
Farm service agency	N/A	N/A
NRCS	N/A	N/A
Cooperative Extension Service / National Institute of Food and Agriculture	College of the Marshall Islands-CRE/Land Grant Program	Stanley Lorennij
Local Government	Marshall Islands Mayors Association (MIMA)	Manini Kabua, Jr
(Association of) S&WCD	N/A	N/A
Forest Products Industry (Profit-making agro-forestry, handicrafts, copra processing, or ecotourism representatives)	Waan Aelon In Majel (WAM)	Alson Kelen
Private Forest landowners *(Agro-forest landowners)*	Council of Iroij	Melvin Majmeto
Land-trust organizations	N/A	N/A
State lead agency for Forest Legacy	N/A	N/A
Environmental/Conservation organizations	RMI EPA	Moriana Phillip
	RMI Climate Change Directorate	Clarence Samuel
State fish & wildlife agency	MIMRA	Glen Joseph
Others	Public School System (PSS)	Kanchi Hosia
	Tobolar	Patrick Langrine
	Marshall Islands Conservation Society (MICS)	Dolores de Brum – Kattil
	Women United Together Marshall Islands	Daisy Alik - Momotaro

"STATE" WILDLIFE AGENCY

MNRC, the forestry agency and submitter of the FAP, is the point of contact for the Endangered Species Act (including terrestrial wildlife), in collaboration with RMI Environmental Protection Agency (EPA) and the Marshall Islands Marine Resources Authority (MIMRA). MIMRA has overall responsibility for near shore marine

fisheries, which are affected by forest (land) management. EPA and MIMRA are both members of the Coastal Management Advisory Council (CMAC) and the RMI Forest Stewardship Committee, and representatives from each agency were consulted during the process of updating this FAP in 2020.

STATE TECHNICAL COMMITTEE

The Farm Bill expects consultation with the USDA NRCS State Technical Committee, which would normally represent interests within the "state", and is a regional body in the Pacific. The State Forester for the Pacific Island Region, Mathew Cocking, is based in Hawaii. Meetings typically cover topics of relevance to the domestic islands, and the interests that would normally be represented by a State Technical Committee are largely the same as the interests represented in the Forest Stewardship Committee. There is no USDA NRCS office or Local Working Group in the Marshalls. The closest office is in Pohnpei, Federated States of Micronesia (FSM). During the time RMI's FAP was being updated in 2020, the District Conservationist, David Komorowski, was unable to take up his post in the FSM due to COVID-19 travel restrictions. Therefore, this requirement was addressed by providing (via an emailed link) the draft updated RMI FAP to Mr. Komorowski and Mr. Cocking for review.

LEAD AGENCY FOR THE FOREST LEGACY PROGRAM

Not applicable, as the Marshall Islands are not yet participating in the Forest Legacy program.

APPLICABLE FEDERAL LAND MANAGEMENT AGENCIES AND MILITARY INSTALLATIONS

The only Federal (US) land management agency is the US Department of Defense (DoD), which leases, occupies and manages most of Kwajalein atoll, under the terms of the Compact of Free Association between the U.S. and the Republic of the Marshall Islands. There is no contiguous land border between DoD-leased land and non-DoD-leased land.

The Forest Action Plan is not expected to involve any land under DoD lease, but the USFS will notify the US Ambassador to the RMI about the FAP and its purpose. If necessary, it will be reviewed through these established channels with the US military.

IV. OTHER PLANS INCORPORATED

The following mentioned plans are either required by the USDA Forest Service and thus addressed, or highly relevant to the RMI Forest Action Plan resource assessment and strategies and included.

COMMUNITY WILDFIRE PROTECTION PLANS

The Marshalls became eligible for FS Fire & Aviation Management funding with the 2008 Farm Bill. No community wildfire protection plans or state-wide fire plan have been written in the Marshall Islands. The development of such plans was a strategy in 2010, but was not prioritized in the 2020 update of the RMI FAP.

"STATE" WILDLIFE ACTION PLAN

As a sovereign nation, the RMI is not subject to the U.S. domestic requirement for states to have a Wildlife Action Plan. Several documents address native terrestrial wildlife as part of broader biodiversity plans, and are included in the following section. All plans and documents related to terrestrial resources were reviewed as part as part of the preparation of this FAP to ensure that strategies do not conflict, complement, or are included herein.

OTHER PLANS

The plans linked below contain key strategies that support RMI's forest resources, and have been described throughout the narrative.

The Republic of the Marshall Islands National Strategic Plan, 2020-2030.

Republic of the Marshall Islands, Ministry of Resources and Development, 2004. "Strategy and Action Plan 2005-2010." (Strategies still used by MNRC)

The Republic of the Marshall Islands Biodiversity Strategy and Action Plan (2000).

Reimaanlok: National Conservation Area Plan for the Marshall. Islands 2007-2012.

RMI Joint National Action Plan for Climate Change Adaptation & Disaster Risk Management 2014-2018

RMI National Invasive Species Strategy and Action Plan 2016-2022

RMI National Environment Management Strategy 2017–2022.

The 2020-2025 RMI Agriculture Sector Plan was finalized in 2020 and is highly important in addressing RMI's food security issue. It is attached to this FAP (Appendix 4).

Additional useful plans were presented in the narrative, and listed in the references below.

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V. APPENDICES

APPENDIX 1

RMI FAP Supplemental Information

RMI FAP Supplementary Information from FIA Summary Data

Prepared by Julian Dendy, August 2020

This information was generated from the FIA database containing both base plot and MC plot data for RMI from 2008, 2018 and GRM (growth, removals and mortality). Most of the possible comparisons of MC terrestrial measures were made in the RMI MC measures report, so most of the additional information contained in this document is focused at the forest community level or northern vs. southern atolls. This information was summarized with the intention to inform the RMI forest action plan, especially priority areas of coastal stabilization and food security. The forest communities used by the FIA seem useful for organizing these priority areas, since strand forest is critical for coastal stabilization, agroforest is important for food security, and lowland rainforest shelters many native plant species. The document is divided into sections based on forest community, and there is a short discussion at the beginning of each to highlight trends in priority areas.

In addition to average (or mean) values which are presented in tables and figures throughout, there are sample error (SE) values which provide an estimate of how reliable the average values are. The larger the sample size (and lower SE), the more reliable the average estimate will be, and the smaller the sample size (and larger SE), the less reliable the average will be. As such, the reader is encouraged to always compare the SE to the average estimate before making any conclusions. Unfortunately, the sample sizes are small for many categories, including at the national level (mangroves), and management level. Additionally, the variation within forest communities is high, which also contributes to high SE values. It is therefore difficult to make definitive statements about the direction of trends of indicators in all priority areas, and if SE values are larger than average estimates, the direction and size of trends should be used and quoted with caution.

Before the forest community sections there are a half dozen tables and figures summarizing the number of plots by region, forest community, or base/MC, as well as summaries of forest communities by disturbance type and canopy cover, which are presented as a reference to the reader to check on sample sizes and general trends among forest communities across RMI. Some important considerations based on these summaries are there was only 1 partial mangrove plot sampled, there were only 7 strand forest plots and 6 lowland rainforest plots in the south, and there were only 9 agroforest plots in the north.

Weather was the largest disturbance type overall, which only affected strand forest, and strand forest was the most disturbed forest community by area. There were not any disturbances recorded for lowland rainforest. Lowland rainforest and strand forest had the highest live canopy cover, with little forest area with less than 60% cover and more than 65% of forest area with greater than 90% cover. Agroforest had less than 10 percent of forest area with canopy cover of 90% or greater, and nearly 20 percent of forest with 50% cover or less. All forest in RMI was recorded as property of local government.

Total number of base FIA forest plots and MC forest plots and by forest community

	Base FIA Inventory	Micronesia Challenge
Total Forest Plots in 2018	54	17
Strand Forest Plots	18	6
Mangrove Plots	1	0
Agroforest Plots	20	7
Lowland Rainforest Plots	17	5

Number of base FIA forest plots, MC forest plots, and MC Area plots by RMI region

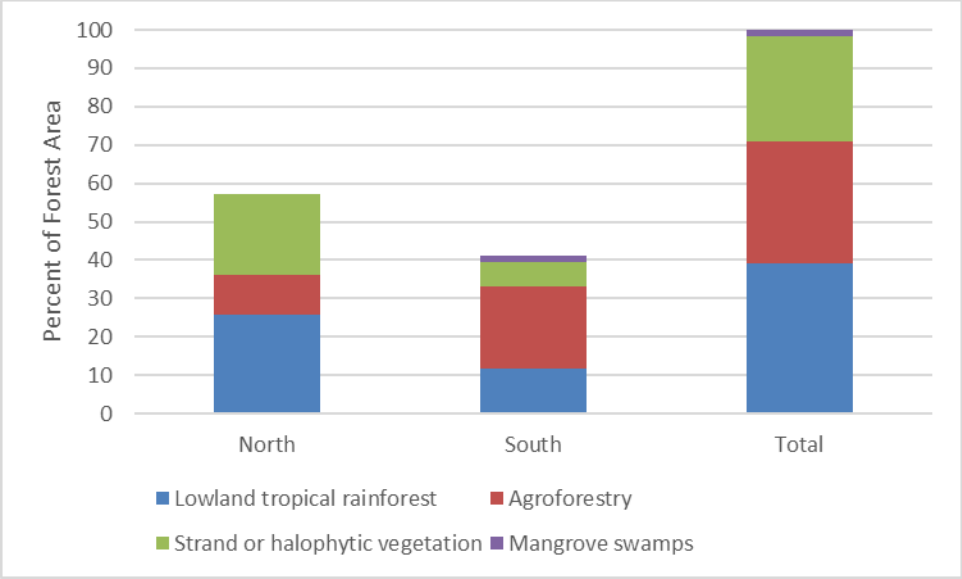
	Base FIA Inventory	Micronesia Challenge	MC Area
North	24	17	3
South	30	0	9

Total number of all forest plots by forest community and RMI Region. Mangrove was only sampled as the smaller partial condition in a plot with two communities.

	RMI North	RMI South
Total Forest Plots in 2018	41	30
Strand Forest Plots	17	7
Mangrove Plots	0	1*
Agroforest Plots	9	18
Lowland Rainforest Plots	15	6

Percent of total forest area by forest community and RMI region

	North		South		Total	
Forest Community	Total	SE	Total	SE	Total	SE
Strand Forest	21.0	7.0	6.6	3.7	27.5	7.6
Mangrove	--	--	1.5	1.5	1.5	1.5
Lowland rainforest	25.8	8.2	11.7	6.6	39.3	9.3
Agroforest	10.4	5.2	21.3	7.2	31.7	7.9
Total	57.2	8.6	41.1	8.7	100.0	0.0



Percent of total forest area by RMI region and forest community overall

Percent of RMI region forest area by forest community by and overall

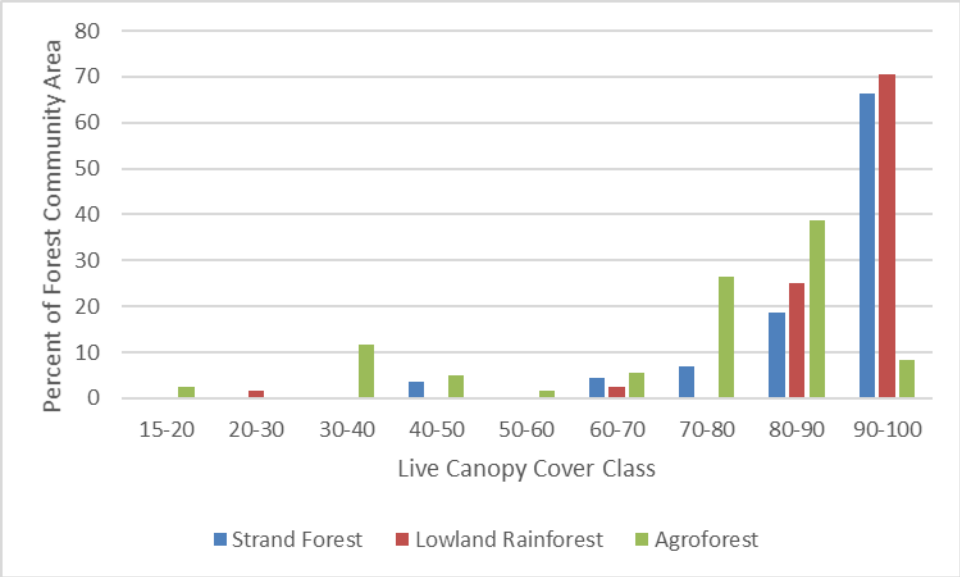
	North			South			Total		
Forest Community	Total	SE	Plots	Total	SE	Plots	Total	SE	Plots
Lowland rainforest	45.1	12.3	15	28.5	14.2	6	39.3	9.3	22
Agroforest	18.2	8.6	10	51.8	14.0	17	31.7	7.9	27
Strand forest	36.7	11.4	17	16.0	8.8	7	27.5	7.6	24
Mangrove	--	--	0	3.7	3.7	1	1.5	1.5	1
Total	100	--	40	100	--	30	100	--	71

Percent of forest area disturbed by type and forest community in RMI

	Strand Forest		Mangrove		Lowland Rainforest		Agroforest		Total	
Disturbance Type	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE
Insect Damage	0.6	0.6	--	--	--	--	--	--	0.6	0.6
Human caused	--	--	--	--	--	--	1.9	2.0	1.9	2.0
Vegetation	2.6	2.6	--	--	--	--	--	--	2.6	2.6
Weather	4.3	3.3	--	--	--	--	--	--	4.3	3.3
Any Disturbance	6.2	4.1	--	--	--	--	1.9	2.0	8.1	4.5
Undisturbed	21.3	7.0	1.5	1.5	39.3	9.3	29.8	8.0	91.9	4.5
Total	27.5	7.6	1.5	1.5	39.3	9.3	31.7	7.9	100.0	0.0

Percent of forest community area by live canopy cover class in RMI

	Strand		Lowland		Agroforest		Total	
Live Canopy Cover	Total	SE	Total	SE	Total	SE	Total	SE
15-20	--	--	--	--	2.4	2.4	0.8	0.8
20-30	--	--	1.7	1.7	--	--	0.7	0.7
30-40	--	--	--	--	11.8	9.7	3.7	3.1
40-50	3.7	3.7	--	--	4.9	3.6	2.6	1.9
50-60	--	--	--	--	1.6	1.6	0.5	0.5
60-70	4.3	4.3	2.6	2.6	5.6	5.6	4.0	3.3
70-80	7.0	6.8	--	--	26.5	14.6	10.3	5.5
80-90	18.7	13.7	25.1	13.1	38.9	15.6	27.3	8.3
90-100	66.3	15.3	70.6	14.1	8.4	7.9	50.1	9.3



Percent of forest community area by live canopy cover in RMI

Mangroves

Mangroves are thought to be native to RMI but are not extensive and probably do not contribute very much to coastal stabilization overall. Impoverished mangrove swamps are known to occur in Jaluit, Arno and Ailinglaplap atolls in the wetter south. In the north, mangrove species (especially *Bruguiera gymnorrhiza*) occur in low, wet spots called mangrove depressions, which in some cases were planted by the Marshallese people who make use of the trees (Muller-Dombois & Fosberg, 1998). While it would be interesting to learn more about the atoll mangrove forest community, only one partial plot was sampled in Arno atoll, so no further mangrove information will be presented here.

Agroforest

The native forests across Micronesia have been heavily altered over the millennia since human beings first established themselves there, but the people of RMI had probably come to an ecological balance, with most of the original native plant species continuing to survive on the inhabited atolls (Muller-Dombois & Fosberg, 1998). A human controlled agroforest has developed in Micronesia over millennia which is quite a sensible, diverse, and efficient system for growing food in the humid tropics (Merlin et al, 2018, Raynor & Fownes, 1989, Falanruw, 1993, Manner, 1993). In RMI, however, a century of planting coconut trees for commerce almost completely converted most of the atoll forests that had developed with human care over time, and some atolls were transformed even further by WWII buildup and military invasions, bombardments, nuclear weapons testing, and urban development.

Agroforests are especially important to food security in RMI. While composed of mainly introduced plant species, they have mostly been established for many generations and are mixed with many useful native species. In RMI, because of the small size of islets, there is an even less distinct boundary between strand forest, lowland rainforest, and agroforest, and strand forest elements permeate throughout. As such, most of the agroforest tree species were summarized for all forest area, unless an agroforest summary is mentioned. Most summaries include estimates for all of RMI, and northern and southern atolls. Because of the latitudinal rainfall gradient, there is interest in comparing regions, and the expectation that more kinds of plants, trees, and food species will occur in the wetter south.

Several species highlighted as agroforest species in the tables and figures are also native (or strand, ie Coconut), and there are varieties selected for various uses grown in agroforests which may be different from those growing wild (ie *Pandanus tectorius*). However, agroforests are usually located close to houses for convenience, efficiency, security, and shade, which unfortunately sometimes means that those forests are not sampled by the FIA inventory since they may not meet minimum canopy cover or size requirements. This seems to be the case in RMI particularly, as there were no observations of common food plants like banana, papaya, citrus, or arrowroot.

The agroforest summary from the FIA inventory is what you might expect given that it is a human managed forest. It was the only forest community with human disturbance, and had the lowest average canopy cover, highest overall tree damage, and highest invasive species presence/coverage among communities.

The southern atolls had the most developed agroforest, with about half of total forest area under agroforest, which accounted for about one fifth of RMI's total forest area. By contrast, the agroforest in northern atolls had about a fifth of forest area in agroforest, accounting for about one tenth of RMI's forest area. Agroforest in both regions was dominated by coconut trees, with *Cocos nucifera* comprising about three quarters of total basal area (square feet of wood).

Southern agroforests had a half dozen other tree species composing the agroforest, and the native and important *Pisonia grandis* was the second most dominant tree species. Perhaps unsurprisingly, other common strand tree species composed most of the rest. Northern agroforests had mostly only *Pandanus tectorius* trees to accompany the coconut trees that compose the agroforest there. Coconut trees were equally spaced throughout all forest communities in RMI, but it appears that *Pandanus* was more densely, and *Morinda* less densely, planted in agroforests compared to the presumably naturally occurring stem densities in other forest communities. *Terminalia catappa* is considered an introduced

and agroforest species in RMI and is a common strand species across the tropical Pacific but made up less than half of one percent of agroforest basal area.

Coconut tree seedlings covered the most agroforest understory among all plant species and covered about twice as much agroforest understory in the south as in the north. Other than seedlings of the common agroforest tree species (Coconut, *Pandanus, Morinda*), there were few other food species in RMI agoforest understory, and all together they covered less forest area than any of the agroforest tree seedlings. There were 40 species of understory plants recorded altogether in agroforest (33 in south, 22 in north), which was more than strand or lowland rainforest totals. Most were native, but three invasive species were recorded, which were present in around a third of agroforest area and covered about 4 percent of agroforest area. Other than agroforest tree seedlings, there were no common food plants observed in strand or lowland rainforest understory.

There were only 11 total live breadfruit trees inventoried, which is probably due to the sampling methodology of agroforest earlier mentioned, and so the total percent of all trees and number of breadfruit trees are probably substantially underestimated for RMI. Only two plots in the northern atolls had breadfruit sampled, and as would be expected there appear to be substantially more breadfruit trees in the southern atolls, but the sample error for number of trees is higher than the estimate for the southern atolls and the sample error for percent of all trees is higher than the estimate for the northern atolls. There appears to be a similar case with *Morinda citrifolia*, with substantially but not significantly more trees in the northern atolls. There were also more, but not significantly, *Pandanus tectorius* trees in the northern atolls. While coconut trees were dominant in 100% of agroforest area in southern atolls, *Pandanus* showed up as dominant in 10% of agroforest area in northern atolls (with high sample error, and coconut dominant in the rest).

As would be expected from the rainfall gradient, there were more smaller diameter trees and fewer large diameter agroforest trees in northern atolls than southern atolls, but the only significant difference by diameter class was in trees >= 10 inches DBH (19.7% more in southern atolls, SE=15.6). This appears to be mainly due to the presence of large breadfruit trees and more estimated coconut trees in southern atolls.

About half of all coconut trees were damaged, and coconut trees had the highest rate of damage of any species from human activities by far, which makes sense since they are usually climbed to harvest, and notches are often cut into the trunk to facilitate climbing. *Morinda citrifolia* had the highest overall percentage of trees damaged, and the highest rates of stem decay and vine damage among agroforest tree species. Stem decay was the most prominent damage type overall but may have been overestimated given the methodology of any observed stem decay being recorded. Breadfruit trees had high estimates of stem decay and relatively high damage overall, with high sample error values. Pandanus had the lowest estimated stem decay among agroforest trees but (along with coconut and breadfruit), surprisingly high estimates of root disease. Contrary to what might be expected, there was no difference in root disease between the northern and southern atoll agroforest trees, and the only significant difference in agroforest tree damage between the regions was parasitic/epiphytic plants (much more in the south, but <3% overall, and high sample error).

Coconut trees are most productive and easier to harvest before they get too old, and tree height is often used as a proxy for age. The FIA trialed a coconut tree age algorithm from Fiji in the 2018 RMI inventory, but apparently it did not align well with what the Marshallese know to be true on the ground,

i.e. that most trees are old and not as productive as would be desirable and many coconut groves are senescent (Merlin et al, 2018).

The northern atolls had more coconut trees in the 15 to 34-foot height class than southern atolls, and significantly more in the 35 to 54-foot height class, while southern atolls had significantly more trees in the two tallest height classes. There were also significant differences in coconut tree height among forest communities, with strand forests having about twice as many of the shortest trees and agroforest having 3 to 8 times more of the tallest trees than other communities. These height differences among communities, and the differing proportions of forest community area between northern and southern lagoon regions likely explain most of the differences in coconut tree height class between regions.

The percentage of coconut trees likely to be young/productive looks to be relatively low (maybe <25%), so projects to harvest older (taller) trees and use them to source local lumber seem practical given the relatively high available volume, although there is potentially a high proportion of trees affected by stem decay. Southern atolls had about twice the coconut volume per acre as northern atolls, and southern agroforests look to be the most productive source of potential coconut lumber.

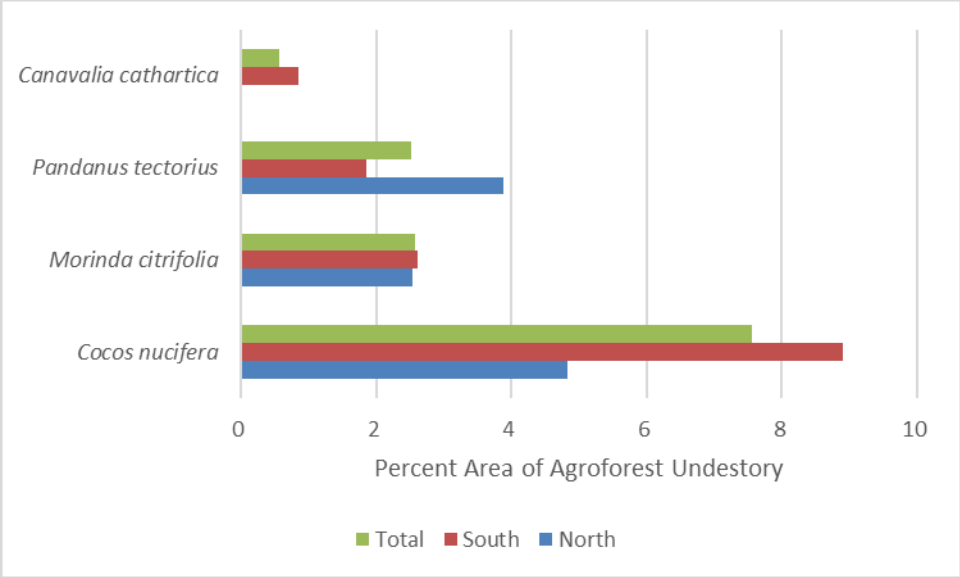
Breadfruit trees are also easier to harvest before they get too tall, and it appears that the average tree height in RMI is at least 10 feet taller than recommended for ease of harvesting, but given the small sample size overall (especially in northern atolls), it's not certain (Elevitch et al, 2014). However, breadfruit trees may be left to grow to around 80 feet in RMI for the nice shade they provide (Merlin et al, 2014), which is about 50 feet taller than the latest inventory average (with almost 20 percent of measured trees taller than 80 feet).

Percent of agroforest understory area covered by edible or common agroforest plant species in RMI regions and overall

	North		South		Total	
Understory Food Species	Total	SE	Total	SE	Total	SE
Cocos nucifera	4.8	1.7	8.9	3.4	7.6	2.5
Morinda citrifolia	2.5	1.2	2.6	1.0	2.6	0.8
Pandanus tectorius	3.9	3.0	1.9	2.1	2.5	1.8
Canavalia cathartica	--	--	0.8	0.8	0.6	0.6
Allophylus timorensis	--	--	0.3	0.3	0.2	0.2
Centella asiatica	--	--	0.2	0.2	0.1	0.1
Artocarpus altilis	--	--	0.1	0.1	0.1	0.1
Cucurbita pepo	--	--	0.1	0.1	0.0	0.0
All Food Species	11.2	4.0	14.9	4.1	13.7	3.0

Acreage of agroforest understory by edible or common agroforest plant species in RMI regions and overall

	North		South		Total	
Food Species	Total	SE	Total	SE	Total	SE
Cocos nucifera	121	80	454	251	575	258
Morinda citrifolia	63	54	133	74	196	88
Pandanus tectorius	97	98	95	103	192	142
Canavalia cathartica	--	--	43	56	43	56
Allophylus timorensis	--	--	16	25	16	25
Centella asiatica	--	--	9	12	9	12
Artocarpus altilis	--	--	4	7	4	7
Cucurbita pepo	--	--	3	5	3	5
All Species	281	203	759	339	1,039	381



Food species covering at least 1% of agroforest understory area in RMI regions

Percent of agroforest area covered by top twenty understory plant species by RMI region

	North		South		Total	
Understory Species	Total	SE	Total	SE	Total	SE
Cocos nucifera	4.8	1.7	8.9	3.4	7.6	2.5
Lepturus repens	0.2	0.2	7.5	3.6	5.1	2.7
Vigna marina	--	--	6.2	5.1	4.2	3.5
Wollastonia biflora	0.4	0.3	5.9	4.3	4.1	3.1
Cassytha filiformis	10.1	5.8	--	--	3.3	2.6
Bidens pilosa	9.5	7.0	0.2	0.2	3.2	3.0
Eleusine indica	8.8	7.0	0.1	0.1	3.0	2.1
Morinda citrifolia	2.5	1.2	2.6	1.0	2.6	0.8
Pandanus tectorius	3.9	3.0	1.9	2.1	2.5	1.8
Guettarda speciosa	0.5	0.4	3.5	1.8	2.5	1.2
Asplenium nidus	--	--	3.5	1.9	2.4	1.4
Scaevola sericea	1.8	1.5	2.0	3.1	2.0	2.1
Eustachys petraea	5.1	3.6	--	--	1.7	1.6
Ipomoea violacea	0.1	0.1	2.4	2.4	1.7	2.1
Fimbristylis cymosa	1.5	0.7	1.1	0.9	1.2	0.6
Clerodendrum inerme	2.4	2.4	--	--	0.8	0.7
Epipremnum pinnatum	--	--	1.1	1.1	0.8	0.8
Bothriochloa bladhii	2.0	1.4	0.2	0.2	0.8	0.6
Pisonia grandis	--	--	1.0	0.9	0.6	0.6
Canavalia cathartica	--	--	0.8	0.8	0.6	0.6

Percent of agroforest area covered by invasive plant species in RMI regions and overall

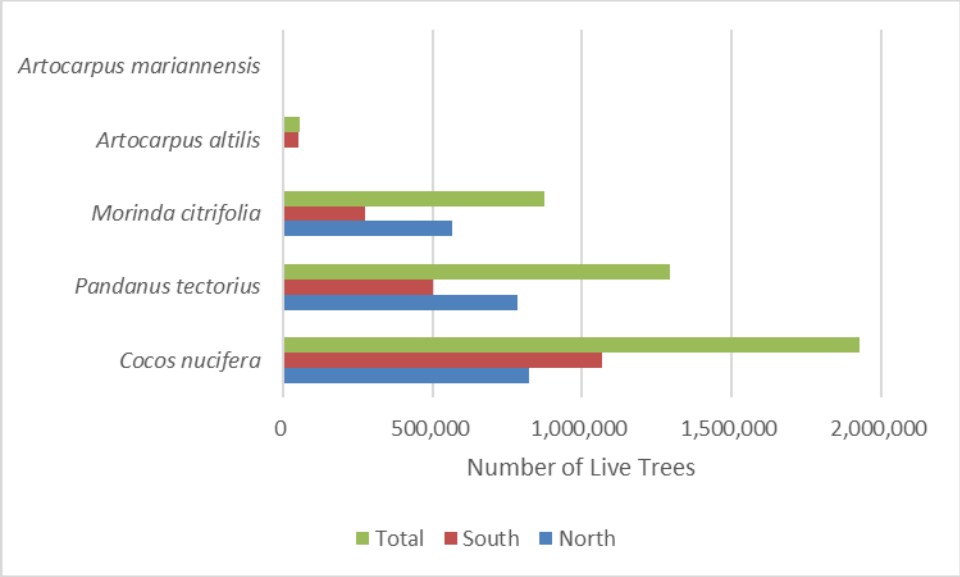
	North		South		Total	
Invasive Plant Species	Total	SE	Total	SE	Total	SE
Bidens pilosa	9.6	7.0	0.3	0.3	3.4	3.0
Turnera ulmifolia	0.9	1.0	0.1	0.1	0.4	0.4
Sphagneticola trilobata	--	--	0.4	0.4	0.3	0.3
Total	10.5	7.1	0.8	0.6	4.0	3.2

Percent of agroforest area with invasives present or absent in RMI regions and overall

	North		South		Total	
	Total	SE	Total	SE	Total	SE
Invasives Present	55.6	19.3	13.0	7.5	27.0	12.4
Invasives Absent	39.1	17.6	65.9	12.5	57.1	12.3

Number of agroforest trees (live trees>1-inch DBH) by species in RMI regions and overall

	North		South		Total	
	Total	SE	Total	SE	Total	SE
Cocos nucifera	825,154	223,315	1,066,420	321,744	1,929,847	340,825
Pandanus tectorius	784,845	369,627	501,376	239,829	1,296,427	416,514
Morinda citrifolia	568,396	406,164	273,298	420,488	873,477	583,974
Artocarpus altilis	2,938	1,957	53,363	63,809	56,301	63,839
Artocarpus mariannensis	--	--	5,103	8,038	5,103	8,038



Number of agroforest trees (live trees>1-inch DBH) by species in RMI regions and overall

Percent of total agroforest trees (live trees >1 inch-DBH) by species by RMI region

	North		South	
Agroforest Tree Species	Total	SE	Total	SE
Artocarpus altilis	5.2	6.8	94.8	6.8
Artocarpus mariannensis	--	--	100.0	100.0
Cocos nucifera	42.8	11.0	55.3	11.2
Morinda citrifolia	65.1	35.4	31.3	36.3
Pandanus tectorius	60.5	16.8	38.7	16.7

Percent of agroforest tree species by damage type

	Cocos nucifera		*Artocarpus altilis*		*Pandanus tectorius*		*Morinda citrifolia*	
Damage Type	Total	SE	Total	SE	Total	SE	Total	SE
Stem Decay	40.2	4.7	18.3	23.6	5.8	2.3	73.0	14.5
Human Activities	21.9	4.5	--	--	1.7	1.1	0.3	0.3
Root Disease	19.2	4.0	11.1	15.1	13.9	4.4	1.2	1.0
Fire	13.3	3.6	--	--	4.3	2.4	1.9	1.9
Open Wound	11.2	3.2	--	--	0.3	0.3	0.3	0.3
Other Damages	1.6	1.3	--	--	0.7	0.5	5.3	5.3
Vine Damage	0.6	0.7	4.5	4.5	5.0	4.5	46.6	15.7
Saltwater Damage	0.6	0.8	--	--	--	--	--	--
Foliage Disease	0.3	0.4	--	--	--	--	--	--
Abiotic Damage	0.3	0.4	--	--	--	--	--	--
General Insects	0.1	0.1	--	--	0.4	0.4	--	--
Parasitic/Epiphytic Plants	0.1	0.1	--	--	3.9	3.9	--	--
Competition	--	--	--	--	--	--	20.7	17.2
Broken Top	--	--	--	--	2.3	1.4	5.6	6.0
Dead Top	--	--	--	--	0.9	0.9	--	--
Any Damage	53.3	5.1	22.8	30.5	27.6	9.4	81.4	13.7

Percent of agroforest trees (*C. nucifera, A. altilis, P.tectorius and M. citrifolia*) by damage type in RMI regions and overall

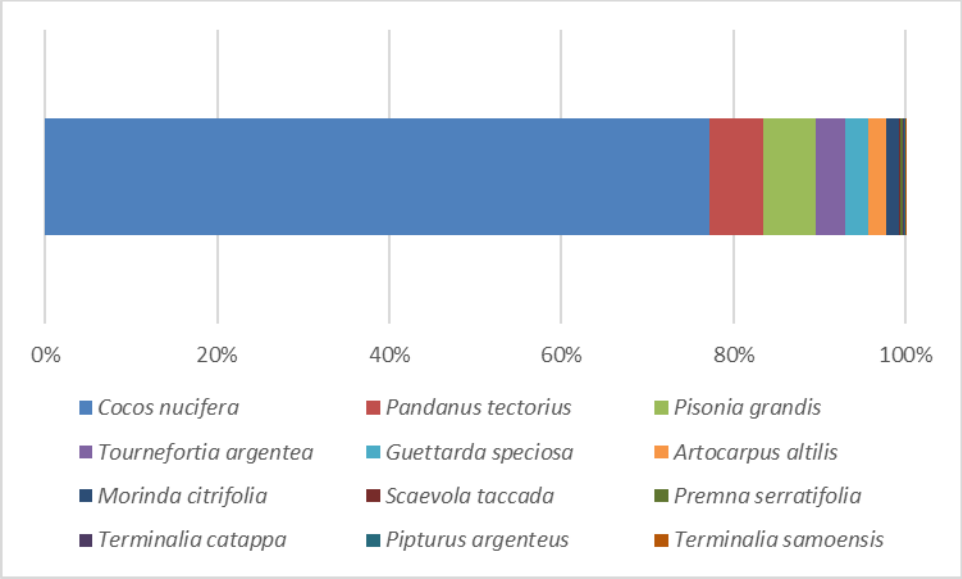
	North		South		Total	
Damage Type	Total	SE	Total	SE	Total	SE
Stem Decay	32.7	12.6	38.7	13.4	36.0	9.1
Root Disease	13.6	3.9	13.9	4.2	13.6	2.8
Vine Damage	13.1	8.8	10.6	13.5	11.7	7.7
Human Activities	9.3	2.2	12.3	4.7	10.7	2.5
Fire	8.2	3.4	7.8	3.2	7.9	2.4
Open Wound	4.9	1.7	5.4	2.7	5.3	1.6
Competition	8.3	7.5	--	--	4.3	4.3
Other Damages	2.7	2.4	1.4	1.3	2.1	1.4
Broken Top	3.0	2.4	0.7	0.5	1.9	1.4
Parasitic/Epiphytic Plants	0.1	0.1	2.6	2.6	1.2	1.6
Dead Top	0.3	0.3	0.2	0.2	0.3	0.3
General Insects	--	--	0.4	0.3	0.2	0.2
Foliage Disease	0.3	0.4	--	--	0.2	0.2
Abiotic Damage	0.2	0.2	0.1	0.1	0.1	0.2
Any Damage	48.7	13.4	51.9	13.4	50.5	9.3

Percent of agroforest area covered by dominant tree species in RMI regions and overall

	North		South		Total	
Dominant Tree Species	Total	SE	Total	SE	Total	SE
Cocos nucifera	90	10	100	0	97	3
Pandanus tectorius	10	10	--	--	3	3

Relative dominance of tree species in agroforest in RMI regions and overall, with agroforest species highlighted in orange and strand forest species highlighted in blue.

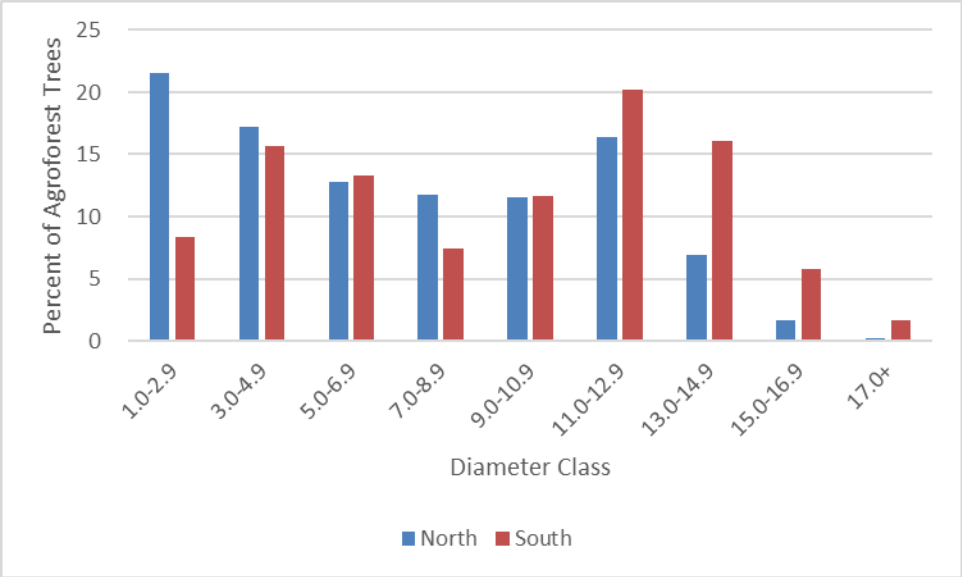
	North		South		Total	
Tree Species	Total	SE	Total	SE	Total	SE
Cocos nucifera	75.0	14.0	77.6	6.4	77.2	6.0
Pandanus tectorius	21.6	12.2	3.2	2.3	6.3	3.7
Pisonia grandis	--	--	7.4	5.2	6.2	4.4
Tournefortia argentea	--	--	4.1	3.5	3.4	2.9
Guettarda speciosa	1.2	1.2	3.0	2.2	2.7	1.8
Artocarpus altilis	--	--	2.5	2.3	2.1	2.0
Morinda citrifolia	0.3	0.3	1.6	2.4	1.4	2.0
Scaevola taccada	--	--	0.3	0.3	0.2	0.2
Premna serratifolia	0.3	0.3	0.2	0.2	0.2	0.3
Terminalia catappa	1.3	1.3	--	--	0.2	0.2
Pipturus argenteus	--	--	0.1	0.1	0.1	0.1
Terminalia samoensis	0.2	0.2	--	--	0.0	0.0



Relative dominance of tree species in RMI agroforest

Percent of agroforest trees by diameter class (in inches) by RMI region and overall

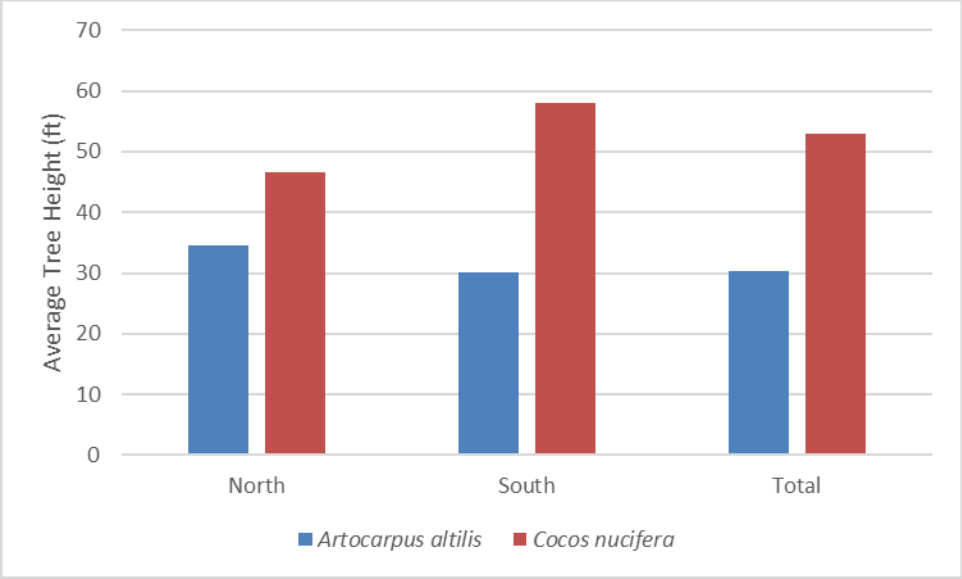
	North		South		Total	
Diameter Class	Total	SE	Total	SE	Total	SE
1.0-2.9	21.5	12.9	8.4	9.0	15.9	8.1
3.0-4.9	17.2	12.1	15.7	8.5	16.2	7.5
5.0-6.9	12.8	5.4	13.3	6.6	12.8	4.1
7.0-8.9	11.8	3.9	7.4	2.5	9.8	2.4
9.0-10.9	11.6	3.6	11.6	4.1	11.5	2.6
11.0-12.9	16.4	5.0	20.2	6.5	18.2	4.0
13.0-14.9	6.9	2.5	16.1	4.7	11.2	2.7
15.0-16.9	1.6	0.8	5.7	2.3	3.6	1.2
17.0+	0.2	0.2	1.7	0.8	0.9	0.4



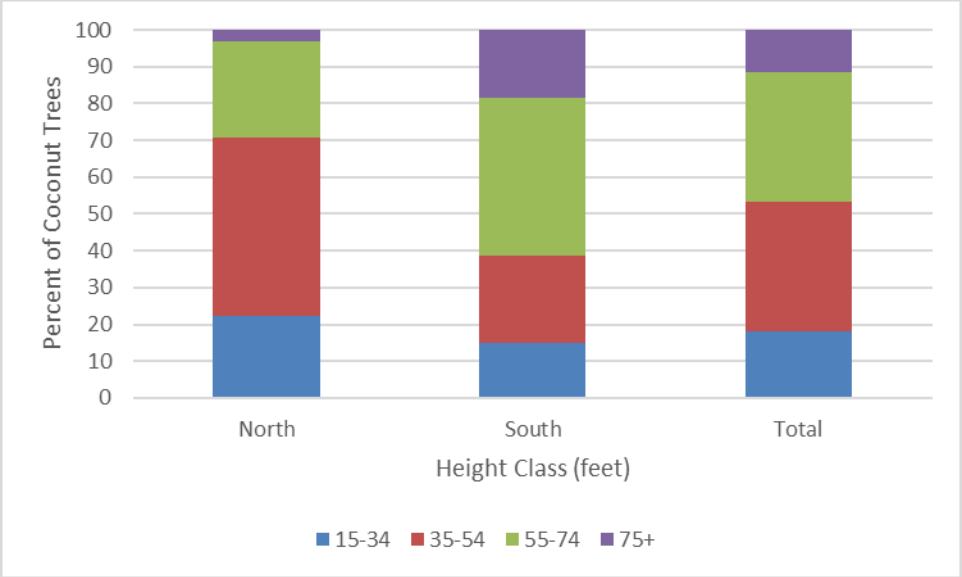
Percent of agroforest trees by diameter class (in inches) by RMI region

Percent of agroforest tree species by abbreviated diameter class (in inches) in RMI

	Cocos Nucifera		*Artocarpus altilis*		*Pandanus tectorius*		*Morinda citrifolia*	
Diameter Class	Total	SE	Total	SE	Total	SE	Total	SE
1.0-4.9	--	--	56.5	56.5	35.3	17.2	96.6	2.2
5.0-9.9	12.8	2.9	18.8	16.8	64.3	17.5	3.4	2.2
10+	87.2	2.9	24.7	16.4	0.4	0.3	--	--



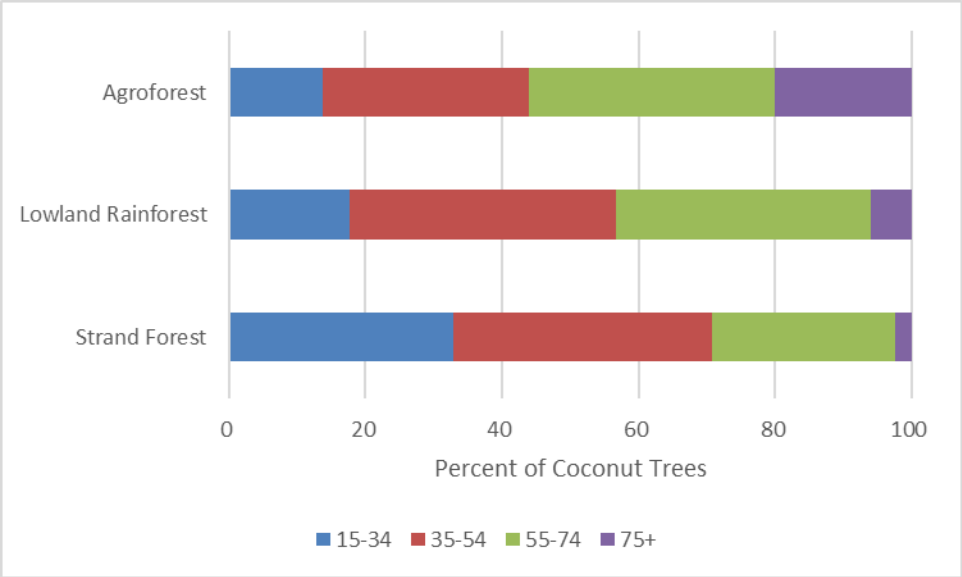
Average height (in feet) of breadfruit and coconut trees (live trees >1 inch DBH) by RMI region and overall. Breadfruit trees were only measured on two plots in the northern atolls.



Percent of coconut trees by height class and RMI region

Percent of coconut trees by height class, RMI region and overall

	North		South		Total	
Coconut Height Class	Total	SE	Total	SE	Total	SE
15-34	22.3	6.9	14.8	3.6	18.0	3.6
35-54	48.6	6.1	23.9	5.4	35.2	5.3
55-74	26.1	8.0	42.7	4.9	35.3	4.8
75+	3.0	1.6	18.5	5.2	11.5	3.6



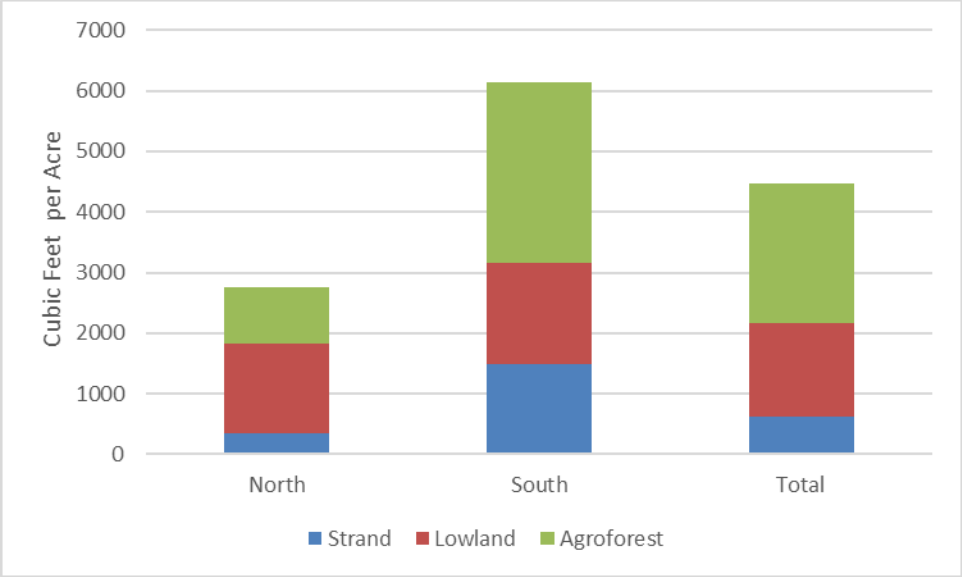
Percent of coconut trees by height class, forest community and overall

Percent of coconut trees by height class, forest community and overall

	Strand		Lowland Rainforest		Agroforest		All Cocos	
Height Class	Total	SE	Total	SE	Total	SE	Total	SE
15-34	33.0	7.8	17.6	6.8	13.7	3.4	18.0	3.6
35-54	37.8	10.9	39.2	6.6	30.3	8.5	35.2	5.3
55-74	26.8	11.6	37.2	7.2	36.0	7.3	35.3	4.8
75+	2.4	2.4	6.0	3.0	20.0	5.4	11.5	3.6

Volume (net cubic feet per acre) of coconut trees by region, forest community and overall, in RMI

	Strand		Lowland		Agroforest		Total	
Region	Total	SE	Total	SE	Total	SE	Total	SE
North	339	271	1,492	326	923	163	966	217
South	1,484	643	1,668	731	2,986	544	2,260	459
Total	612	288	1,550	306	2,308	496	1,509	256



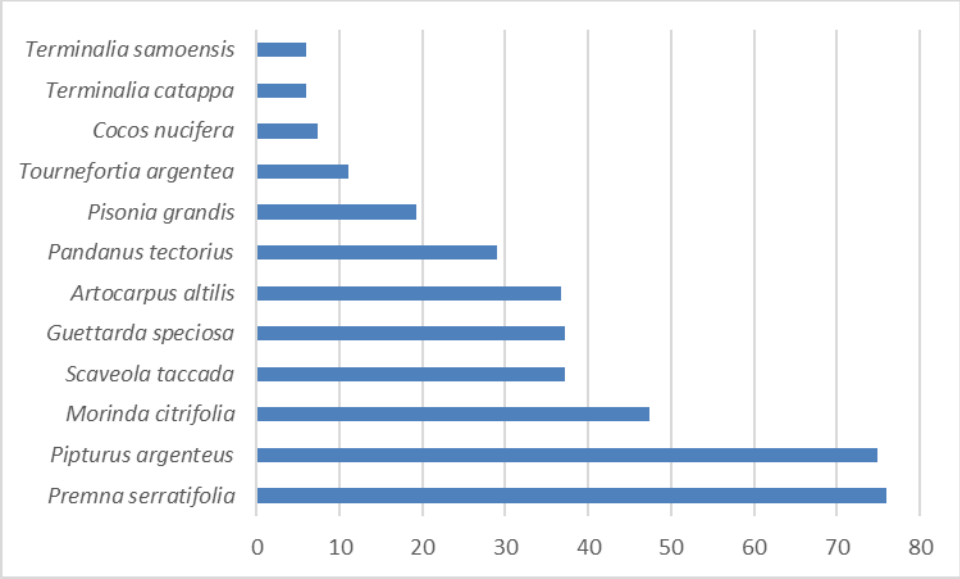
Volume of live coconut trees by region and forest community in RMI

Average stem density (number of live trees >1 inch DBH per acre) of agroforest tree species in RMI regions and overall

	North		South		Total	
Tree Species	Total	SE	Total	SE	Total	SE
Cocos nucifera	6.7	0.3	7.7	0.8	7.2	0.4
Pandanus tectorius	10.4	4.1	12.2	2.7	11.0	2.8
Artocarpus altilis	6.0	--	18.6	20.4	16.8	17.0
Morinda citrifolia	65.4	10.7	41.7	10.7	55.8	9.5

Stem density (live trees >1 inch DBH per acre) of trees in RMI agroforest by region and overall, with agroforest species highlighted in orange and strand species highlighted in blue.

	North		South		Total	
Tree Species	Total	SE	Total	SE	Total	SE
Premna serratifolia	150	150	12	12	76	63
Pipturus argenteus	--	--	75	75	75	75
Morinda citrifolia	75	75	45	6	47	6
Scaveola taccada	--	--	37	37	37	37
Guettarda speciosa	6	6	41	49	37	44
Artocarpus altilis	--	--	37	33	37	33
Pandanus tectorius	36	18	20	7	29	12
Pisonia grandis	--	--	19	1	19	1
Tournefortia argentea	--	--	11	2	11	2
Cocos nucifera	7	1	7	1	7	1
Terminalia catappa	6	6	--	--	6	6
Terminalia samoensis	6	6	--	--	6	6



Stem density (live trees>1 inch per acre) of tree species in RMI agroforest

Strand Forest

Strand vegetation is common along coastlines across much of the tropical Pacific, especially in Micronesia (Mueller-Dombois & Fosberg, 1998). On smaller islands and atolls, the forest vegetation is at least somewhat strand like even in island interiors, and strand forests play an important role in coastal stabilization. They are limited in tree species diversity compared to lowland rainforest and agroforest,

because not many plant or tree species can survive the challenges of salt spray from living next to the ocean.

Perhaps unsurprisingly, the shrublike strand specialists *Scaveola taccada* and *Guettarda speciosa* were the most abundant tree species in RMI forest overall. *S. taccada* was also the most common understory species, covering about a quarter of strand forest area, followd by *G. speciosa* and coconut tree seedlings which covered about 8 percent of strand forest each. The presence of abundant coconut trees in strand forest makes it almost more of a subtype of agroforest than strand forest per se, although strand forest and strictly defined agroforest (and lowland rainforest) tend to overlap and merge on atoll islets. However, *Pandanus tectorius* likely plays more of strand species role within strand forest by stabilizing the coast and buffering interior forest vegetation, than being commonly utilized for food or fibers by local residents. *Morinda citrifolia* was barely picked up by the inventory in strand forest and probably does not grow well in salty conditions.

Other than coconut, *Pandanus tectorius* was the only other agroforest tree species that was dominant in strand forest, and mostly in southern strand forests. Five more tree species were observed to be dominant on the plot footprint in northern atoll strand forests, so it would appear that they have been less altered by coconut plantations than southern atoll strand forests. The relative dominance of tree species in strand forest shows a similar trend, and coconuts had about twice as much wood proportionally in southern atoll strand forests compared to northern strand forests. There were also about 5.2 (SE=3.5) more coconut trees per acre in southern strand forests. *Pisonia grandis* and *Cordia subcordata*, both important atoll species, were the third and fifth most dominant trees (after coconut, *Scaveola* and *Guettarda*) in northern strand forests, and each made up about a fifth of total wood there. It southern strand forest both species were essentially absent.

Southern strand forests had higher, but insignificant, average stem density and basal area per acre in strand forests. More tree stems per acre could mean better protection against coastal erosion, but it is possible that larger trees or a combination of root systems from different native species might be even more resilient to erosion. Certainly, building houses or walls right next to the water does not help prevent erosion, and is often a major cause of erosion in many places on many islands, ie Hawaii. Local patterns of currents and sand movement are complicated and it is difficult to know how construction or other activities in one locality will affect nearby beaches and vegetation. However, it is recommended that to the greatest extent possible, native vegetaton should not be removed,replaced or raked, and trees on the coast should not be cut. One possible exception is if the tree species in question can resprout after being cut, in which case, cutting the top of the tree but keeping it alive can lead to extra root generation. Dead trees and logs washed up on the shore should not be removed.

While there were not any observations of flood disturbance at the plot level in any measured RMI forest, four coconut trees (around 1% of all coconut trees) were observed with salt water damage. Three of those were in southern strand forest with the fourth in southern agroforest. Other than saltwater damage, coconut trees in strand forest were less damaged by every other damage type, and about 8 times less damaged by any damage than in agroforest and by about 6 times less than in lowland rainforest. As such, it would appear that the healthiest coconut trees in RMI are growing in strand forest.

Number of tree species observed in strand forest estimated for all forest in RMI regions and overall, with strand tree species highlighted in blue and agroforest species highlighted in orange

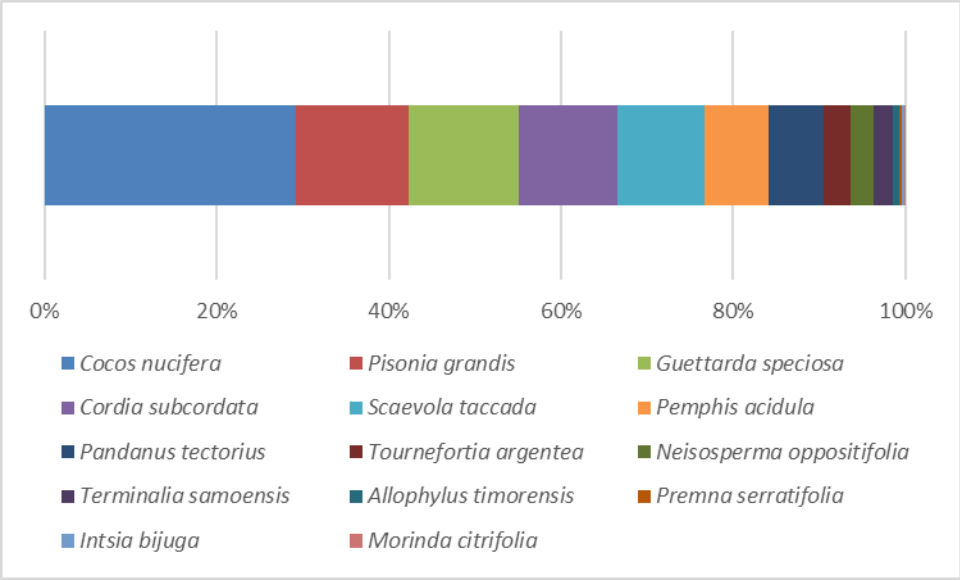
	North		South		Total	
Scientific name	Total	SE	Total	SE	Total	SE
Scaevola taccada	5,037,859	2,054,248	1,899,695	1,690,297	6,937,554	2,508,868
Guettarda speciosa	1,474,488	776,872	763,766	432,843	2,296,939	856,489
Cocos nucifera	825,154	223,315	1,066,420	321,744	1,929,847	340,825
Pandanus tectorius	784,845	369,627	501,376	239,829	1,296,427	416,514
Pisonia grandis	874,115	790,837	228,462	202,245	1,107,680	806,432
Morinda citrifolia	568,396	406,164	273,298	420,488	873,477	583,974
Neisosperma oppositifolia	401,671	286,319	401,600	357,095	803,271	454,121
Allophylus timorensis	299,939	268,766	152,668	186,003	452,607	318,601
Pemphis acidula	319,785	177,900	11,156	14,548	330,940	178,157
Terminalia samoensis	239,638	134,670	8,822	9,387	248,460	134,765
Cordia subcordata	166,697	196,350	--	--	166,697	196,350
Premna serratifolia	139,834	95,507	21,362	15,454	161,195	96,749
Tournefortia argentea	28,346	18,854	93,197	66,242	121,543	68,023
Intsia bijuga	--	--	27,414	30,185	27,414	30,185

Percent of strand forest area by dominant tree species in RMI regions and overall, with agroforest species highlighted in orange and strand species highlighted in blue.

	North		South		Total	
Dominant species	Total	SE	Total	SE	Total	SE
Cocos nucifera	18.6	16.0	49.4	28.5	26.0	14.1
Scaevola taccada	23.3	14.6	9.8	9.8	20.1	11.6
Pandanus tectorius	6.1	6.1	40.7	29.6	14.4	10.9
Pisonia grandis	17.1	15.1	--	--	13.1	11.8
Guettarda speciosa	15.3	12.3	--	--	11.6	9.5
Cordia subcordata	12.3	12.3	--	--	9.4	9.4
Tournefortia argentea	4.8	4.8	--	--	3.7	3.7
Pemphis acidula	2.4	2.4	--	--	1.8	1.8

Relative dominance (percent of total square feet per acre) of tree species observed in strand forest in RMI regions and overall, with agroforest species highlighted in orange and strand species highlighted in blue.

	North		South		Total	
Strand Tree Species	Total	SE	Total	SE	Total	SE
Cocos nucifera	19.4	15.5	53.0	16.8	29.2	13.1
Pisonia grandis	18.4	11.9	0.2	0.2	13.1	9.3
Guettarda speciosa	13.8	6.3	10.4	4.5	12.8	4.7
Cordia subcordata	16.0	17.6	--	--	11.4	13.1
Scaevola taccada	10.7	4.0	9.0	6.3	10.2	3.3
Pemphis acidula	8.6	6.3	4.7	4.7	7.4	4.5
Pandanus tectorius	3.2	1.8	14.1	6.8	6.4	3.1
Tournefortia argentea	3.1	3.4	3.3	3.3	3.2	2.6
Neisosperma oppositifolia	2.5	3.3	2.8	2.8	2.6	2.7
Terminalia samoensis	3.2	1.9	--	--	2.3	1.4
Allophylus timorensis	1.0	0.9	--	--	0.7	0.7
Premna serratifolia	--	--	1.3	1.3	0.4	0.4
Intsia bijuga	--	--	1.2	1.2	0.4	0.4
Morinda citrifolia	0.0	0.0	--	--	0.0	0.0



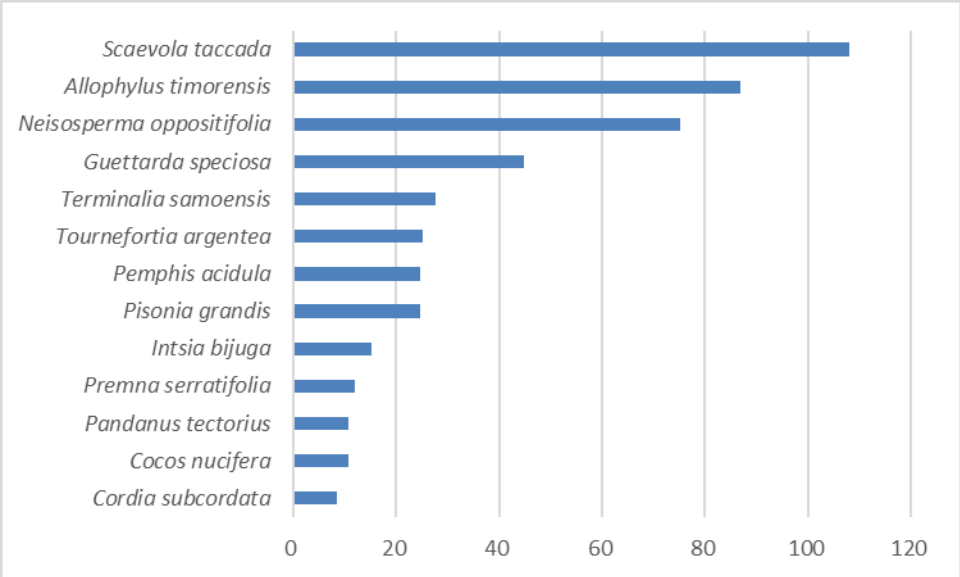
Relative dominance of tree species in RMI strand forest

Percent of strand forest area covered by the top twenty understory plant species in RMI regions and overall

	North		South		Total	
Understory species	Total	SE	Total	SE	Total	SE
Scaevola taccada	21.5	7.0	34.5	10.1	24.6	6.1
Guettarda speciosa	10.4	2.6	2.1	1.1	8.4	2.2
Cocos nucifera	4.8	3.5	17.9	6.7	8.0	3.5
Cassytha filiformis	6.8	4.3	3.6	2.6	6.0	3.4
Pisonia grandis	4.5	3.6	0.5	0.5	3.6	2.8
Pandanus tectorius	1.2	0.7	7.7	5.0	2.7	1.4
Cordia subcordata	3.0	2.1	--	--	2.3	1.7
Wollastonia biflora	2.0	2.0	0.5	0.5	1.6	1.9
Pemphis acidula	2.1	1.3	--	--	1.6	1.0
Neisosperma oppositifolia	1.6	1.4	1.3	1.3	1.6	1.2
Asplenium nidus	--	--	6.3	7.5	1.5	1.9
Terminalia samoensis	1.8	0.8	0.2	0.2	1.4	0.6
Allophylus timorensis	1.5	1.4	--	--	1.2	1.1
Tournefortia argentea	1.0	0.9	0.3	0.3	0.8	0.7
Soulamea amara	1.1	1.1	--	--	0.8	0.8
Ipomoea violacea	0.3	0.2	0.4	0.4	0.3	0.2
Canavalia cathartica	--	--	1.0	1.0	0.2	0.2
Boerhavia tetrandra	0.3	0.3	--	--	0.2	0.2
Lepturus repens	0.3	0.2	--	--	0.2	0.2
Phymatosorus grossus	0.1	0.1	0.3	0.3	0.1	0.1

Stem density (number of live trees> 1-inch DBH per acre) of tree species in strand forest by RMI region with strand species highlighted in blue and agroforest species highlighted in orange

	North		South		Total	
Strand Forest Tree Species	Total	SE	Total	SE	Total	SE
Cordia subcordata	8.4	0.0	--	--	8.4	0.0
Cocos nucifera	8.6	0.8	13.8	3.4	10.7	2.2
Pandanus tectorius	9.0	1.1	12.0	4.0	10.7	2.1
Premna serratifolia	--	--	12.0	12.0	12.0	12.0
Intsia bijuga	--	--	15.1	15.1	15.1	15.1
Pisonia grandis	23.6	5.2	187.9	187.9	24.6	4.7
Pemphis acidula	26.4	14.1	8.4	8.4	24.6	12.2
Tournefortia argentea	11.4	4.3	48.1	32.5	25.2	14.4
Terminalia samoensis	27.6	7.7	--	--	27.6	7.7
Guettarda speciosa	41.6	16.0	63.5	30.6	44.8	14.2
Neisosperma oppositifolia	118.0	56.6	12.9	12.9	75.2	56.0
Allophylus timorensis	86.8	14.1	--	--	86.8	14.1
Scaevola taccada	106.5	22.8	110.5	14.7	107.9	15.6
Morinda citrifolia	299.9	299.9	--	--	299.9	299.9



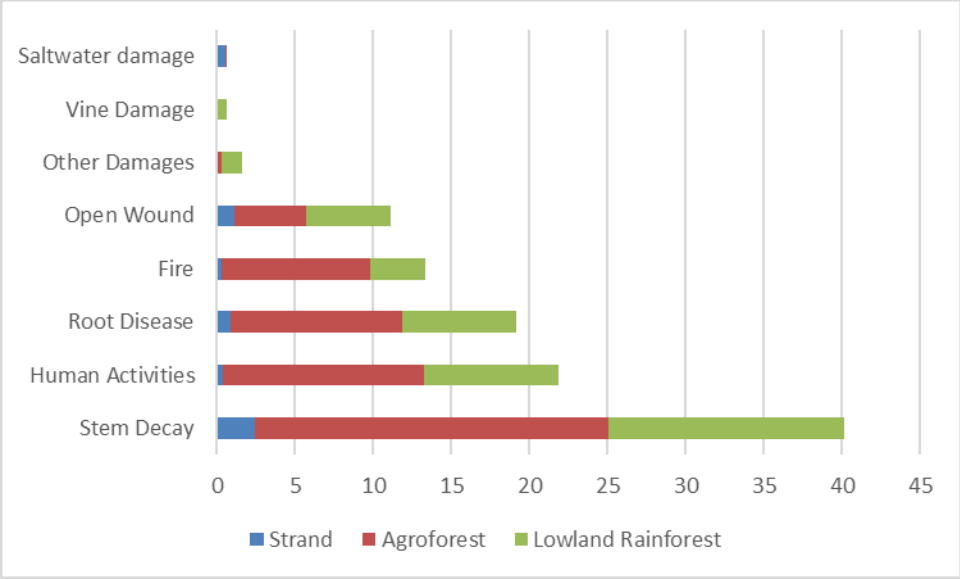
Stem density of tree species in RMI strand forest (*Morinda* not shown).

Basal area (square feet of wood per acre) of tree species in strand forest by RMI region with agroforest species highlighted in orange and strand species highlighted in blue

	North		South		Total	
Strand Forest Tree Species	Total	SE	Total	SE	Total	SE
Cocos nucifera	18.6	15.6	66.0	29.8	29.9	14.8
Pisonia grandis	17.5	12.7	0.3	0.3	13.4	10.1
Guettarda speciosa	13.2	6.3	12.9	4.4	13.1	4.9
Cordia subcordata	15.3	17.7	--	--	11.7	13.8
Scaevola taccada	10.2	3.5	11.2	7.8	10.4	3.3
Pemphis acidula	8.2	5.4	5.8	5.8	7.6	4.3
Pandanus tectorius	3.1	1.3	17.6	9.0	6.5	3.1
Tournefortia argentea	3.0	3.1	4.1	3.6	3.2	2.5
Neisosperma oppositifolia	2.4	3.2	3.4	3.4	2.6	2.7
Terminalia samoensis	3.1	1.8	--	--	2.4	1.5
Allophylus timorensis	0.9	0.8	--	--	0.7	0.7
Premna serratifolia	--	--	1.6	1.6	0.4	0.4
Intsia bijuga	--	--	1.5	1.5	0.4	0.4
Morinda citrifolia	0.0	0.0	--	--	0.0	0.0
All Trees	95.5	19.1	124.4	23.8	102.4	15.7

Percent of coconut trees by damage type in RMI forest communities and overall

	Strand		Agroforest		Lowland Rainforest		All Cocos	
Damage Type	Total	SE	Total	SE	Total	SE	Total	SE
Stem Decay	2.4	1.6	22.6	6.5	15.2	4.6	40.2	4.7
Human Activities	0.4	0.4	12.9	4.7	8.6	3.0	21.9	4.5
Root Disease	0.9	1.0	10.9	4.1	7.3	2.7	19.2	4.0
Fire	0.3	0.3	9.5	3.7	3.5	1.4	13.3	3.6
Open Wound	1.1	1.1	4.5	2.6	5.5	2.2	11.2	3.2
Other Damages	--	--	0.3	0.3	1.3	1.3	1.6	1.3
Vine Damage	--	--	--	--	0.6	0.7	0.6	0.7
Saltwater damage	0.5	0.5	0.1	0.1	--	--	0.6	0.8
Foliage Disease	--	--	0.3	0.4	--	--	0.3	0.4
Abiotic Damage	0.2	0.2	0.1	0.1	--	--	0.3	0.4
General Insects	--	--	--	--	0.1	0.1	0.1	0.1
Parasitic/Epiphytic Plants	--	--	--	--	0.1	0.1	0.1	0.1
Any Damage	3.6	2.1	28.2	7.6	21.5	6.1	53.3	5.1



Percent of coconut trees by damage type and forest community in RMI

Lowland Tropical Rainforest

As mentioned earlier, most of the original natural vegetation of the Marshall Islands was replaced with coconut plantations, but areas of lowland rainforest (or mixed broadleaf forest) often survived as windbreaks, and in some remote or uninhabited atolls/islets (Mueller-Dombois & Fosberg, 1998, Thomas et al, 1988). More lowland rainforest has survived in the northern atolls, where it makes up almost half of forest area there and about a quarter of total forest in RMI. In the south lowland rainforest made up about a third of its forest area, and about a tenth of total forest in RMI. Coconut trees were dominant in two thirds of lowland rainforest area and composed about half of all basal area.

The presence of abundant *Pandanus tectorius* in addition to the dominant coconuts almost make the lowland rainforest here another subtype of agroforest. Breadfruit showed up as the dominant tree in the plot footprint in 15% of lowland rainforest area, and made up over three percent of total basal area, both higher than in agroforest (but with high sample error). The only tree species endemic to Micronesia inventoried in RMI was *Artocarpus mariannensis* (Costion & Lorence, 2012). It was inventoried in southern lowland rainforest, whereas in the FSM inventory it only showed up in strand forest. The mangrove tree species *Bruguiera gymnorrhiza* also showed up in lowland rainforest, probably due to overlap with the partial mangrove plot on Arno.

There was a high rate of damage overall for non-agroforest species observed in lowland rainforest, with stem decay again being the most prominent category with high values for many species. Given the methodology of recording any visible stem decay, many of these be overestimated. Root disease was also observed in almost all tree species inventoried, but at more reasonable rates except for *Premna serratifolia* and *Cordia subcordata*, which should be potentially investigated further for root disease issues. Damage from vines and potentially associated damage (broken tops and dead tops) made up about third of all damage recorded in non-agroforest species, which seems within reason for tropical forest.

One interesting and unusual characteristic of native forest vegetation in RMI is that some atoll forests are dominated by a single tree species. This is thought to be because of the overall low number of species in the area (for tropical forest) combined with stressful environments and frequent disturbances from high exposure to oceanic weather. Before being drastically altered, forest dominated by *Pisonia grandis* on atoll islets was probably much more common than it is today since it is easily cleared and tends to have fertile soil (Mueller-Dombois & Fosberg,1998). *P. grandis* trees can grow to huge sizes and are favored as nesting sites by many species of sea birds.

Neisosperma oppositifolia dominated islet forests are also thought to have been much more common in the recent past, but it was the second most common tree dominant on the plot footprint in lowland rainforest in the south. Reports from the 1980/90's mention not seeing it at all in southern atolls, but in the recent inventory it was more common there than in the north (Mueller-Dombois & Fosberg,1998, Thomas et al, 1988). Perhaps (hopefully) this is a sign that some of the native species are gradually coming back as planted coconut trees senesce.

There is strong evidence on Palmyra atoll (central Pacific Ocean) that invasive rats play a large role in preventing new recruitment of *Pisona grandis*, other native species, and coconut trees (Wolf et al, 2018). So, in areas where native species are lacking or not returning in RMI, rats could be an important factor, and eradicating invasive rats is a recommended management action on any island. However, the study points out that management of coconut trees may be necessary after removing rats, in order to avoid the uneaten coconut seedlings from dominating the new forest.

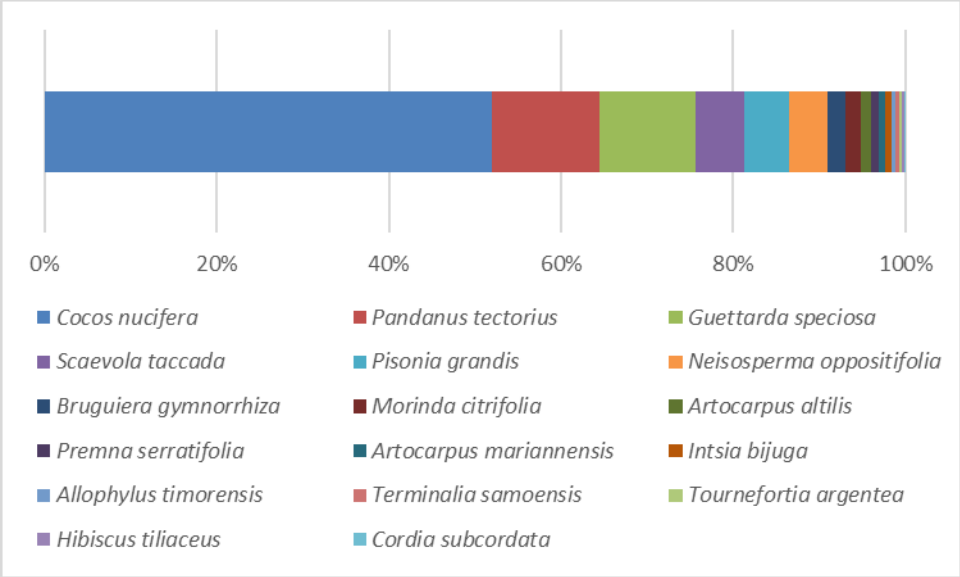
Understory coverage of lowland rainforest with native non-agroforest tree seedlings was relatively low, although both *P. grandis* and *N. oppositifolia* seedlings were both recorded in lowland and strand forest understory. Strand forest had slightly higher coverage of *P. grandis* (mostly in the north) and lowland rainforest slightly more *N. oppositifolia* coverage (more in the south). *C. subcordata* seedlings were only observed in strand forest, and most large native non-agroforest tree species seedlings (except *P. grandis*) were not observed in agroforest.

Percent of lowland rainforest area by dominant trees species in RMI regions and overall

	North		South		Total	
Dominant Species	Total	SE	Total	SE	Total	SE
Cocos nucifera	65.8	17.0	59.1	29.9	65.3	14.5
Neisosperma oppositifolia	6.8	6.8	22.0	22.0	11.1	10.5
Pandanus tectorius	12.5	12.6	--	--	8.2	8.6
Pisonia grandis	7.5	7.5	--	--	4.9	4.9
Scaevola taccada	7.3	7.3	--	--	4.8	4.8
Artocarpus altilis	--	--	15.1	15.1	4.5	4.5
Intsia bijuga	--	--	3.8	3.8	1.1	1.1

Relative dominance (percent of total square feet per acre) of tree species in lowland rainforest by RMI region and overall, with agroforest species highlighted in orange, strand species highlighted in blue, and mangrove species highlighted in brown.

	North		South		Total	
Lowland Tree Species	Total	SE	Total	SE	Total	SE
Cocos nucifera	52.1	7.3	51.1	19.8	51.9	7.7
Pandanus tectorius	13.9	5.6	11.3	7.2	12.6	4.3
Guettarda speciosa	9.7	4.6	10.5	5.3	11.2	3.7
Scaevola taccada	7.7	5.8	2.3	2.3	5.6	3.8
Pisonia grandis	6.3	6.1	2.6	2.6	5.2	4.0
Neisosperma oppositifolia	2.3	2.5	9.5	6.5	4.4	2.9
Bruguiera gymnorrhiza	3.3	3.3	--	--	2.1	2.1
Morinda citrifolia	2.6	1.7	0.2	0.2	1.8	1.2
Artocarpus altilis	0.1	0.0	3.5	3.5	1.1	1.6
Premna serratifolia	1.1	1.1	0.8	0.8	0.9	0.7
Artocarpus mariannensis	--	--	2.6	2.6	0.8	0.8
Intsia bijuga	--	--	2.1	2.1	0.6	0.6
Allophylus timorensis	0.1	0.1	1.6	1.3	0.5	0.4
Terminalia samoensis	0.4	0.3	0.7	0.7	0.5	0.3
Tournefortia argentea	0.1	0.1	0.6	0.6	0.3	0.3
Hibiscus tiliaceus	--	--	0.6	0.6	0.2	0.2
Cordia subcordata	0.2	0.2	--	--	0.1	0.1



Relative dominance of tree species in lowland rainforest of RMI

Percent of lowland rainforest understory covered by the top twenty plant species in RMI regions and overall

	North		South		Total	
Understory species	Total	SE	Total	SE	Total	SE
Cocos nucifera	21.2	7.4	7.7	5.1	16.6	5.6
Scaevola sericea var. taccada	6.6	4.6	5.7	6.2	6.0	3.6
Pandanus tectorius	6.0	2.5	5.8	3.4	5.8	1.9
Guettarda speciosa	4.5	1.8	4.1	1.7	4.8	1.5
Asplenium nidus	0.3	0.2	14.9	7.7	4.6	3.2
Neisosperma oppositifolia	2.4	2.2	5.9	4.3	3.3	2.0
Wollastonia biflora	4.2	2.6	1.0	0.6	3.0	1.8
Ipomoea violacea	3.2	1.6	0.9	1.0	2.4	1.1
Morinda citrifolia	2.6	0.9	--	--	1.8	0.7
Allophylus timorensis	0.2	0.2	4.9	2.9	1.6	1.2
Canavalia rosea	2.2	1.5	0.3	0.3	1.6	1.0
Cassytha filiformis	2.3	1.9	--	--	1.5	1.3
Soulamea amara	0.6	0.6	1.9	1.9	1.0	0.9
Hemigraphis reptans	--	--	2.9	2.9	0.9	0.9
Phymatosorus grossus	1.1	1.2	--	--	0.8	0.8
Pisonia grandis	1.3	1.3	--	--	0.8	0.9
Premna serratifolia	0.7	0.7	1.1	1.1	0.8	0.6
Bruguiera gymnorrhiza	1.1	1.1	--	--	0.7	0.7
Nephrolepis hirsutula	--	--	2.4	2.4	0.7	0.7
Clerodendrum inerme	0.2	0.2	--	--	0.7	0.9

Percent of trees and all non-agroforest species observed in lowland rainforest by damage type. Damage types with total damage percentage values of less than 1 percent for all non-agroforest trees are not shown.

	Allophylus timorensis		*Intsia bijuga*		*Premna serratifolia*		*Cordia subcordata*		*Guettarda speciosa*		*Neisosperma oppositifolia*		*Pemphis acidula*		*Pisonia grandis*		*Scaevola taccada*		*Terminalia samoensis*		*Tournefortia argentea*		*All Non-Agro Trees*	
Damage Type	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE
Stem Decay	1.4	1.7	67.8	67.8	52.3	7.7	54.4	7.5	20.1	5.7	17.2	6.7	15.9	10.5	33.4	8.0	7.6	3.3	43.2	22.2	53.4	28.9	14.7	3.3
Root Disease	0.8	0.8	40.7	40.7	31.1	14.9	36.5	3.8	8.5	3.2	2.2	2.4	10.3	9.4	7.7	5.8	6.9	3.3	6.2	4.4	22.9	17.0	7.5	2.0
Vine Damage	0.6	0.6	--	--	38.6	38.6	2.2	2.2	12.0	8.1	6.5	5.0	--	--	0.8	1.0	5.1	3.0	0.6	0.6	4.3	4.7	5.8	2.8
Dead Top	21.3	22.2	--	--	--	--	2.2	2.2	5.9	3.9	0.3	0.3	19.3	10.6	0.8	0.4	4.7	2.3	4.5	4.5	5.4	5.0	5.1	1.7
Broken Top	0.6	0.6	--	--	--	--	3.8	2.7	4.2	4.2	--	--	--	--	1.8	0.9	3.1	2.1	2.7	1.8	5.4	6.8	2.7	1.3
Human Activities	--	--	--	--	--	--	--	--	4.3	4.5	7.6	9.8	--	--	2.9	2.9	1.2	1.2	1.2	1.2	2.1	2.1	2.1	1.5
Dieback	20.5	20.5	18.6	18.6	--	--	--	--	2.5	2.0	0.5	0.5	5.5	5.5	--	--	0.6	0.6	--	--	2.1	2.1	1.7	1.1
Open Wound	--	--	--	--	--	--	6.7	6.7	4.8	4.0	1.9	2.1	0.4	0.4	--	--	0.7	0.7	--	--	--	--	1.4	1.2
Parasitic/Epiphytic Plants	--	--	--	--	--	--	--	--	0.5	0.5	--	--	--	--	12.7	17.1	--	--	--	--	--	--	1.1	1.5
Defoliators	--	--	--	--	--	--	--	--	6.4	6.1	--	--	--	--	--	--	--	--	--	--	--	--	1.1	1.2
Other Damages	20.5	20.5	--	--	2.3	2.3	2.2	2.2	0.3	0.3	--	--	--	--	0.5	0.6	--	--	0.6	0.6	2.1	2.1	0.9	1.0
Competition	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.7	0.7	7.4	7.4	--	--	0.5	0.4
Any Damage	22.7	22.2	86.4	5.2	75.0	19.3	58.8	6.8	45.7	8.5	28.6	10.1	40.0	15.8	44.7	11.6	23.1	6.6	51.7	20.5	57.6	30.6	30.9	5.2

Growth, Removals, Mortality, and Net Change

Repeated measurements of FIA plots over time allow for estimation of growth, removals, mortality and net change of tree species by numbers of trees, volume, or biomass. The reader should keep in mind though, that this means only data from the base FIA plots was used, since the MC plots have only been measured once so far (in 2018). While the FIA framework allows for calculation of net change for most tree species, the sample error values tend to be high, so for interpretation of trends only species with sample error/estimate ratios of less than 0.9 were used.

Sample error values for net change in forest volume were higher than estimates for RMI regions but showed a barely significant decrease in volume between inventories for RMI overall. Lowland rainforest had the largest increase in volume due to growth, and relatively high mortality so positive net change was not significant. Strand forest showed negative (and not significant) growth and significant morality for a significant total net loss. Agroforest had about five times less growth than lowland rainforest and equally high mortality contributing to the highest net loss (but not significantly) among forest communities.

Both the number and volume of coconut trees decreased significantly between inventories, with the estimated net change being approximately equal to total net change value for all forest in RMI. This was obviously the biggest change between inventories, but there were also significant losses of the agroforest species *Morinda citrifolia* and the native lowland rainforest tree *Premna serratifolia,* and a significant gain in numbers of the strand forest tree *Terminalia samoensis*. *Neisosperma oppositifolia* and *Guettarda speciosa* trees seem to have grown the most wood, and *Cordia subcordata* had negative growth in addition to mortality for a significant loss in volume. Sample sizes of forest plots and other observed tree species were insufficient to generate reliable change estimates between inventories.

Volume (net cubic feet) of RMI forest by growth, mortality, removals and net change in RMI regions and overall (2008 – 2018)

	North		South		Total	
GRM Category	Total	SE	Total	SE	Total	SE
Time 1	17,253,308	4,143,414	31,636,512	6,985,717	50,768,694	6,421,705
Time 2	16,117,567	4,130,115	30,723,355	6,382,589	48,360,485	6,021,912
Gross Growth	1,295,545	1,114,451	2,647,776	1,099,412	3,851,180	1,575,878
Mortality	-2,431,286	906,250	-3,268,293	956,929	-5,966,750	1,188,304
Net Change	-1,135,741	1,588,538	-913,156	1,472,199	-2,408,209	2,167,943
Removals	--	--	-292,639	263,616	-292,639	263,616

Volume (net cubic feet) of RMI forest by growth, mortality, removals and net change in RMI forest communities (2008-2018)

	Strand		Lowland Forest		Agroforest	
GRM Category	Total	SE	Total	SE	Total	SE
Time 1	6,653,893	2,359,257	20,334,229	5,145,024	21,279,778	6,215,677
Time 2	5,490,413	1,846,809	21,400,839	5,276,030	19,314,435	5,720,214
Gross Growth	-86,391	381,142	3,487,704	1,376,743	674,139	671,282
Mortality	-1,060,348	728,409	-2,421,093	848,768	-2,363,584	785,199
Net Change	-1,163,481	913,409	1,066,611	1,558,220	-1,965,342	1,102,787
Removals	-16,742	16,742	--	--	-275,897	263,084

Number of trees by species in RMI showing growth, mortality, removals and net change between the inventories in 2008 and 2018, in order of smallest to largest ratio of SE/estimate (only showing species with values <0.9), with agroforest species highlighted in orange and strand species in blue.

	Time 1		Time 2		Gross Growth		Mortality		Removals		Net Change	
Tree Species	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE
Cocos nucifera	1,683,850	244,787	1,578,979	223,376	42,783	42,783	-140,523	32,430	-7,131	7,131	-104,871	56,730
Morinda citrifolia	1,517,014	582,848	885,435	418,621	418,514	270,747	-1,005,682	470,522	-44,412	44,412	-631,579	387,854
Premna serratifolia	357,856	228,936	14,764	8,791	--	--	-292,410	182,085	-50,682	50,682	-343,092	226,131
Terminalia samoensis	27,482	17,337	121,212	82,106	101,363	69,947	-4,069	4,069	-3,565	3,565	93,729	70,436

Volume (net cubic feet) of trees by species in RMI showing growth, mortality, removals and net change between the inventories in 2008 and 2018, in order of smallest to largest ratio of SE/estimate (only showing species with values <0.9), with strand species highlighted in blue and agroforest species in orange.

	Time 1		Time 2		Gross Growth		Mortality		Removals		Net Change	
Tree Species	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE	Total	SE
Neisosperma oppositifolia	832,830	487,739	1,199,784	700,937	449,003	259,279	-82,050	69,570	--	--	366,954	213,616
Guettarda speciosa	2,393,379	734,347	3,341,741	1,064,157	1,267,181	576,688	-312,731	175,486	-6,088	6,088	948,362	604,408
Cocos nucifera	35,746,038	5,744,062	33,354,068	5,157,079	1,735,572	1,198,270	-3,863,911	959,226	-263,631	263,631	-2,391,970	1,742,679
Terminalia samoensis	72,475	44,893	42,390	31,824	-6,554	13,496	-17,352	17,352	-6,178	6,178	-30,085	22,387
Cordia subcordata	1,062,974	980,356	917,793	865,244	-116,051	114,544	-29,130	29,130	--	--	-145,181	121,008

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APPENDIX 2

RMI FAP Spatial Methodology and Maps

Republic of the Marshall Islands Priority Area Maps for Land and Conservation

Methodology for assessment & geospatial analysis

Source Data

- from USFS R5 FHP Davis
    - Land Cover Types
        - created based on QuickBird (Satellite) imagery by the FHP Davis team (2008)
    - Coastal Buffer Zone
        - based on the atoll land boundary lines generated from the FHP land cover data
        - by buffering inland 70-feet and outwards 30-feet into the ocean

- from Karness Kusto[1] (these layers were created by Caleb McClennan, 2010[2], for Reimaanlok); mostly digitized based on various satellite imagery, and described as "*for display and informational purpose only."* Maps of these data had only been published in Reimaanlok for sample atolls.)
    - Airports
    - Point (Fine-Scale) Conservation Targets. Fine-scale targets were mapped as points, though one point might characterize the entire islet.
    - Protected (Conservation) Area (Type I & Type II). A discrepancy was noted between Type I and Type II conservation areas, in the printed Reimaanlok compared to the metadata; the difference in management strategy between the types was determined to be irrelevant for terrestrial portions of the conservation areas.
    - Coarse-Scale Conservation Targets (Areas) – polygons. Three different terrestrial coarse-scale targets were described in Reimaanlok, but were all mapped as the same class (land) in the GIS data; therefore "land cover types" (described above) provided more detail for terrestrial areas.

Method[3]

- Software
    - ESRI ArcGIS 9.3
    - Windows XP with Service Pack 3

[1] State Forester, Republic of the Marshall Islands, personal communication 2010
[2] Personal communication; currently Director for Marine Conservation, Wildlife Conservation Society, New York.
[3] Mapping done and metadata documented by Zhangfeng Liu, 2010.

- Process
    - We started with a set of overview maps created with only the FHP landcover data, while in the mean time searching for available data layers for RMI.
    - Data searching turned out very few results other than a set of digitized maps created by Caleb McClennen based on satellite imagery, which we decided to use for this SWARS reporting.
    - After the first draft of overview maps were reviewed, comments were gathered and the second round of maps were produced with the McClennen layers.
    - The third revision of the maps was focused on determining exactly which maps to produce, the map layouts, styling (color, elements, etc.), and contents. Major changes including the use of separate maps for previously insets only contents and simplification/modification of symbology.
    - The maps went through two more revisions after each new set of maps were reviewed and new comments were made. The final fine-tuning is all about making the maps look better and all the map elements are exactly what the report wants.

Notes

- Data Gap
    - There is no question that the lack of up-to-date geospatial data for the RMI is a major problem. There are very few data available. Those do exist may not have the sufficient information including metadata or geographic accuracy to warrant a precise GIS modeling analysis as required by SWARS.
    - Significant efforts and resources should be committed to building a set of baseline spatial data for these very important RMI islands which obviously are facing many challenges that require the assistance of Geospatial technology and analyses.

Imagery available for various atolls

High-resolution (60 centimeter) QuickBird Imagery Purchased for 2008 FHP (Davis) PIC Mapping -- Landcover Maps

Ailinglaplap, Arno, Aur, Enewetok, Jaluit, Kwajalein, Likiep, Majuro, Maloelap, Mili, Rongelap, Wotje

Other Satellite Imagery (14-meter resolution/4 band) provided by Karness

Ailinginae, Ailinglaplap, Ailuk, Arno, Aur, Bikar, Biniki, Bokak, Ebon, Enewetak, Erikub, Jabat, Jaluit, Jemo, Kili, Kwajelein, Lae, Likiep, Majuro, Maloelap, Mejit, Mili, Namorik, Namu North, Namu South, Rongelap, Rongerik, Taka, Ujae, Ujelang, Utrik, Wake, Wotho, Wotje East, Wotje West.

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REPUBLIC OF THE MARSHALL ISLANDS

*Landcover data not available.

Priority Area

- Conservation Areas
- Coastal Buffer Zone

Conservation Targets

- Crab population
- Breadfruit forest
- Climax forest
- Mangrove area
- Pemphis acidula forest
- Pond
- Shrubland/Grassland
- Windward forest
- Bwebwenato

Landcover

- Forest
- Rangeland
- Urban
- Barren
- Water

Landform

- Land
- Lagoon
- Others
- Airports

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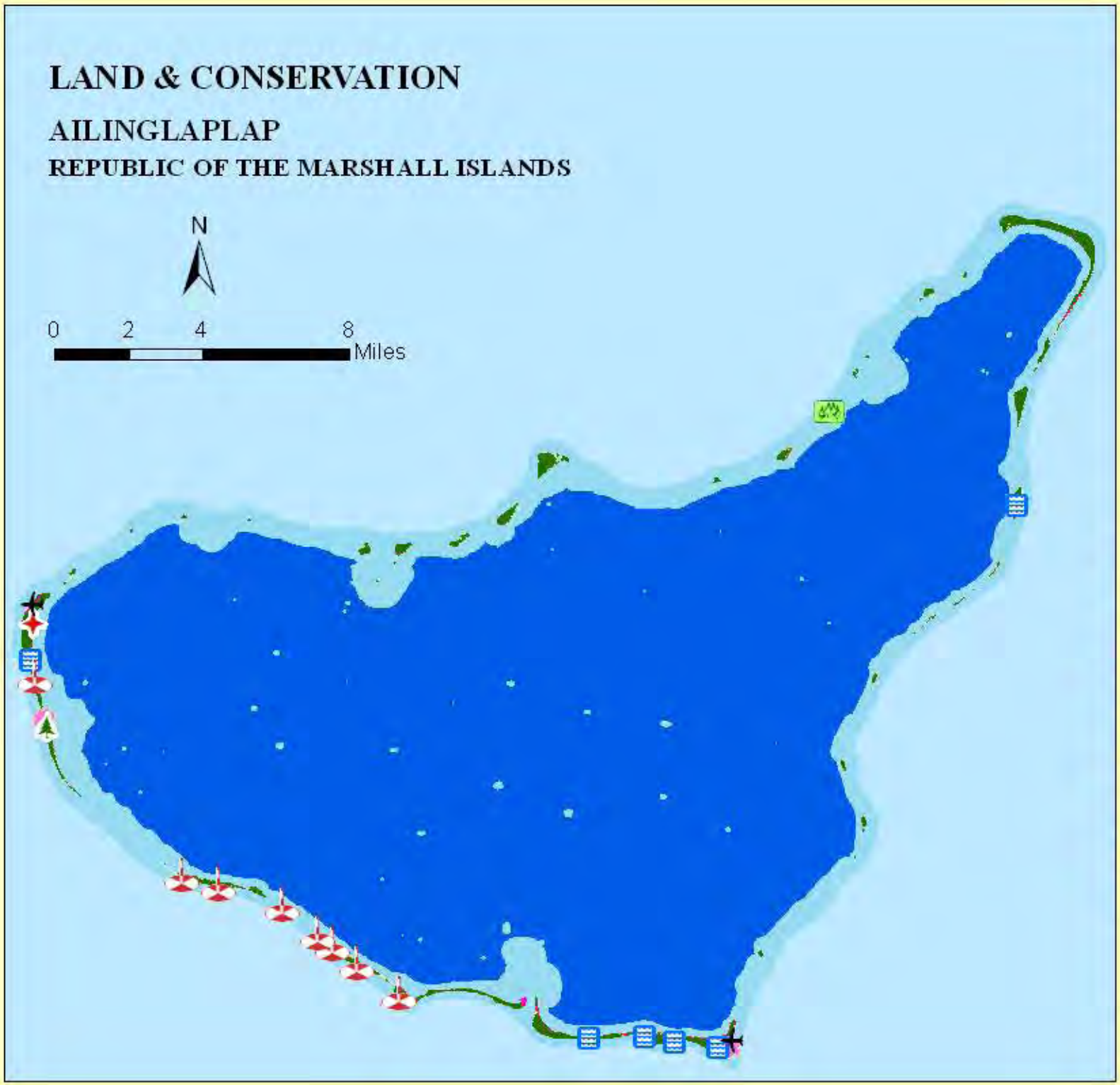

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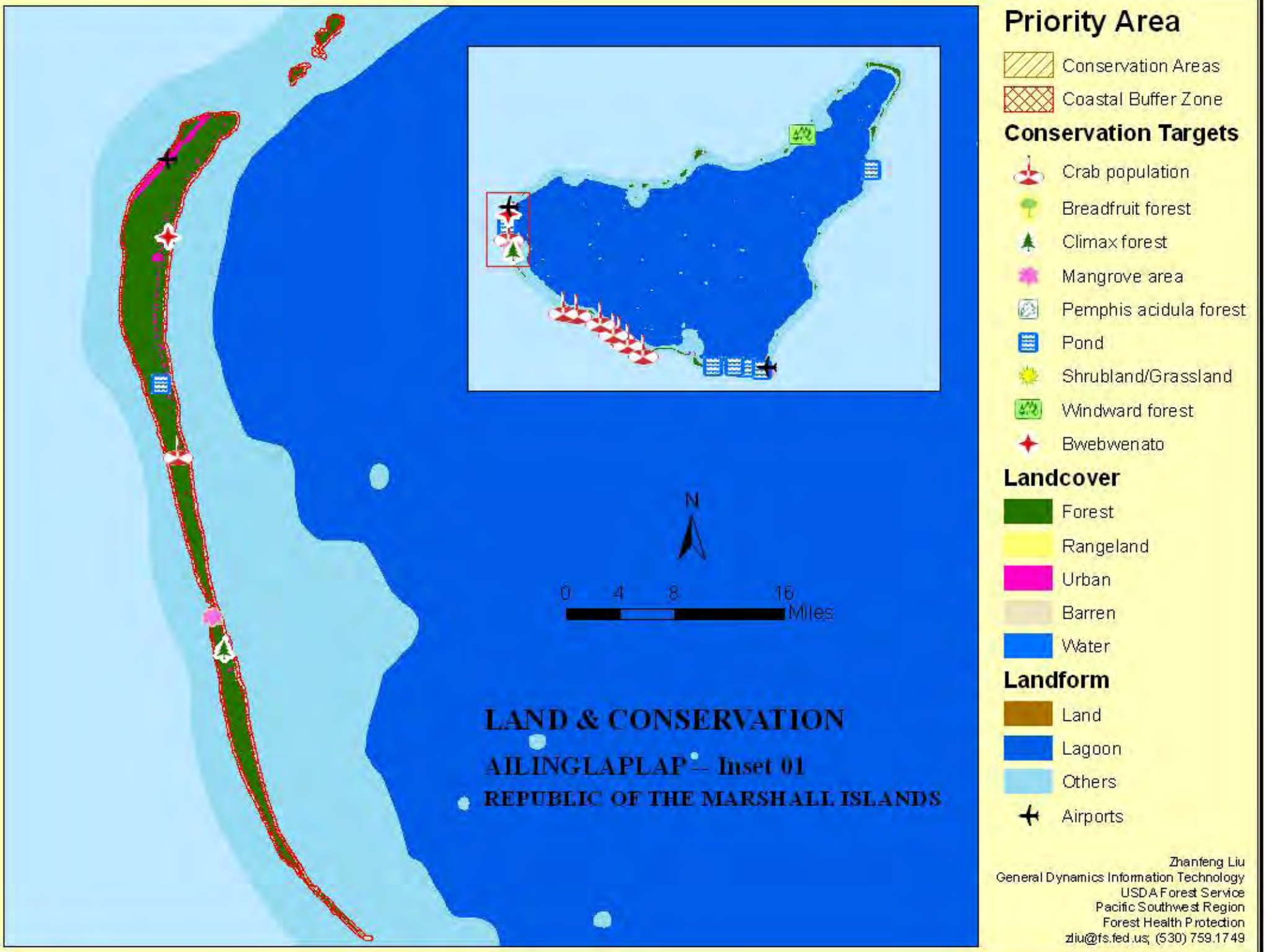

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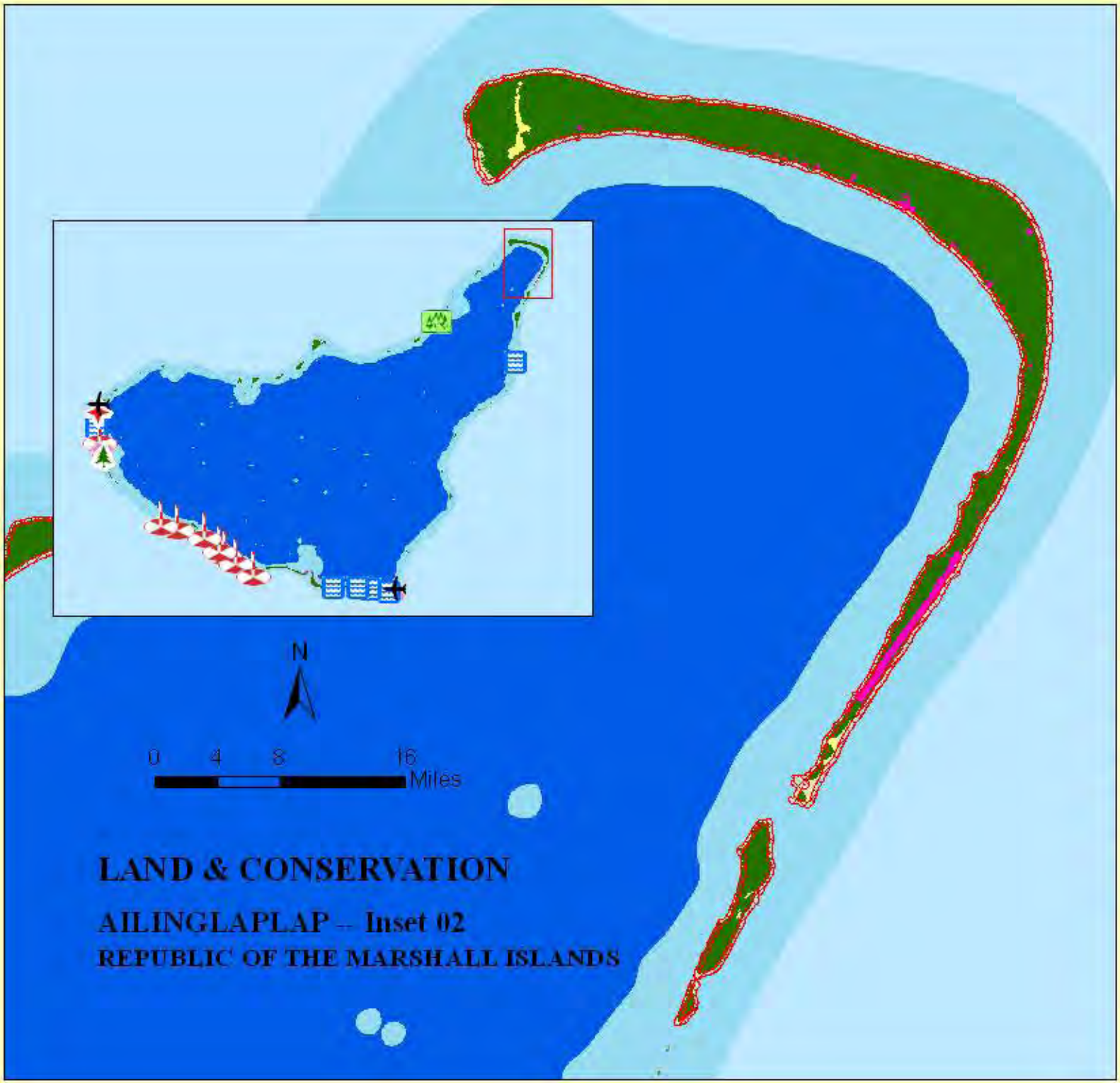

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Priority Area

- Conservation Areas
- Coastal Buffer Zone

Conservation Targets

- Crab population
- Breadfruit forest
- Climax forest
- Mangrove area
- Pemphis acidula forest
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Landcover

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Landform

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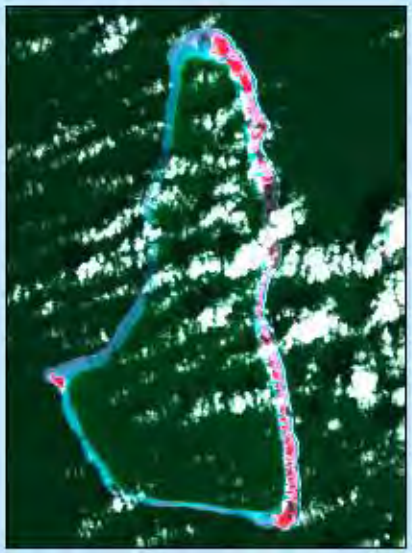

*Landcover data not available.

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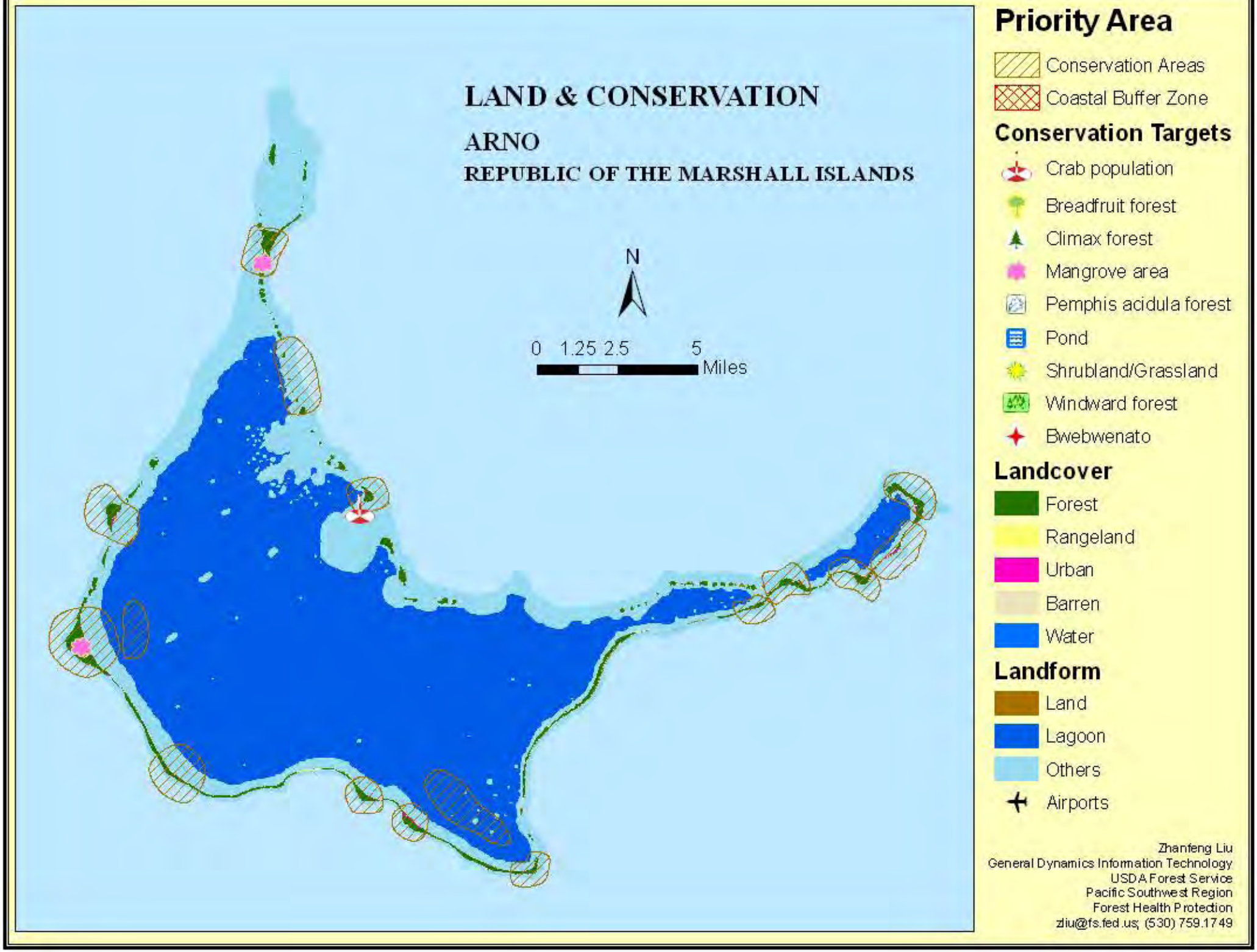

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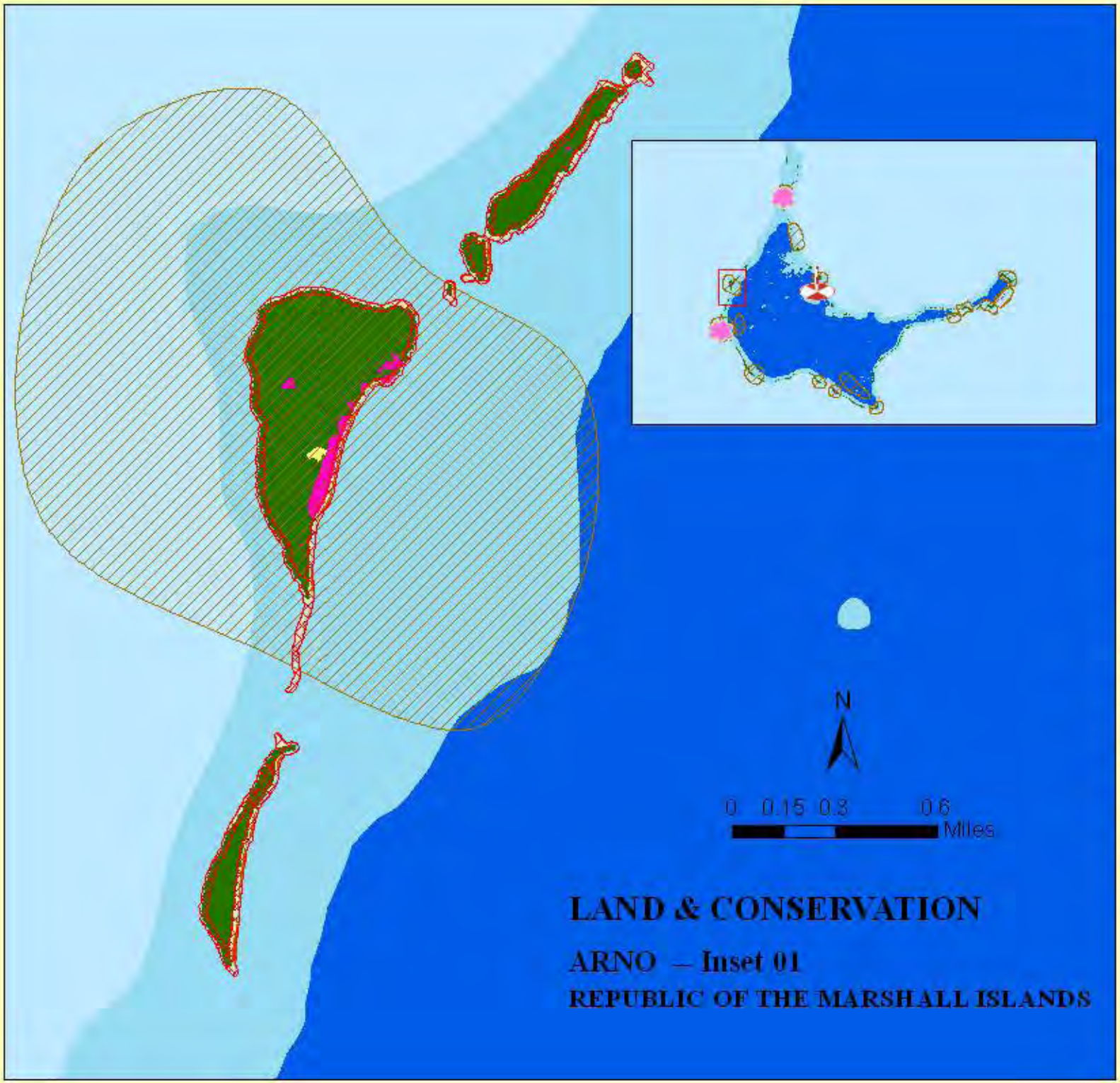

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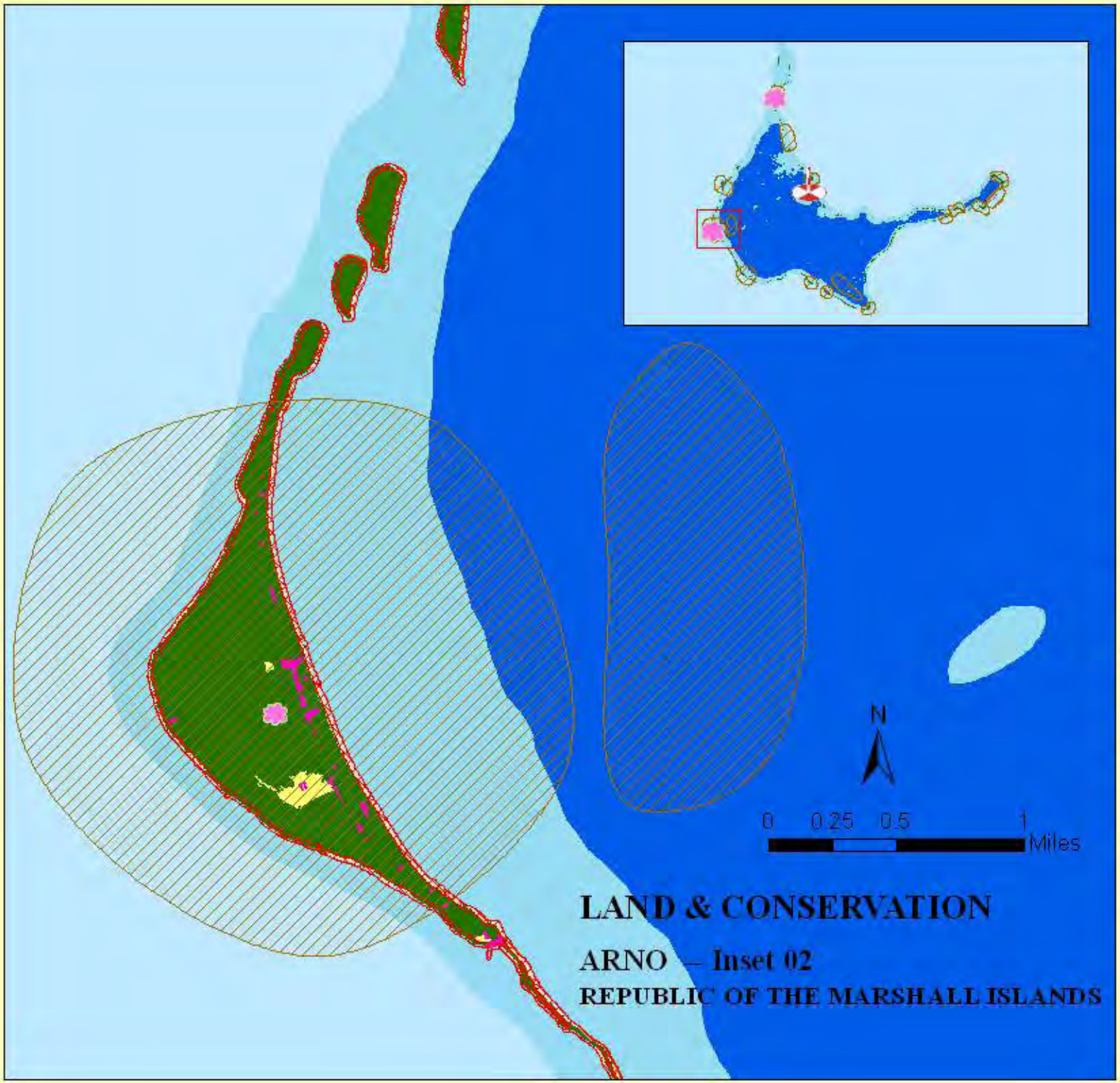

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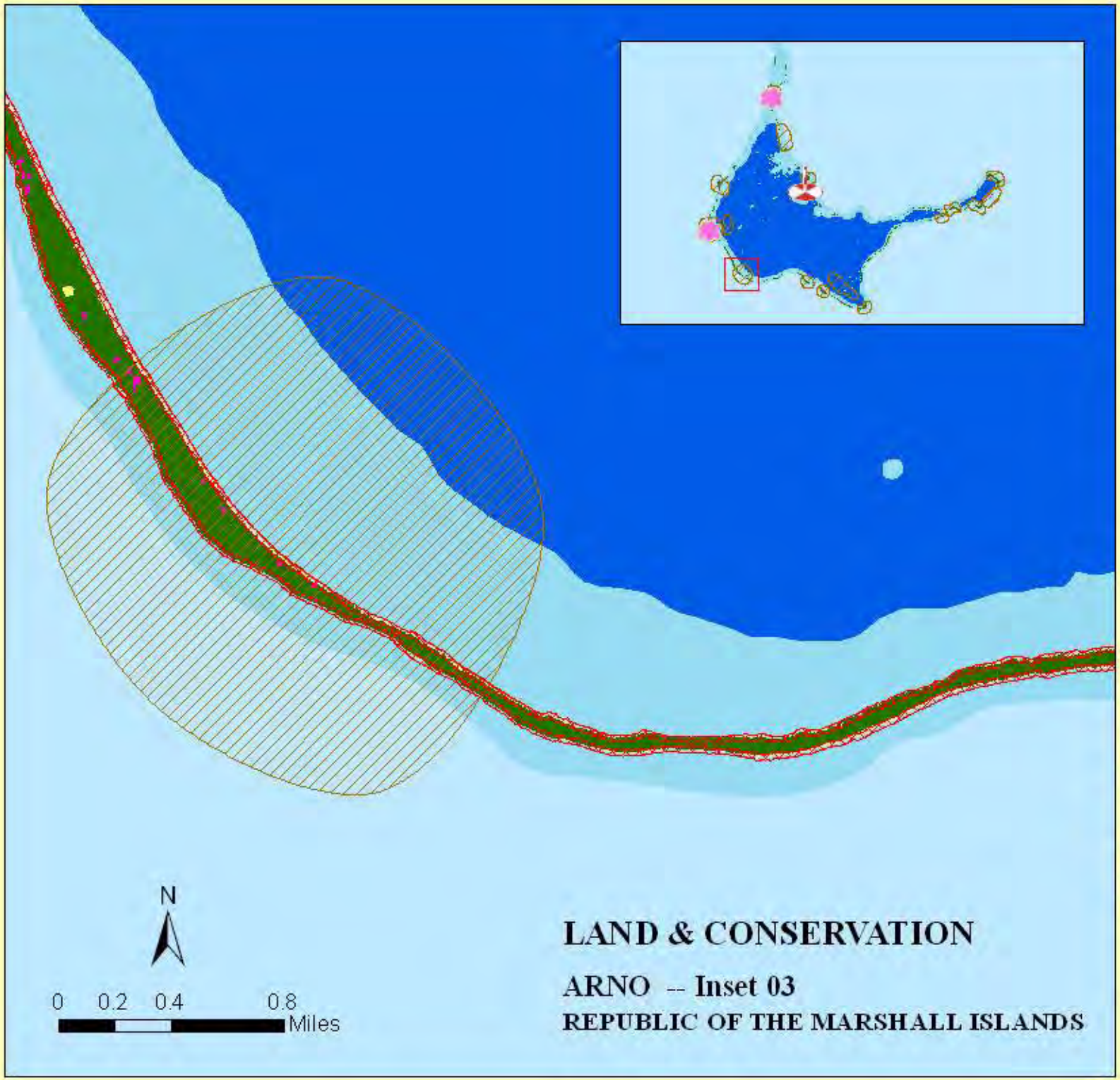

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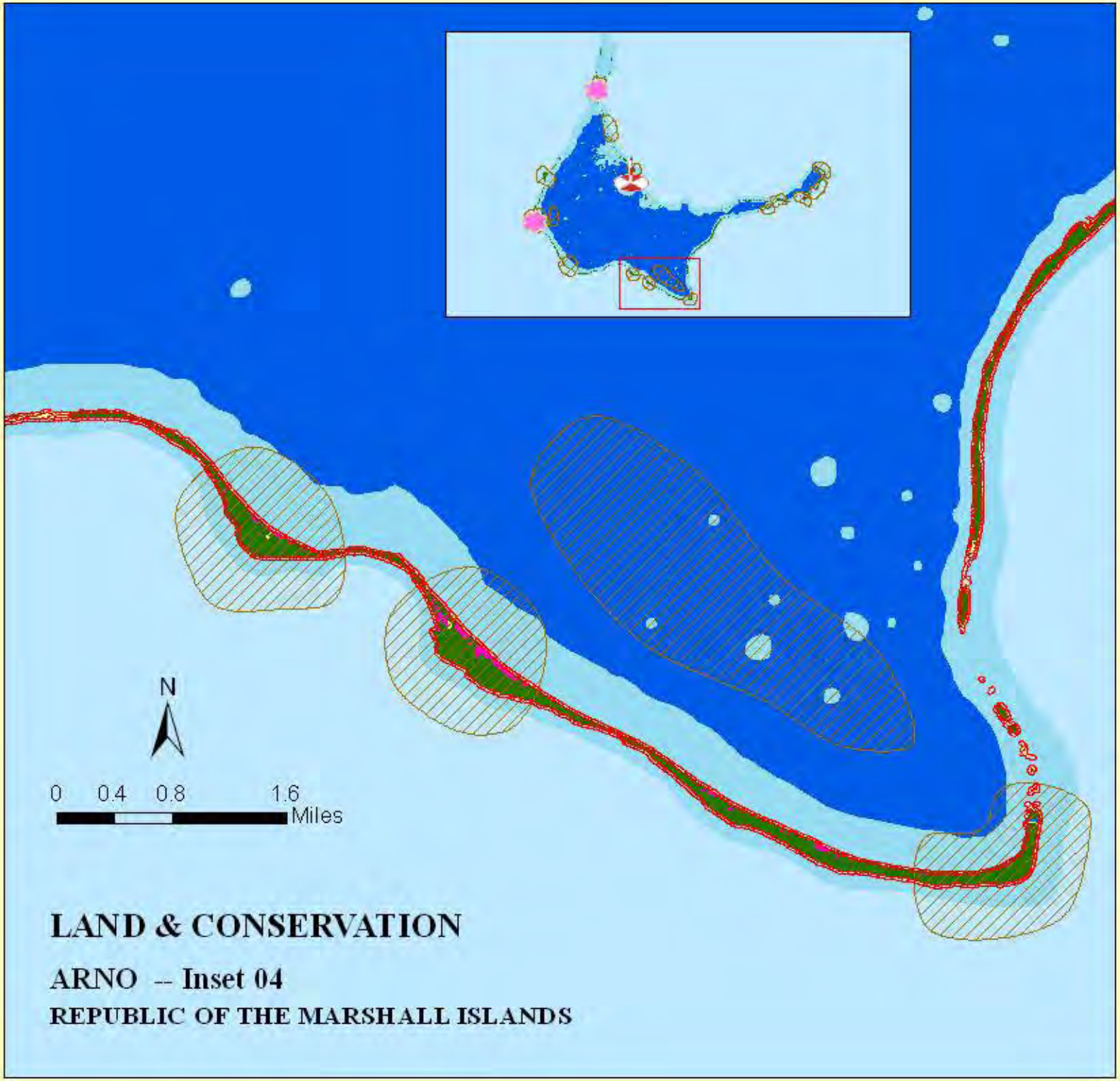

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- Conservation Areas
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Conservation Targets

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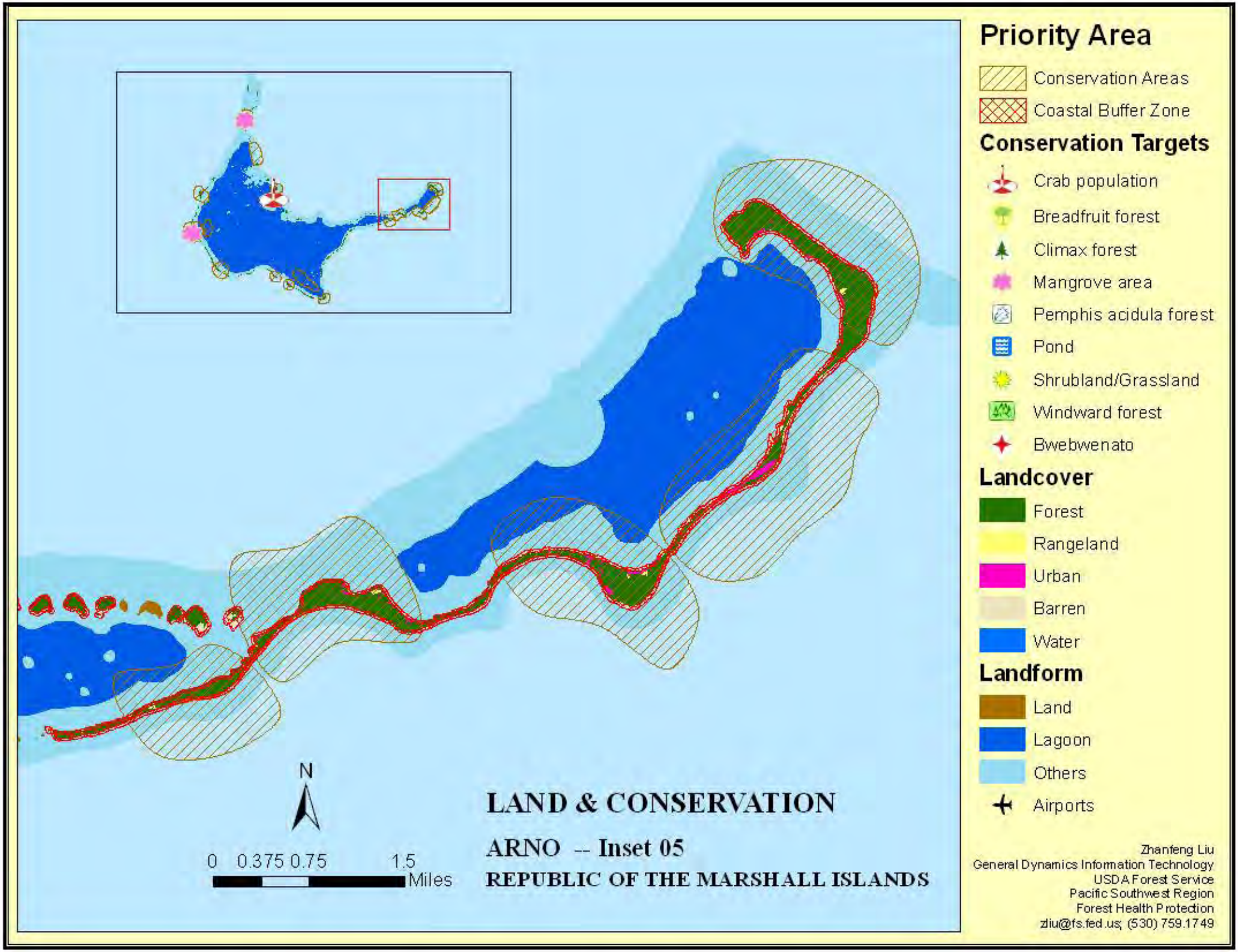
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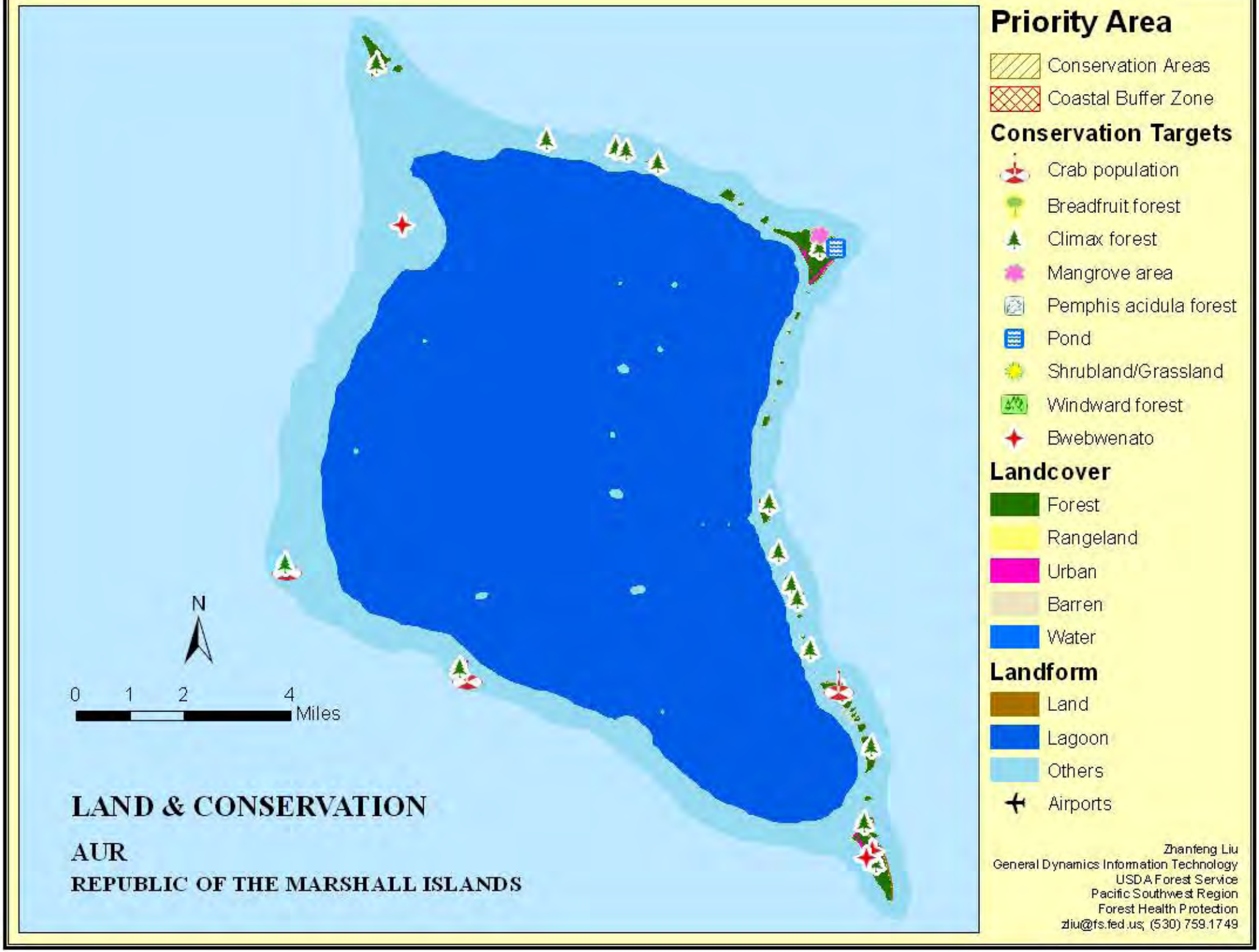
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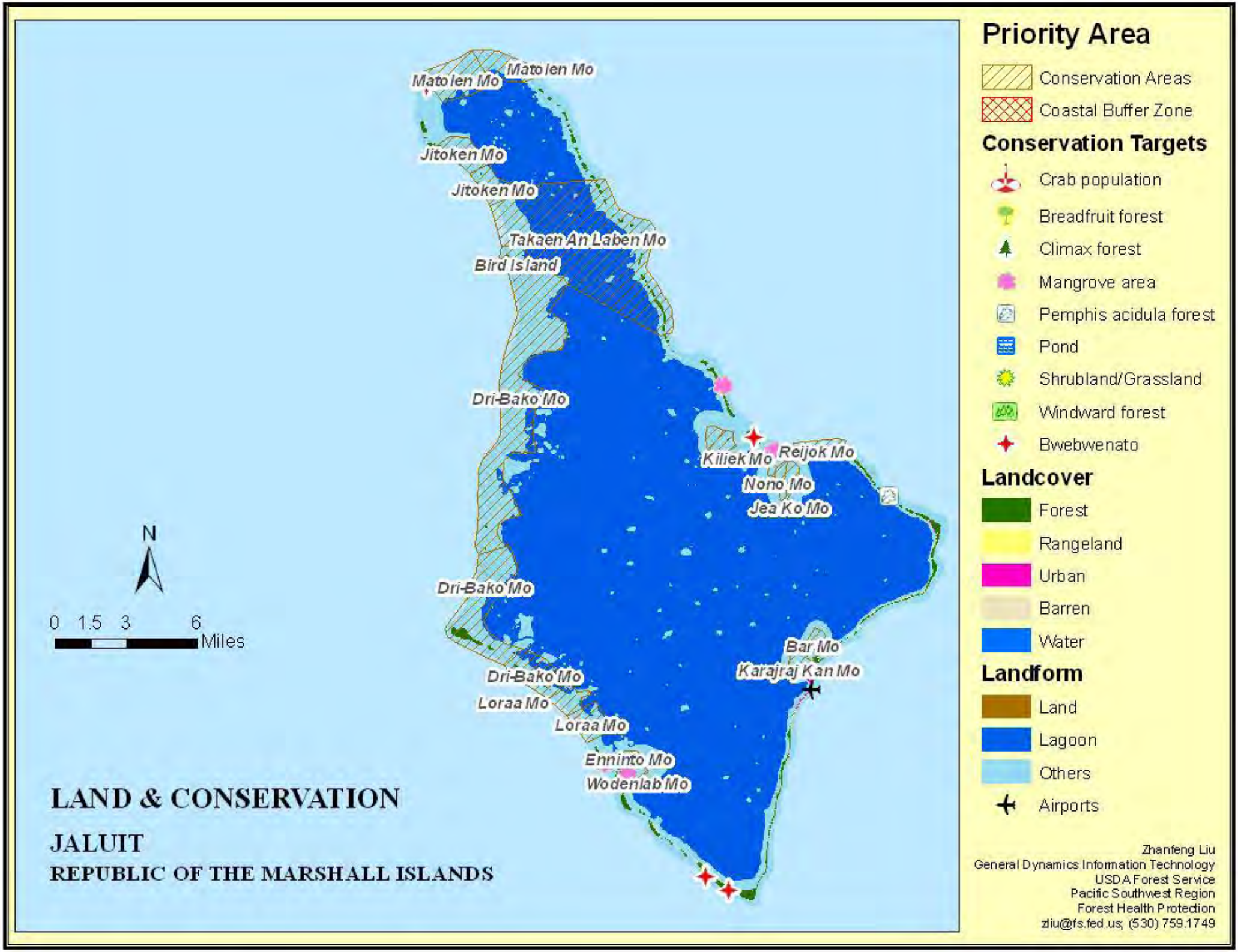
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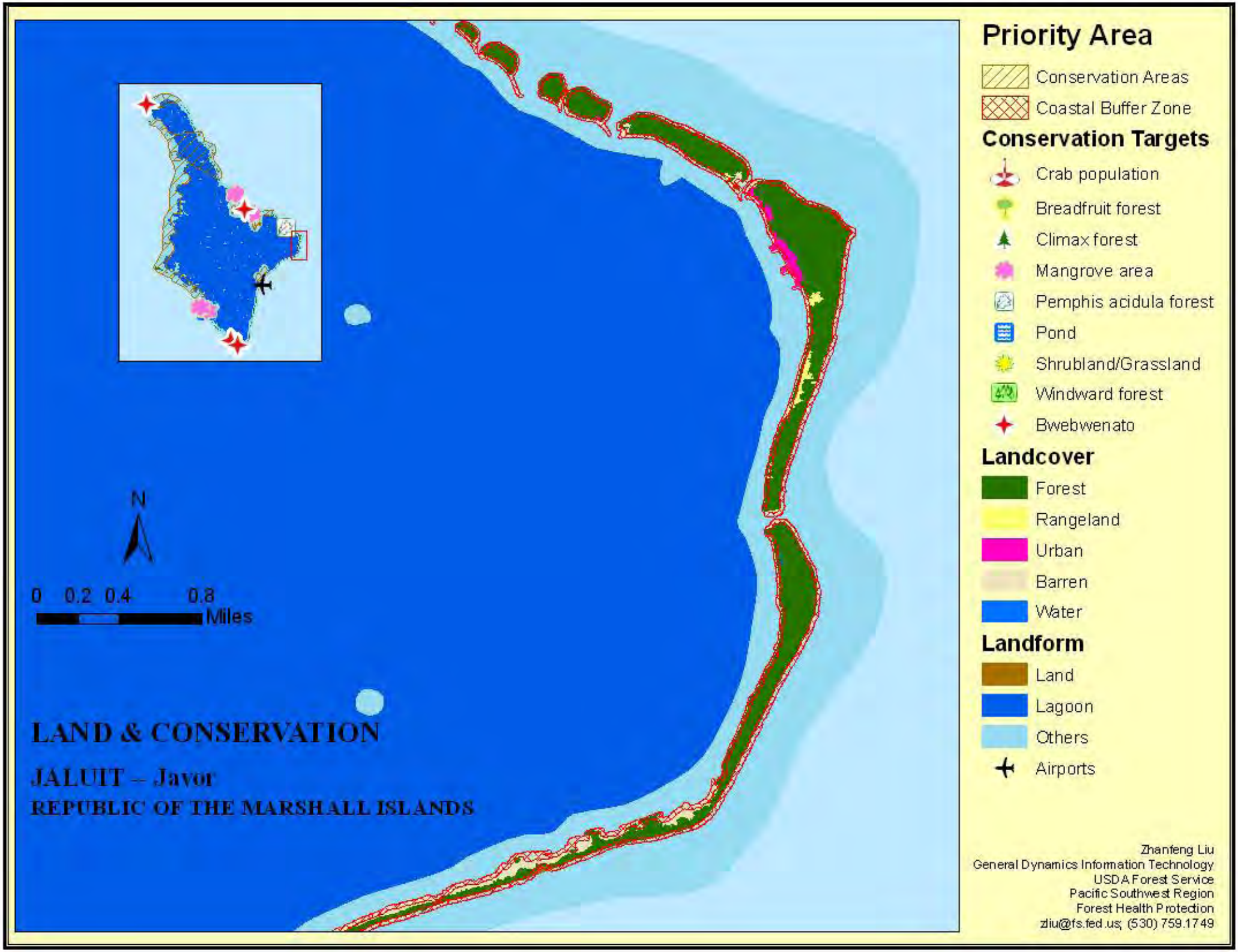
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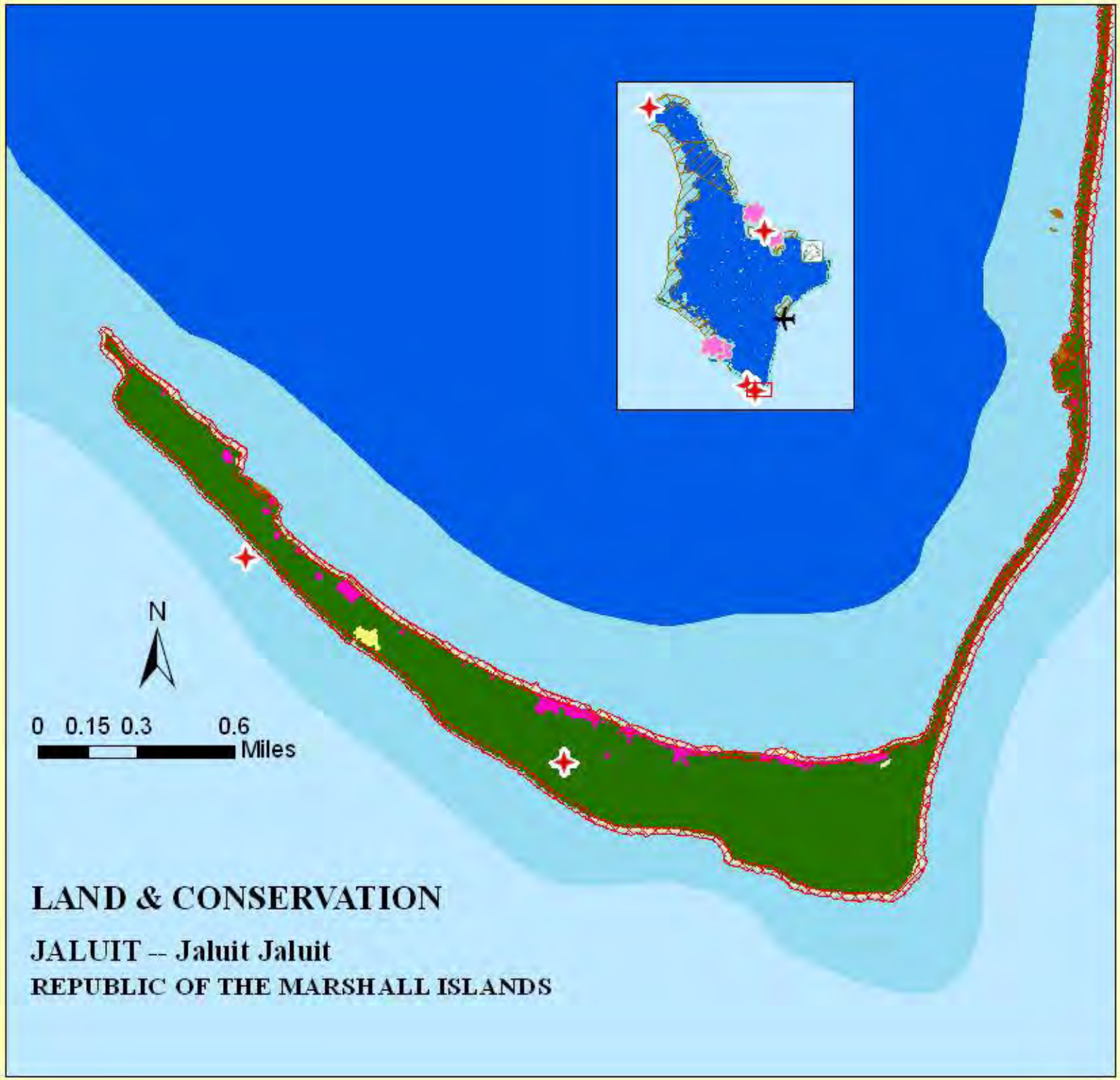

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Priority Area

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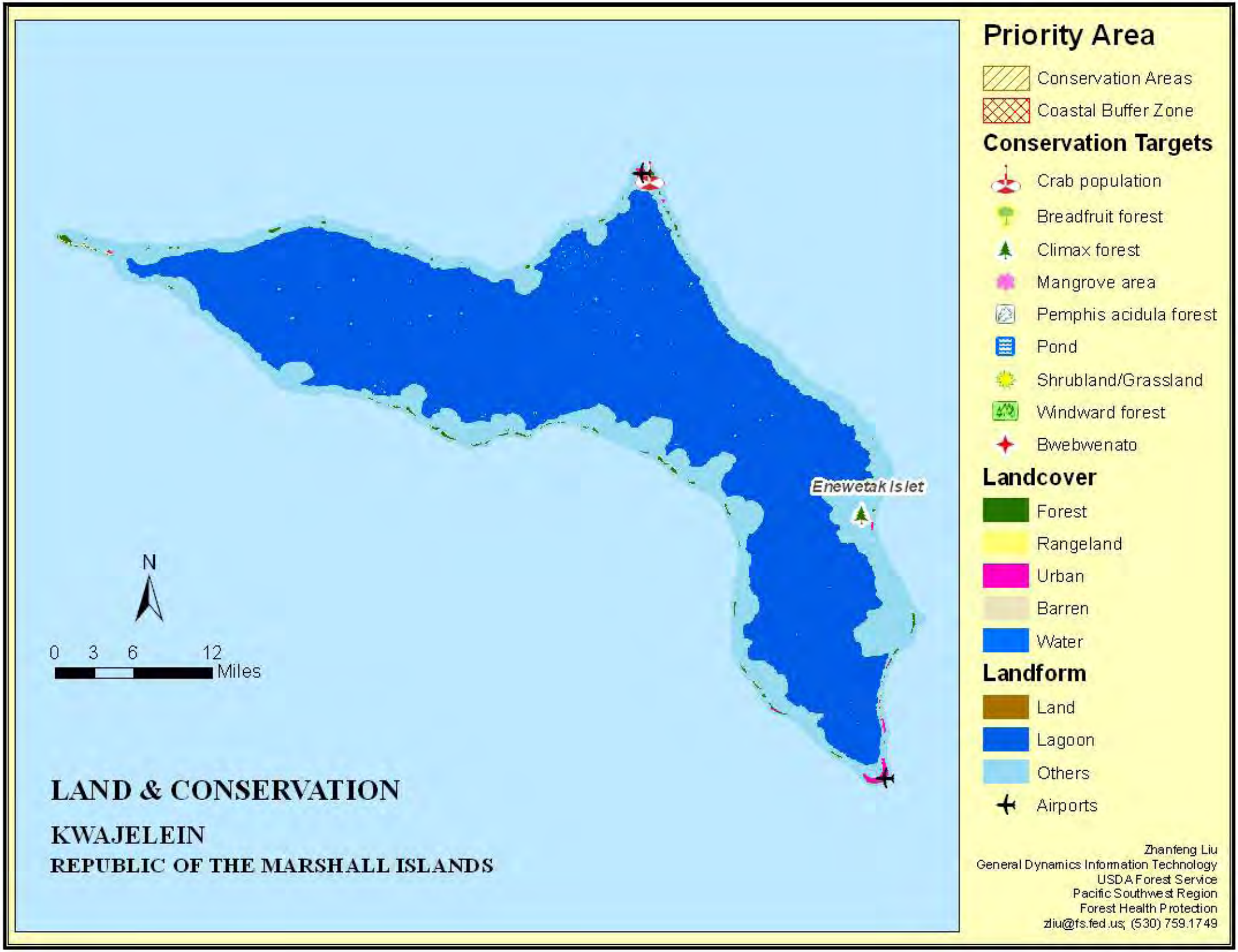

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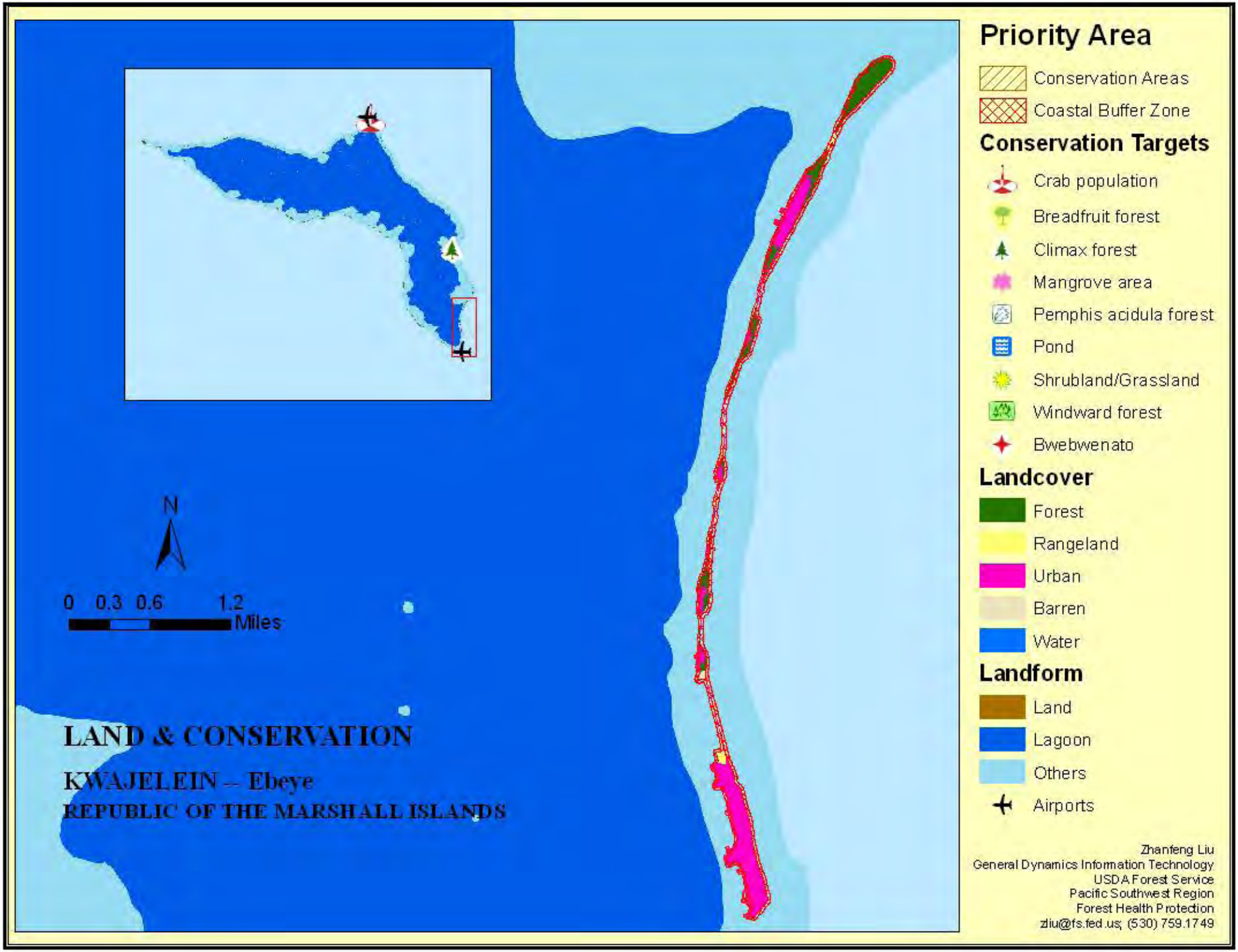
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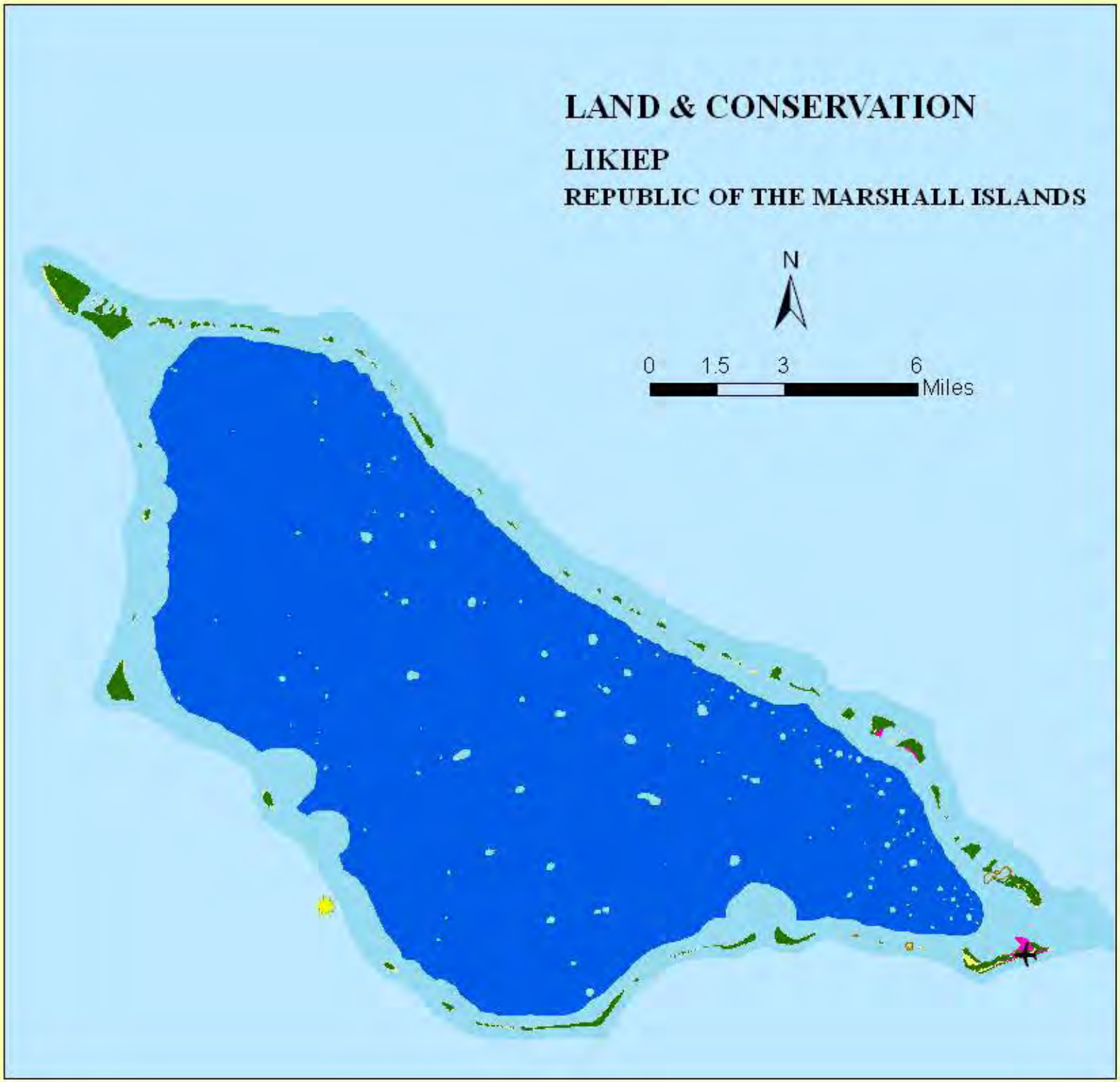

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- Airports

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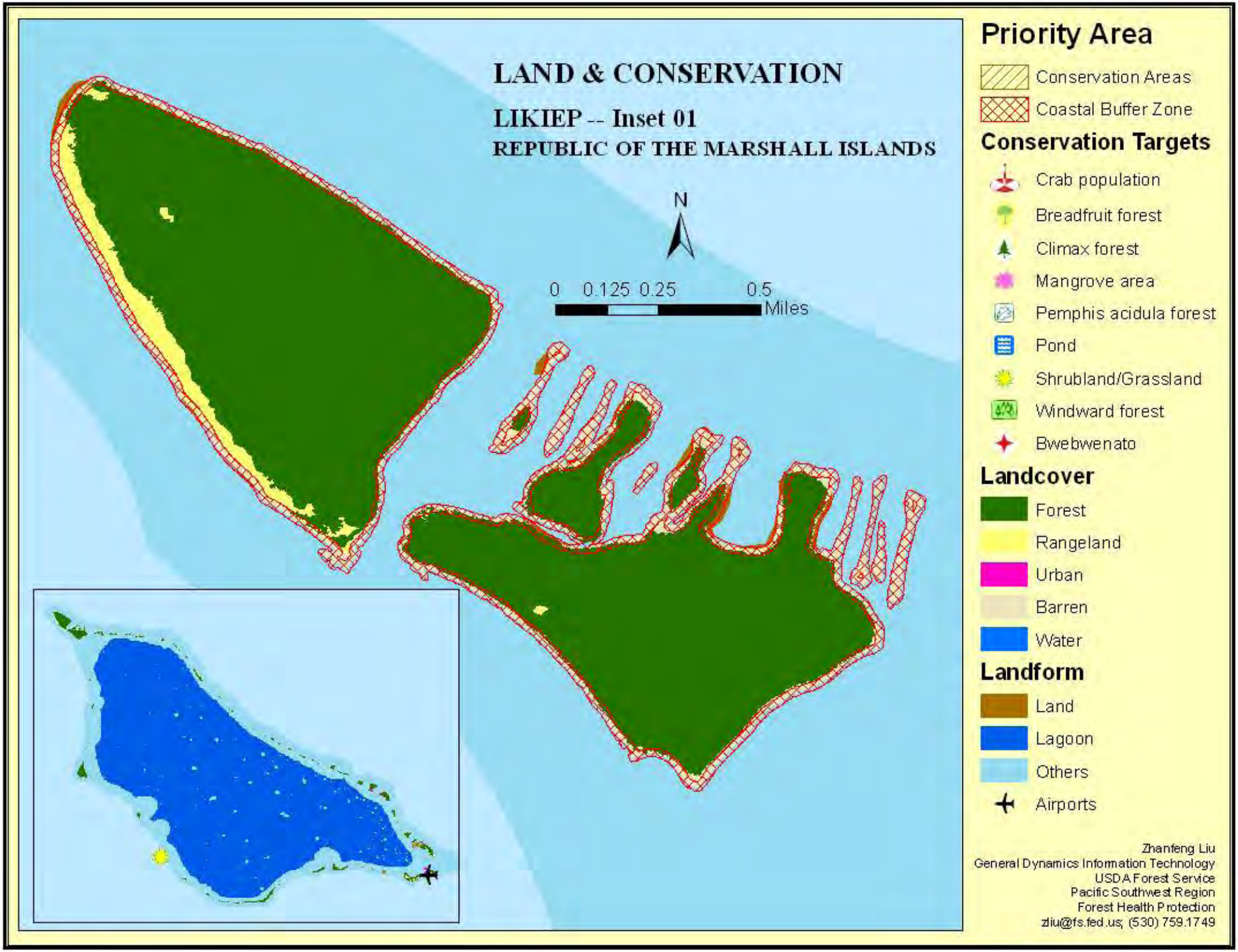
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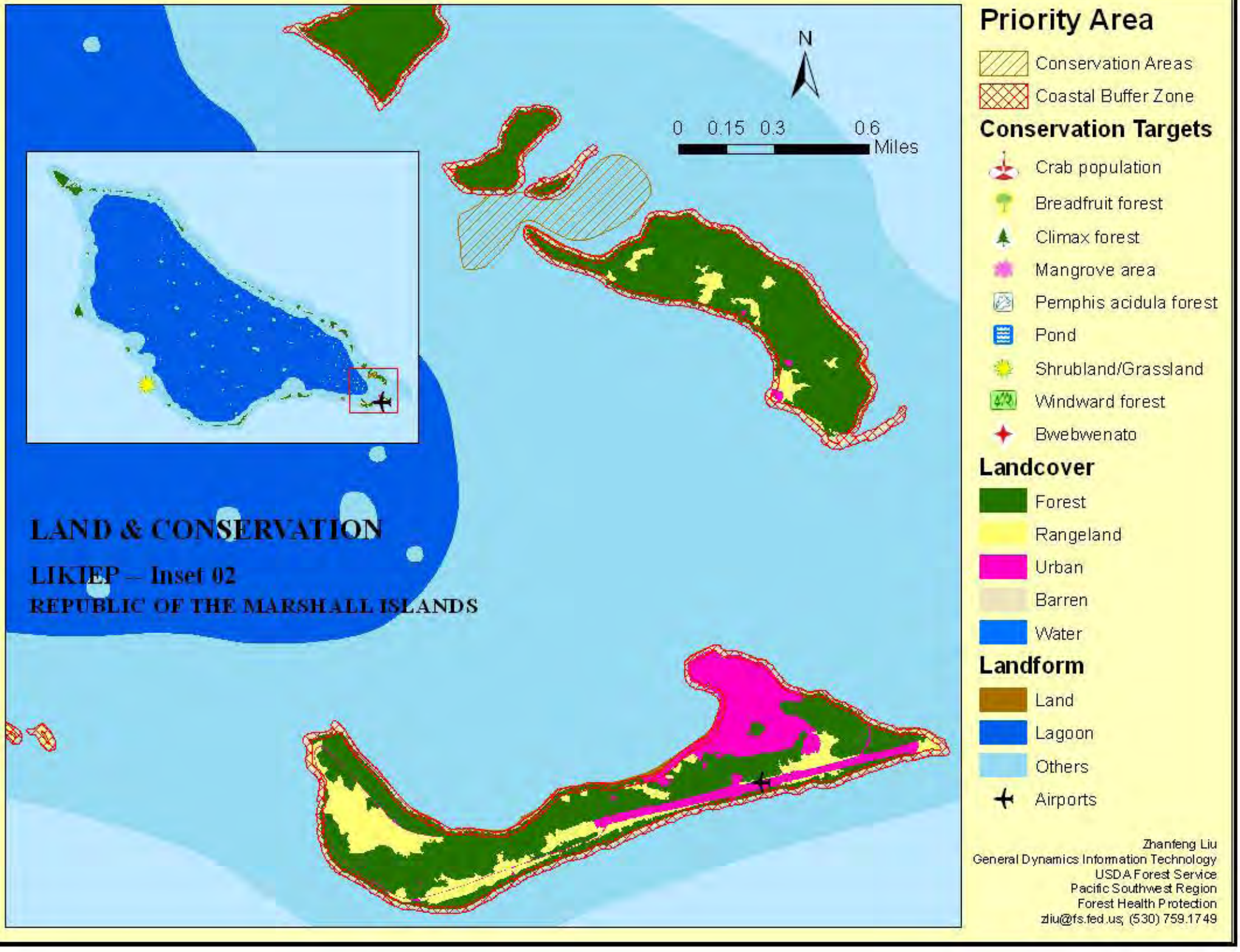

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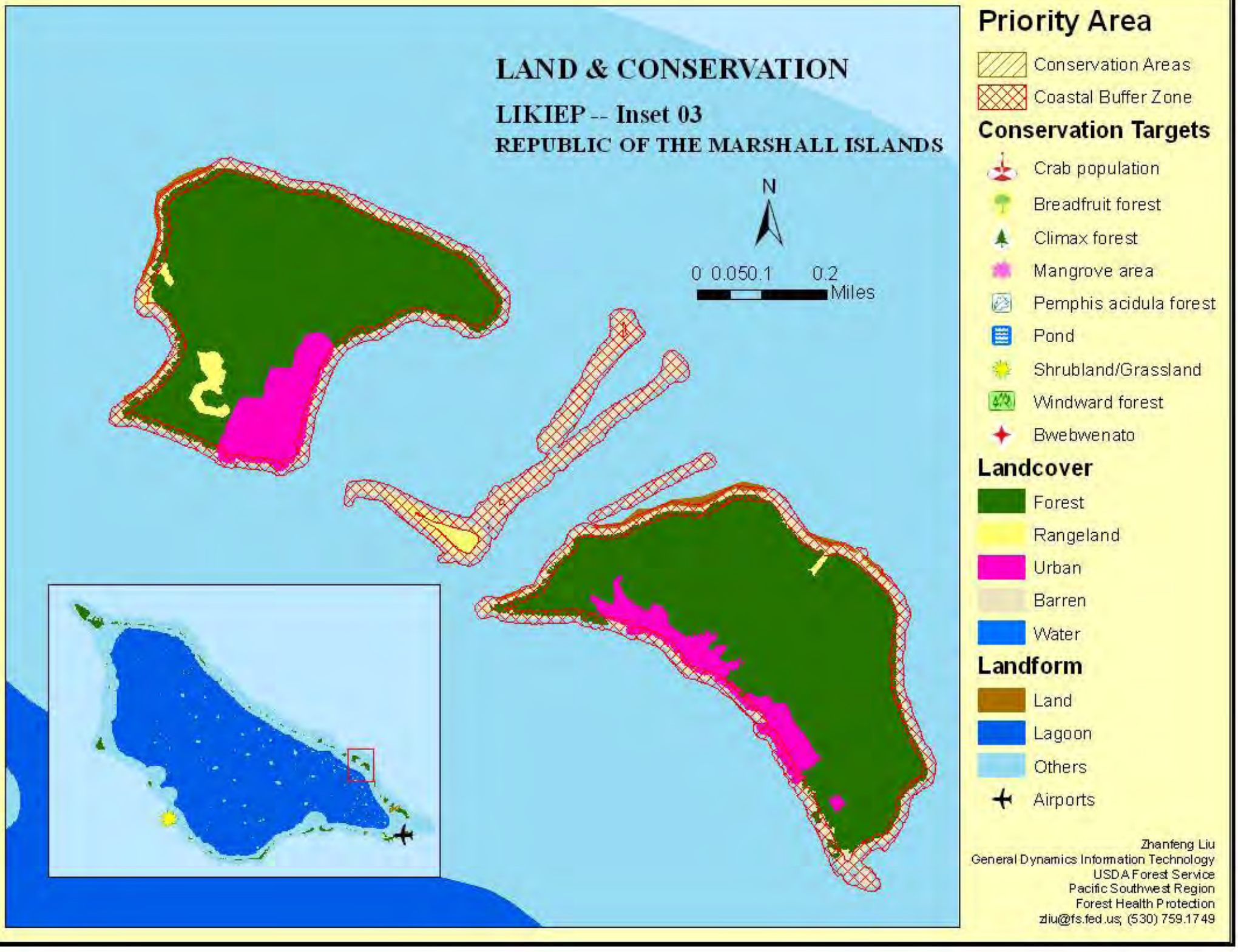
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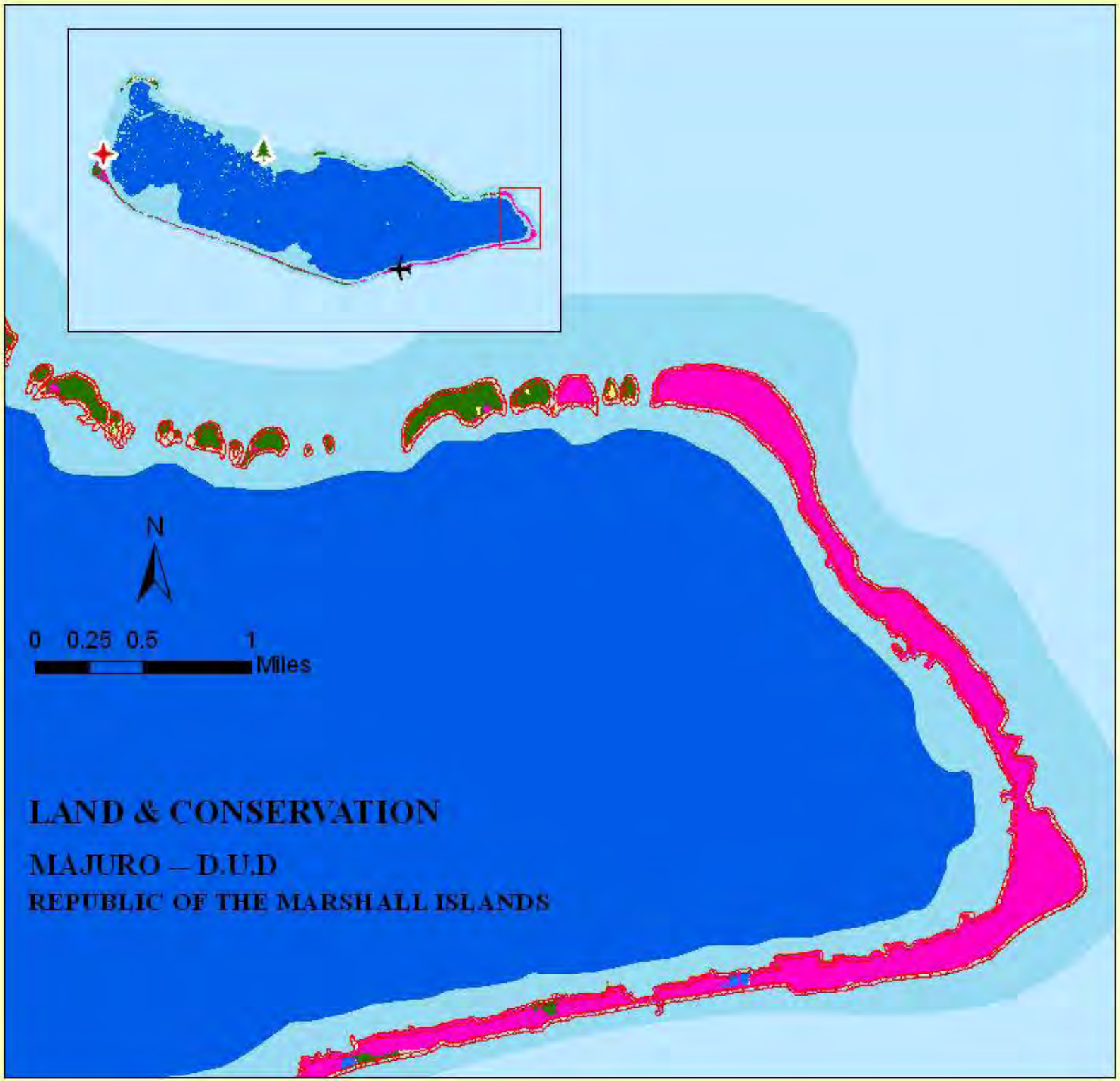

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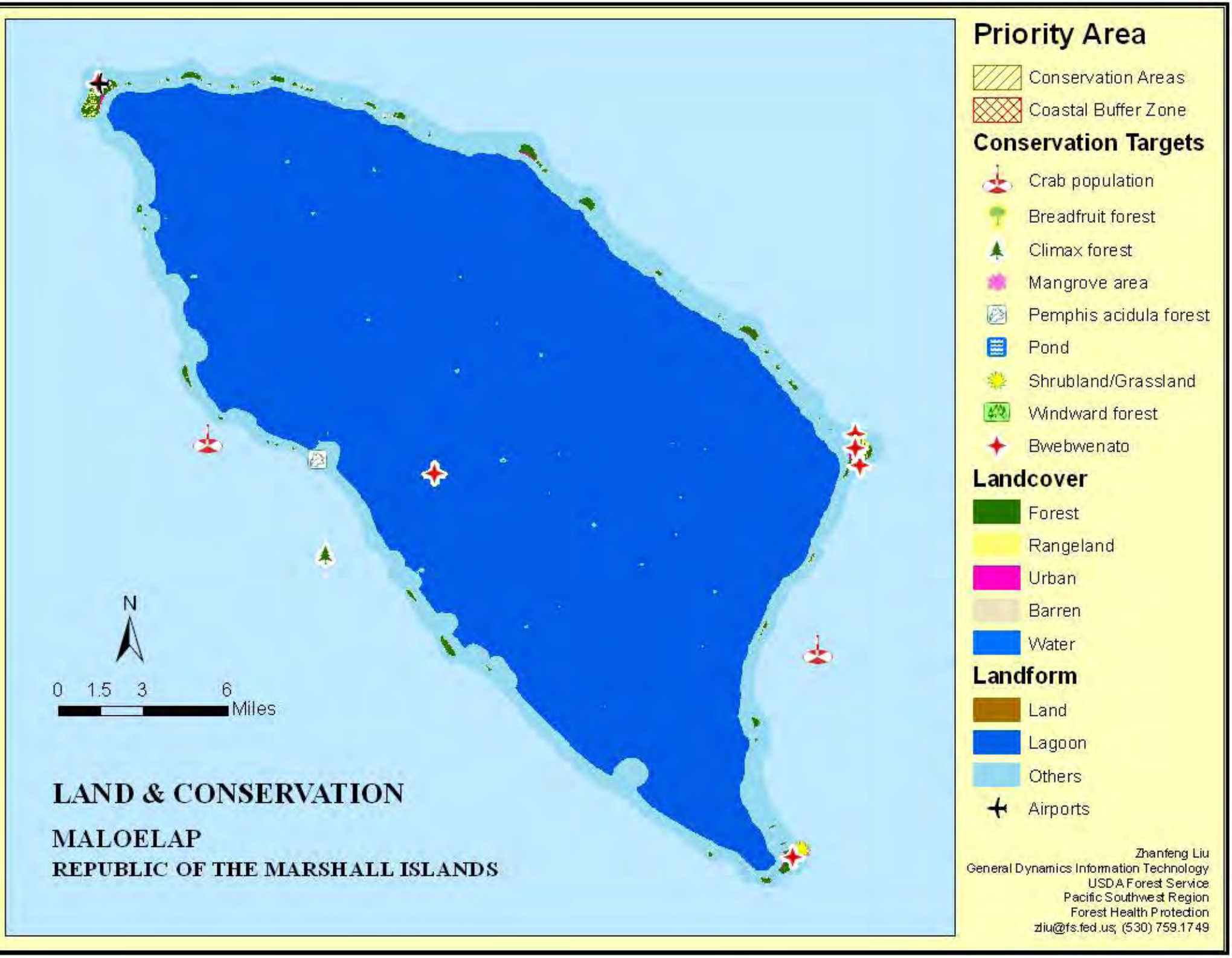
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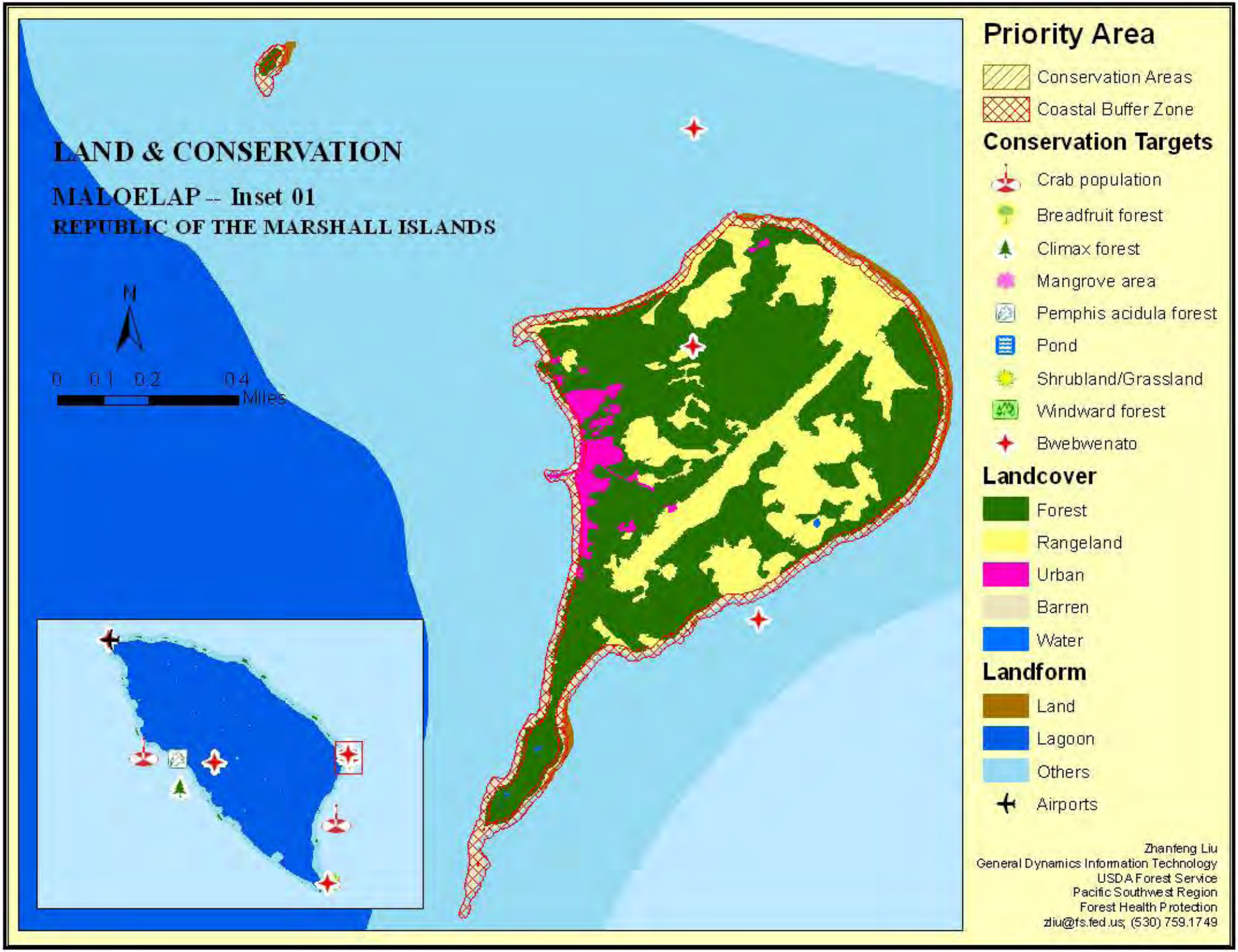
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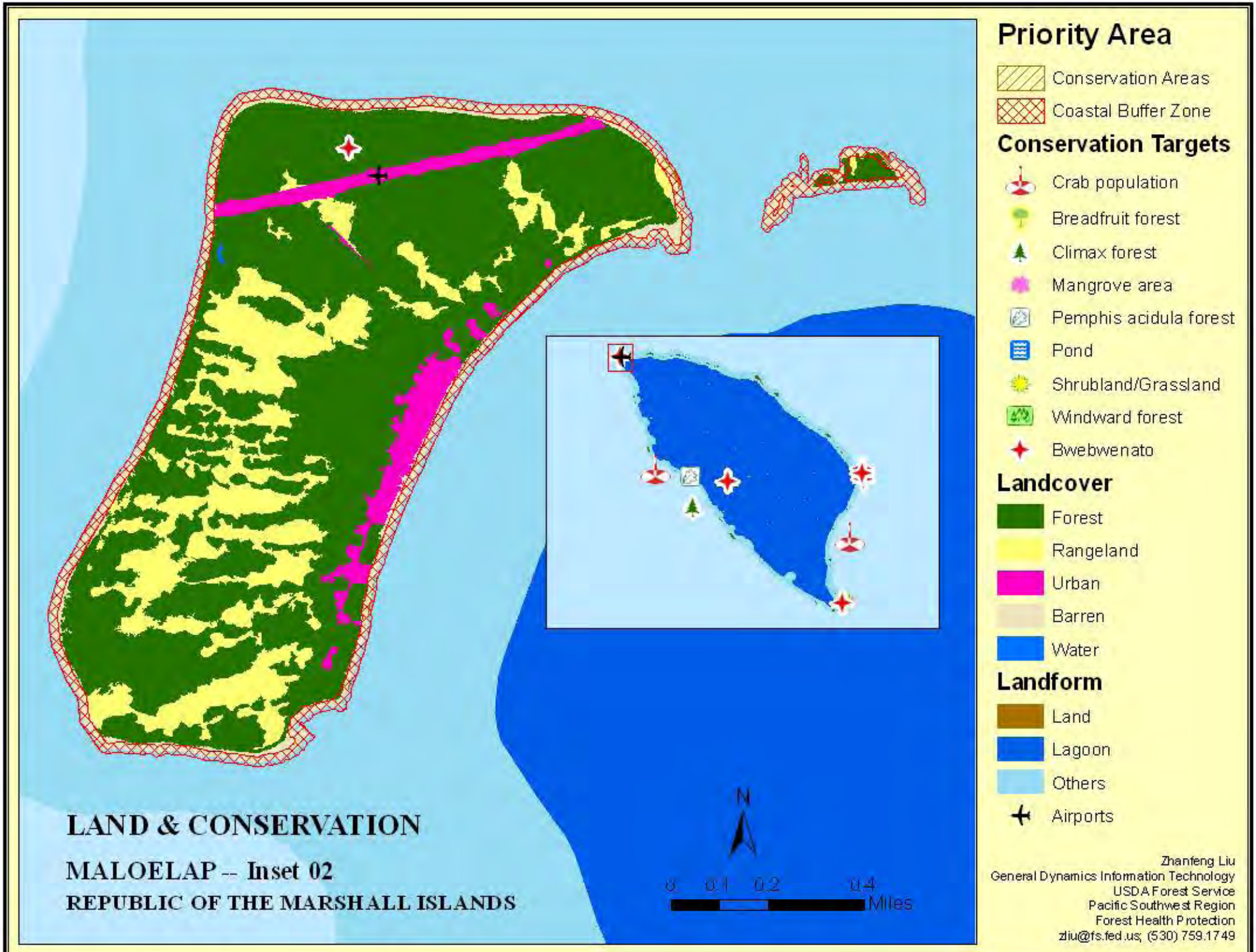
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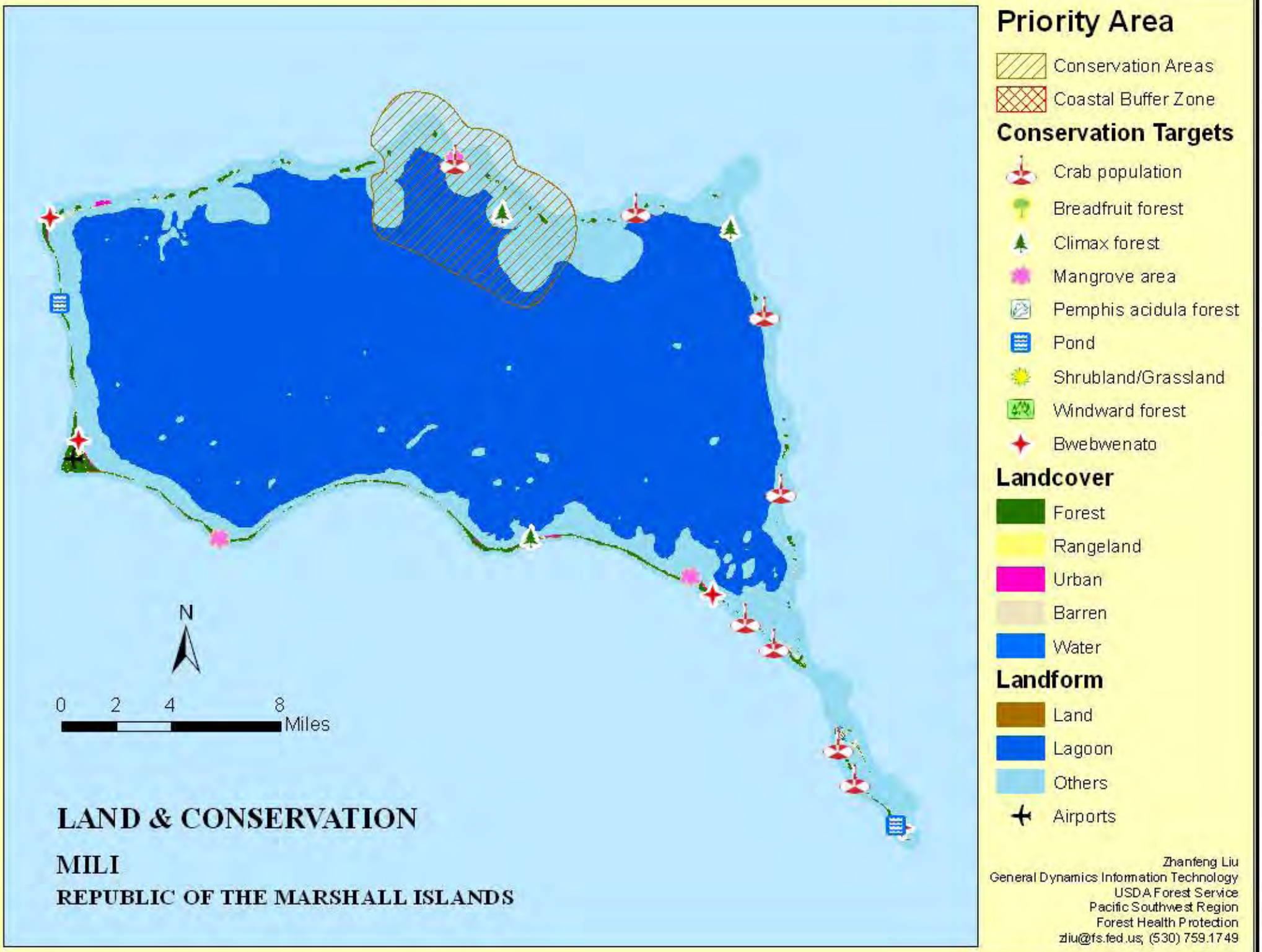
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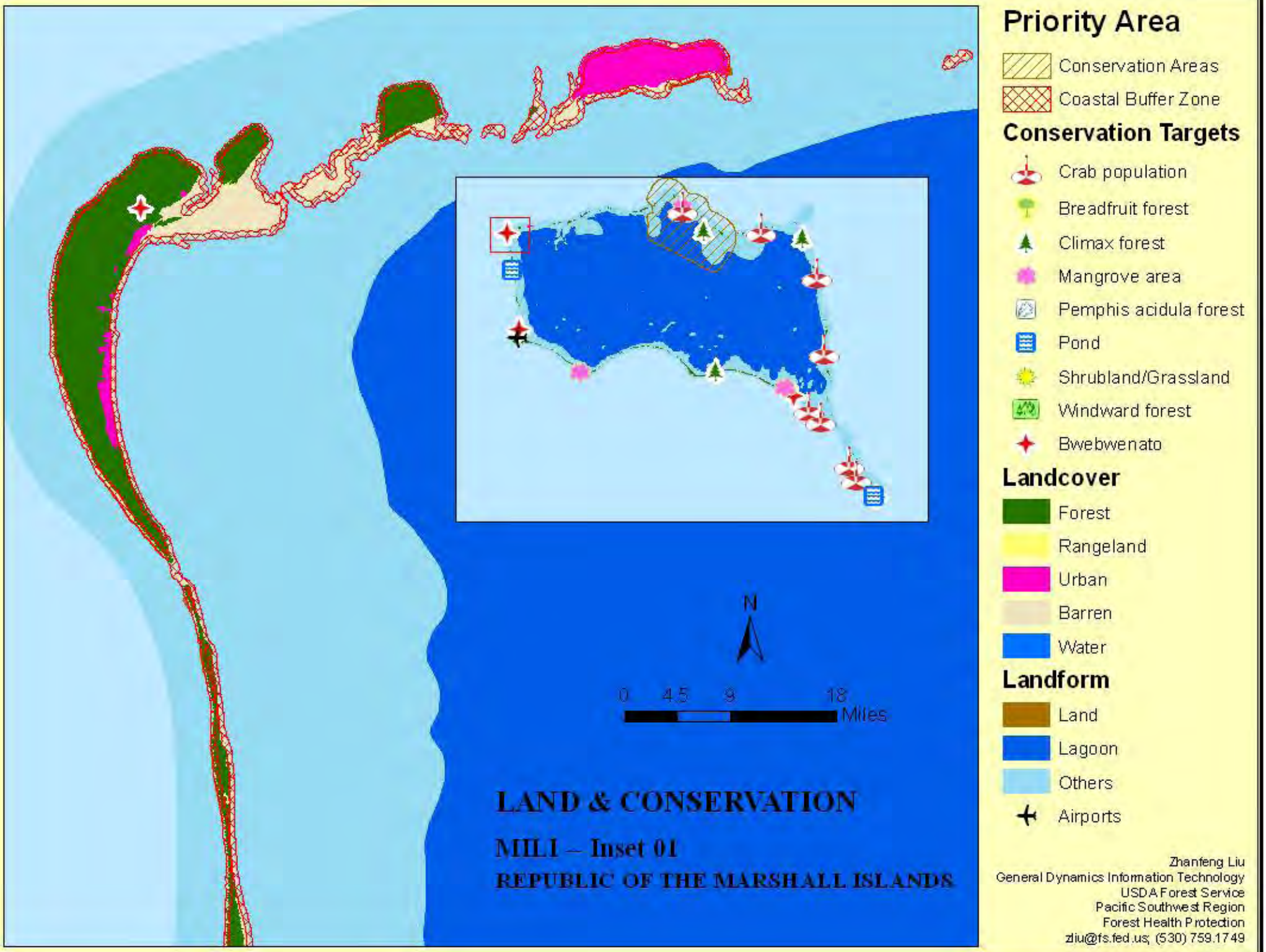
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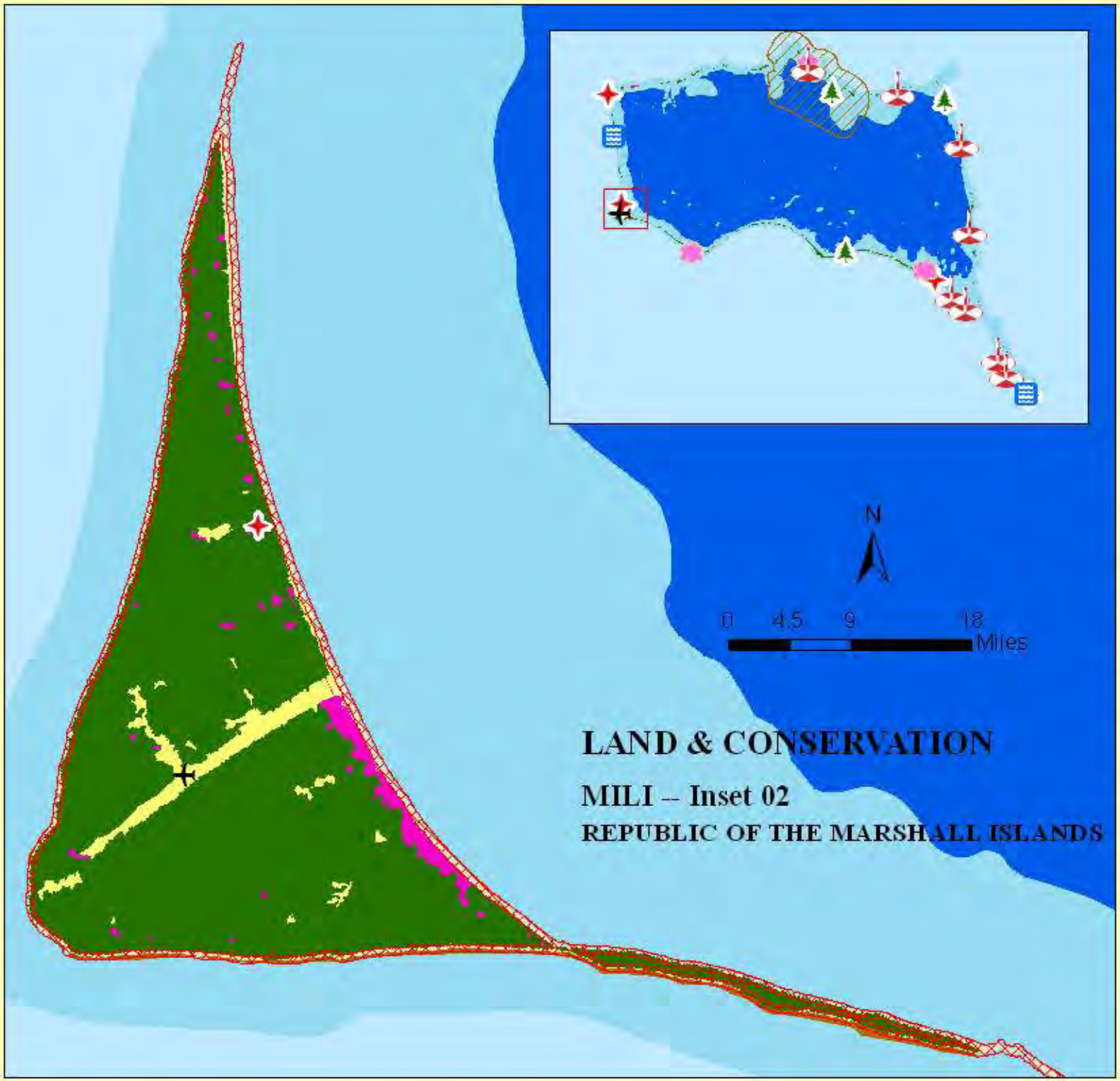

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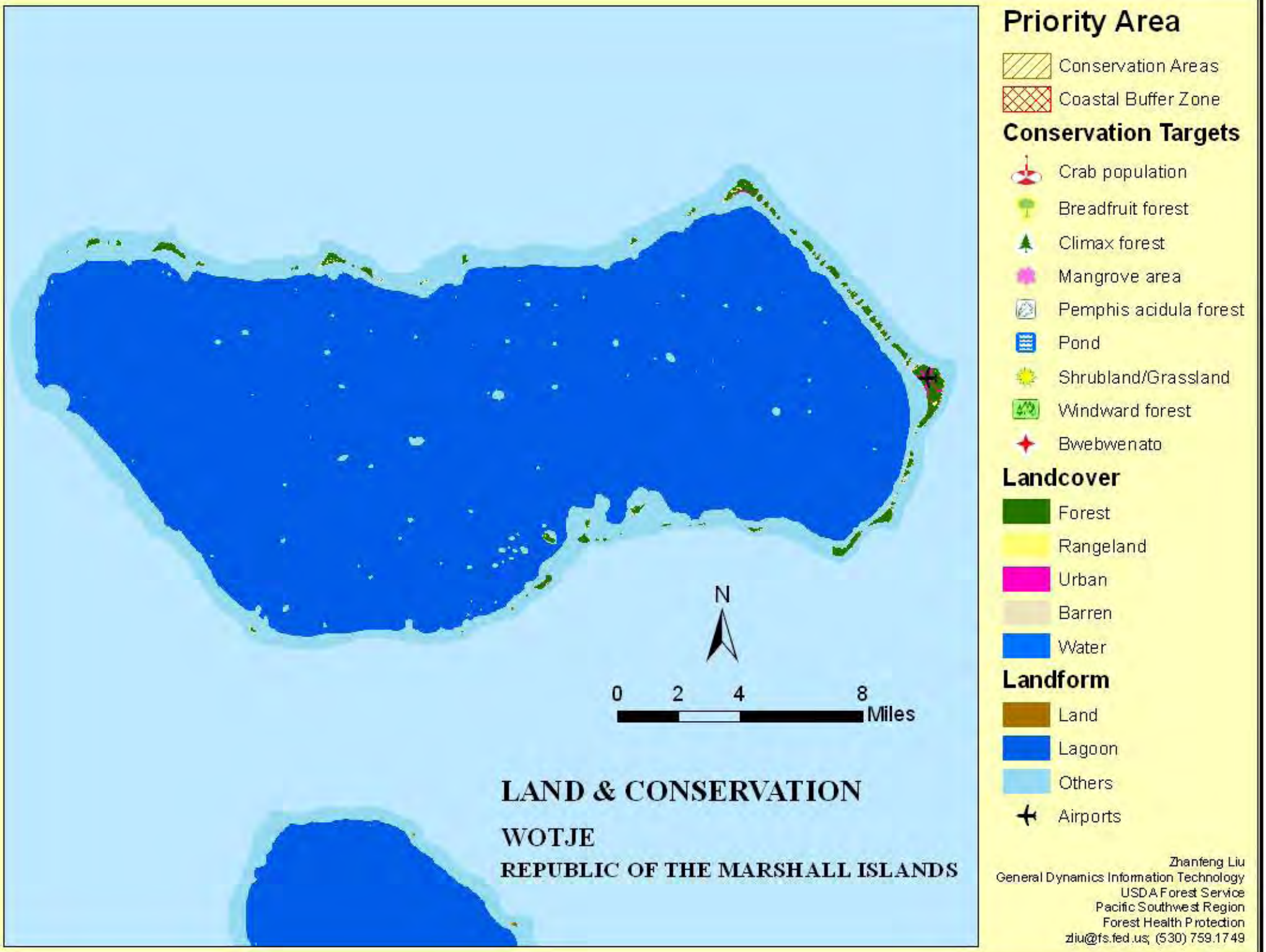
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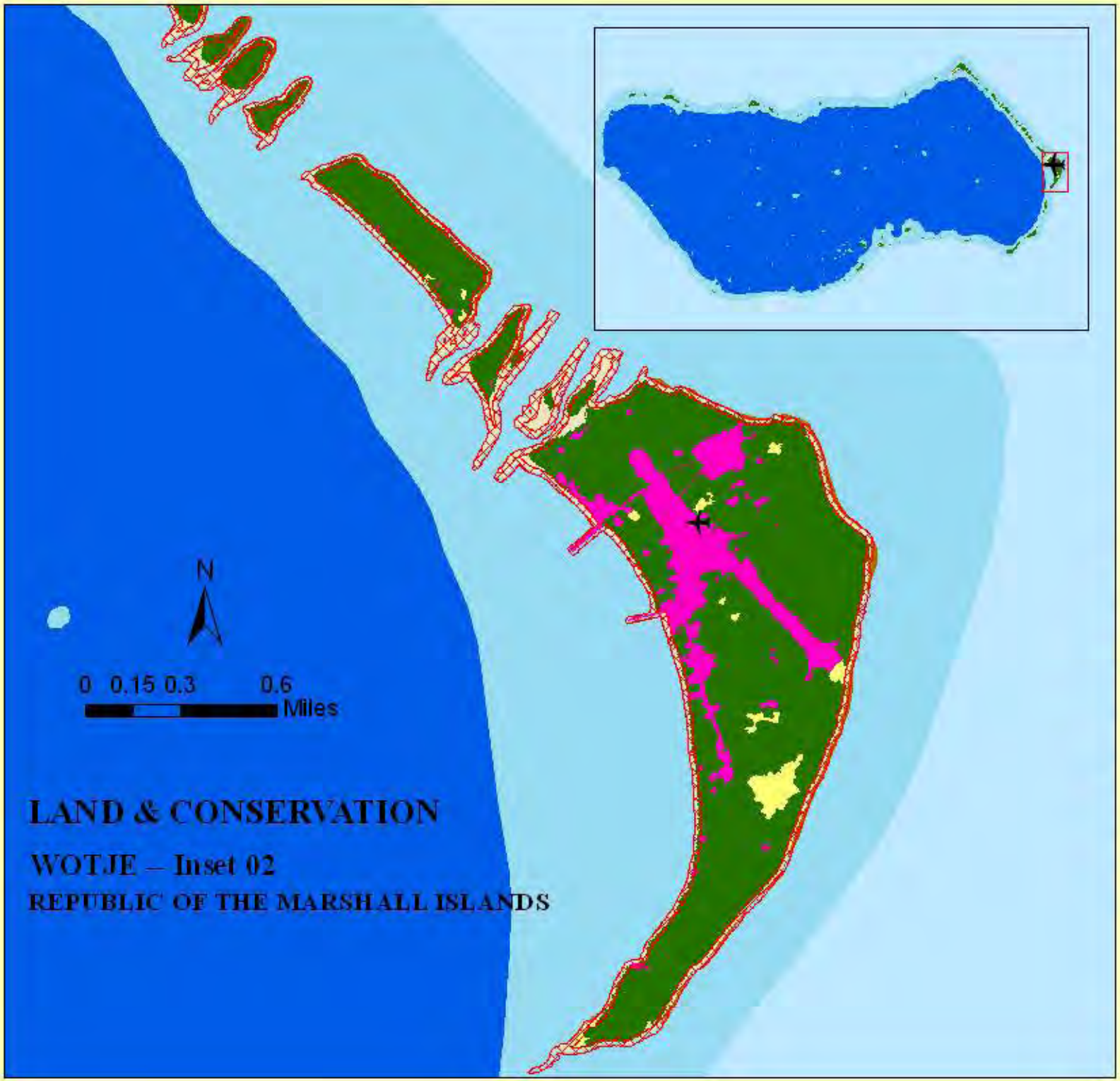

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APPENDIX 3

RMI FAP Workshop

Republic of the Marshall Islands Forest Action Plan Workshop
July 30-31, 2020, Majuro

REPUBLIC OF THE MARSHALL ISLANDS
Ministry of Natural Resources and Commerce
Post Office Box 1727
Majuro, Marshall Islands 96960

MEMORANDUM

DATE: **July 24, 2020**

TO: **See Distribution List**

FROM: **Secretary of Natural Resources & Commerce**

SUBJECT: **Marshall Islands State Wide Assessment and Resource Strategy/Forest Action Plan (SWARS/FAP) Consultation Workshop – July 30-31, 2020**

Iokwe,

The Ministry of Natural Resources & Commerce, with the support of the United States Forest Service (USFS) and the Micronesia Conservation Trust (MCT), will host a validation workshop to update the aforesaid SWARS/FAP. The two-day workshop will be held at the Marshall Islands Resort – Jemanin Room on July 30-31, 2020 from 9:00am to 4:30pm. The tentative agenda is attached for your information and ease of reference.

As key stakeholders in the focus areas of biodiversity, food security and sustainable livelihoods, coastal reinforcement and urbanization, your views and opinions are considered to be crucial to the discussion on the outcomes of the consultation and the way forward for the revised SWARS/FAP. We look forward to your active participation and contribution to this important workshop.

Should you have any questions concerning the workshop and the SWARS/FAP, please do not hesitate to contact one of our Forestry officials within the Ministry.

Kommol tata,

Iva Reimers – Roberto

Telephone: (692) 625-3206 Fax: (692) 625-7471 Email: rndadmin@minta.mh

Distribution List

1. Ministry of Cultural and Internal Affairs – Historic Prevention Office
2. Ministry of Works, Infrastructure and Utilities – Lands and Survey Division
3. National Disaster Management Office
4. Marshall Islands Marine Resources Authority
5. Climate Change Directorate
6. Environmental Protection Authority
7. Public School System
8. Marshall Islands Mayors Association
9. Majuro Atoll Local Government
10. Kwajalein Atoll Local Government
11. CMI Land Grant
12. CMI Youth Corp
13. Taiwan Technical Mission
14. Women United in the Marshall Islands
15. Waan Aelon in Majel
16. Marshall Islands Conservation Society
17. Marshall Islands Organic Farmers Association
18. Canvasback Wellness Center
19. CMAC – Terrestrial Working Group
20. Relevant stakeholders

Workshop for the update of the Marshall Islands State-Wide Assessment and Resource Strategy/Forest Action Plan (SWARS/FAP)

Location: **Marshall Islands Resort – Jemanin Room**
Date: **July 30 – 31, 2020**

DAY 1

9:00 – 9:30	**Introduction** Opening prayer Introductions/Meeting Purpose	NRC
9:30 – 10:15	**Background** USFS Programs and Funds International/National Plans Micronesia Challenge RMI FIA SWARS/FAP Purpose RMI's SWARS/FAP	TBA
10:15 – 10:30	**Morning tea**	
10:30 – 12:00	**SWARS/FAP Updates:** **Biodiversity and Food Security/Alt Livelihoods** Trends, Conditions and Threats (SWOT) Priority Areas	
12:00 – 1:00	**Lunch**	
1:00 – 2:30	**SWARS/FAP Updates: Biodiversity and Food Security/Alt Livelihoods** Strategies/Resources (Matrix)	Groups
2:30 – 2:45	**Break**	Groups
2:45 – 4:15	**SWARS/FAP Updates:** **Coastal Stabilization and Urbanization** Trends, Conditions and Threats (SWOT) Priority Areas	
4:15 - 4:30	**Recap/close**	

DAY 2

9:00 – 10:30	**SWARS/FAP updates:** **Coastal Stabilization and Urbanization** Strategies and Resources (Matrix)	Groups
10:30 – 10:45	**Morning tea break**	Groups
10:45 – 12:00	**SWARS/FAP updates:** Cross-cutting issues Trends, Conditions and Threats (SWOT) Priority Areas	Groups
12:00 – 1:00	**Lunch**	
1:00 – 2:30	**SWARS/FAP updates: cross-cutting issues** Strategies/Resources (Matrix)	Groups
2:30 – 2:45	**Break**	
2:45 – 4:30	**Stakeholder Groups** **Other plans** **Other appendices** **Wrap up**	NRC

Please sign in ☺

RMI Statewide Assessment and Resource Strategy/Forest Action Plan
Validation Workshop
Ministry of Natural Resources and Commerce
July 30th/31st

Day One/Two
Sign-in Sheet

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Randon Jack	NRC	randonj18@gmail.com
DON Hess	MCS	CMIHESS@GMAIL.com
David Lin	TTM	y.j.lin@icdf.org.tw
Scott B. Paul	ICALGOV	scottbpaul@gmail.com
DOLORES	MCS	

RMI Statewide Assessment and Resource Strategy/Forest Action Plan
Validation Workshop
Ministry of Natural Resources and Commerce
July 30th/31st

Day One/Two
Sign-in Sheet

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LOREDEL ARELETA	LAND GRANT	455-5374
SAMUEL BIKAJE	PSS	625-5202
Gideon Lay	Wellness Center	455-6119
Kevin Lee	TTM	455-7186
Miram deBrum	WG TMI	455-1119
Tomeko Maddison	WitMI	455-2681

RMI Statewide Assessment and Resource Strategy/Forest Action Plan
Validation Workshop
Ministry of Natural Resources and Commerce
July 30th/31st

Day One/Two
Sign-in Sheet

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Randon Jack	NRC	455-3848
Silver Nase	NRC	456-1474
Risa K. Myazel	NRC	456-7474
Joel Pujen	NRC	455-0131
Don Hess	MICS	455-5544
Rufus Layfat	NRC	625-4020

RMI Statewide Assessment and Resource Strategy/Forest Action Plan
Validation Workshop
Ministry of Natural Resources and Commerce
July 30th/31st

Day One/Two
Sign-in Sheet

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Warrick Harris	~~OPPC~~ Climate Change Directorate CCD	warrick47@gmail.com

RMI Statewide Assessment and Resource Strategy/Forest Action Plan
Validation Workshop
Ministry of Natural Resources and Commerce
July 30th/31st

Day One/Two
Sign-in Sheet

Name	Organization	Contact
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APPENDIX 4

RMI Agriculture Sector Plan

Republic of the Marshall Islands

AGRICULTURE SECTOR PLAN

2021 – 2031

Republic of the
Marshall Islands

AGRICULTURE SECTOR PLAN

2021 – 2031

CONTENTS

ACRONYMS

ABS	Access and Benefit Sharing
CBD	Convention on Biological Diversity
CMAC	Coastal Management Advisory Council
CMI	College of the Marshall Islands
CGRFA	Commission on Genetic Resources for Food and Agriculture
COGENT	International Coconut Genetic Resources Network
DA	Division of Agriculture of the Ministry of Natural Resources and Commerce
ENSO	El Nino Southern Oscillation
EPA	Environmental Protection Authority (also RMIEPA)
FAO	United Nations Food & Agriculture Organization
FAP	Forest Action Plan
FS USDA	Forest Service
ICC	International Coconut Community
IPPC	International Plant Protection Convention
ITGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
LFA	Laura Farmers Association
LRD	Land Resources Division of SPC
MICS	Marshall Islands Conservation Society
MCT	Micronesia Conservation Trust
MIMRA	Marshall Islands Marine Resources Authority
MIOFA	Marshall Islands Organic Farmers Association
MOE	Ministry of Education
MOHHS	Ministry of Health & Human Services
MOU	Memorandum of Understanding
MNRC	Ministry of Natural Resources and Commerce
NCD	Non-Communicable Diseases
NES	National Export Strategy
NGO	Non-Governmental Organizations
NSP	National Strategic Plan
NTC	National Training Council
OEPPC	Office of Environmental Planning and Policy Coordination
PIFS	Pacific Islands Forum Secretariat
PTD	Participatory Technology Development
RBP	Regional Biosecurity Plan for Micronesia and Hawaii
RICS	Regional Invasive Species Council
RMI	Republic of the Marshall Islands
R2R	Ridge to Reef
SDG	Sustainable Development Goal
SLM	Sustainable Land Management
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environmental Programme
SWARS	State-Wide Assessment and Resource Strategy
TTM	Taiwan Technical Mission
UNDP	United Nations Development Program
UNFCC	United Nations Framework Convention on Climate Change
USDA	United States Department of Agriculture
USFS	Unites States Forestry Services
USP	University of the South Pacific

ACKNOWLEDGMENTS

The Ministry of Natural Resources and Commerce would like to express our gratitude to the many people who saw us through the development and production of this agriculture sector plan. Our thanks to all those from government entities, NGOs and private sectors who provided support and actively involved in the development of the sector plan, offered comments on drafts, and assisted in the editing, proofreading, and design of the strategy. The plan could not have been produced without your valuable assistance.

We wish to acknowledge the efforts made by the team which formulated the plan and carried out stakeholder consultations. We are grateful to Dr. Siosiua Moala Halavatau who led the drafting and also training of our officials. We would also like to acknowledge our very own Chief of Agriculture, Ms. Risa Kabua Myazoe, and the entire Division of Agriculture staff who had taken all the efforts to finalize this plan.

Finally, we acknowledge the contribution of all those whose names are not mentioned but who have been with us throughout this work (Appendix 2).

FOREWORD

It gives me great pleasure to introduce the first agricultural strategy of the Marshall Islands - Agriculture Sector Plan 2021 to 2031. To provide a foreword to such an important document is indeed a momentous occasion for me as Minister responsible for Agriculture. The Ministry, in particular the Division of Agriculture, must attach considerable importance to this plan, as it will now serve as the principal guide to their operations over the next 10 years.

Achieving sustainable growth will depend on strengthening effective partnerships and support for private sector development and increased foreign investment. The Agriculture sector has been identified in the National Strategic Plan (NSP) as one of the priority areas for economic development. Hence, this sector plan was formulated to guide a coordinated approach in addressing the challenges to the sector and thus strengthen the contribution of the sector to economic growth and the attainment of food security.

The launching of this Agriculture Sector Plan is a historic feat by the Ministry. This is the first time that a plan is being applied to guide our efforts to address the emerging and challenging issues of agriculture production and food security. The sector plan will provide policy guidelines and direction for the Agriculture Sector to implement programs that will focus on the needs related to increasing agriculture productivity. The Sector Plan will also provide a clear direction to the sector to align its objectives in a well-coordinated and integrated approach. The use of funds and the application of appropriate technologies to address specific issues faced by the communities will be transparent. In this way, the Sector Plan will also provide an avenue for donors to complement what the Ministry is doing to maximize benefits to the community.

I wish to give my sincere gratitude and a special tribute to the mayors, farmers, women representatives, youths, government and non-government organizations and private sector stakeholders who participated in and provided guidance during the consultation. Last but not least I acknowledge the effort and sacrifice rendered by the hard-working team from the Division of Agriculture who, through their dedication and hard work have enabled the timely completion of this Plan.

Hon. Sandy Alfred
Minister of Natural Resources and Commerce
Republic of the Marshall Islands

EXECUTIVE SUMMARY

Agriculture was integral to the livelihood of the Marshall Islands and lost its status for a while but has been identified in the NSP 2015-2017 as one of the priority areas for attaining food security. The agriculture sector also contributes to achieving development sectors (2) Environment, Climate Change, and Resiliency and (4) Sustainable Economic Development.

Marshal Islands has a food security policy, a trade policy, an export strategy, a Marshall Islands Organic Farmers Association (MIOFA) Strategy and a 2010 State-Wide Assessment and Resource Strategy (SWARS), subsequently known as and soon to be updated as the 2020 "Forest Action Plan" (FAP); and to complete the package there is a need to develop an Agriculture Sector Plan and a partnership model for these plans to better integrate and address food production, food security and deliver ecosystem services for the nation.

The Marshall Islands Agriculture Sector Plan 2021–2031 is the result of participatory stakeholder consultations and desk-based reviews of relevant literature for the Marshall Islands to guide the formulation process. Participatory rural appraisal tools were also used to ensure the involvement of stakeholders in this agriculture plan and to start building partnerships at the beginning of the process which should follow through to implementation. The stakeholders were representatives of various government ministries, including the Ministry of Health & Human Services (MOHHS); Office of Environmental Planning and Policy Coordination (OEPPC), Local Government, and the Ministry of Natural Resources and Commerce (MNRC). Other bodies, such as Taiwan Technical Mission (TTM), Wellness Center, MIOFA, Marshall Islands Conservation Society (MICS), Youth Corp, and women's and farmers' organizations, were also represented.

During the consultations, the stakeholders broadly agreed on the key guiding principles, goal, purpose and the key outputs and activities to pursue over the implementation period. The key guiding principles were that the strategy will contribute to the achievement of food security, economic sustainability, social sustainability, and environmental sustainability while valuing public-private partnerships in the implementation of the plan. The plan not only recognizes the needs and aspirations of the diverse stakeholders but also requires the involvement of all relevant stakeholders in the implementation process.

There are seven key outputs defined to be achieved over the implementation period:

1. Environmental degradation minimized
2. Sustainable small-livestock production systems developed and promoted
3. Sustainable crop production systems developed and promoted
4. Increased consumption of nutritious locally-produced foods
5. Improved biosecurity and marketing
6. Improved capacity of agriculture sector stakeholders
7. Developed enabling policies/legislations

Under each output, a range of activities, which are interrelated in their effects, will be implemented over the next ten years. The implementation of any one activity will help to achieve and also be helped by the implementation of, the other activities. Some of the activities, when implemented, will contribute to achieving more than one output.

The implementation process will use a results-based approach with coordinated participation of all stakeholders, including governmental, non-governmental and community-based organizations. The Division of Agriculture of MNRC will assume the lead role in facilitating the implementation and monitoring and evaluation process. The plan includes a Logical Framework Matrix which will serve as the basis to guide the implementation process and as well as the monitoring and evaluation to determine impacts. The plan will be reviewed every six months.


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GLOSSARY

Adaptation: It is an evolutionary process whereby an organism becomes better able to live in its habitat or habitats.

Agriculture: Agriculture is the science and art of cultivating plants and livestock. Agriculture was the key development in the rise of sedentary human civilization, whereby farming of domesticated species created food surpluses that enabled people to live in cities. The history of agriculture began thousands of years ago.

Agroforestry is the deliberate growing of woody perennials on the same unit as crops and/or animals, either in some form of spatial mixture or sequence. And there must be a significant interaction (positive and/or negative) between the woody and nonwoody components of this system, either ecologically and/or economically.

Biodiversity: It is the shortened form of two **words** "biological" and "diversity". It refers to all the variety of life that can be found on Earth (plants, animals, fungi, and micro-organisms) as well as to the communities that they form and the habitats in which they live.

Biological Control: Biological control or biocontrol is a method of **controlling** pests such as insects, mites, weeds and plant diseases using other organisms. It relies on predation, parasitism, herbivory, or other natural mechanisms, but typically also involves an active human **management** role.

Biosecurity: They are procedures or measures designed to protect the population against harmful biological or biochemical substances.

Breed: A breed is a group of animals that is consistent enough in type to be logically grouped, and that when mated within the group reproduces the same type.

Carbon Sinks: Forest, ocean, soil, or other natural environment viewed in terms of its ability to absorb carbon dioxide from the atmosphere.

Climate Change: A change in global or regional climate patterns, in particular, a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.

Compost: Composting is nature's way of recycling. Composting biodegrades organic waste. i.e. food waste, manure, leaves, grass trimmings, paper, wood, feathers, crop residue, etc., and turns it into valuable organic fertilizer.

Fertilizer: A substance that is added to the soil to supply essential nutrients for plant growth. Fertilizers may be natural or artificial (manufactured).

Forestry: Traditionally defined to include the management of trees for the production of wood, but more broadly defined includes agroforestry and home garden trees, production of non-timber forest products (notably pandanus fiber), conservation of forest biodiversity, conservation and management of ecosystem services from forests (for example, coastal protection), and urban forestry (such as street and park trees).

Genetic Diversity: Genetic diversity is the total number of genetic characteristics in the genetic makeup of a species. It is distinguished from genetic variability, which describes the tendency of genetic characteristics to vary. Genetic diversity serves as a way for populations to adapt to changing environments.

Integrated Crop Management (ICM)) is a holistic approach to sustainable agriculture. It considers the situation across the whole farm, including socioeconomic and environmental factors to deliver the most suitable and safe approach for long-term benefit.

Integrated Pest Management: A system of pest control that uses a combination of most appropriate control measures including pesticides, cultural, mechanical and biological means. The monitoring of pest numbers is an important step in integrated pest management.

Land Degradation is a process in which the value of the biophysical environment is affected by a combination of human-induced processes acting upon the **land**. It is viewed as any change or disturbance to the **land** perceived to be deleterious or undesirable.

Mitigation: Mitigation to climate change consists of actions to limit the magnitude or rate of long-term global warming and its related effects.

Mulch: A mulch is a layer of material applied to the surface of the soil. Reasons for applying mulch include conservation of soil moisture, improving fertility and health of the soil, reducing weed growth and enhancing the visual appeal of the area. A mulch is usually, but not exclusively, organic. It may be permanent (e.g. plastic sheeting) or temporary (e.g. bark chips). It may be applied to bare soil or around existing plants.

Nutrients: Plant nutrients are the chemical elements that are essential to the nourishment of plant health. Some nutrients like nitrogen, phosphorus, and potassium are needed in large quantities (kg/ha) are called *macronutrients* and some like iron, zinc, and copper are needed in small quantities (g/ha) are called *micronutrients.*

Organic Farming: A farming system based on the use of natural materials for supplying nutrients and protection to plants and animals. No chemicals such as artificial fertilizers, pesticides or herbicides are allowable for a farm that is certified organic.

Pesticides: A general term for chemicals that will kill weeds, fungi, insects or other pests of plants, animals or products.

Resilience: Climate resilience can be generally defined as the capacity for a socio-ecological system to (1) absorb stresses and maintain function in the face of external stresses imposed upon it by climate change and (2) adapt, reorganize, and evolve into more desirable configurations that improve the sustainability of the system, leaving it better prepared for future climate change impacts.

Soil Degradation: Soil degradation is the physical, chemical and biological decline in soil quality. It can be the loss of organic matter, decline in soil fertility, and structural condition, erosion, adverse changes in salinity, acidity or alkalinity, and the effects of toxic chemicals, pollutants or excessive flooding.

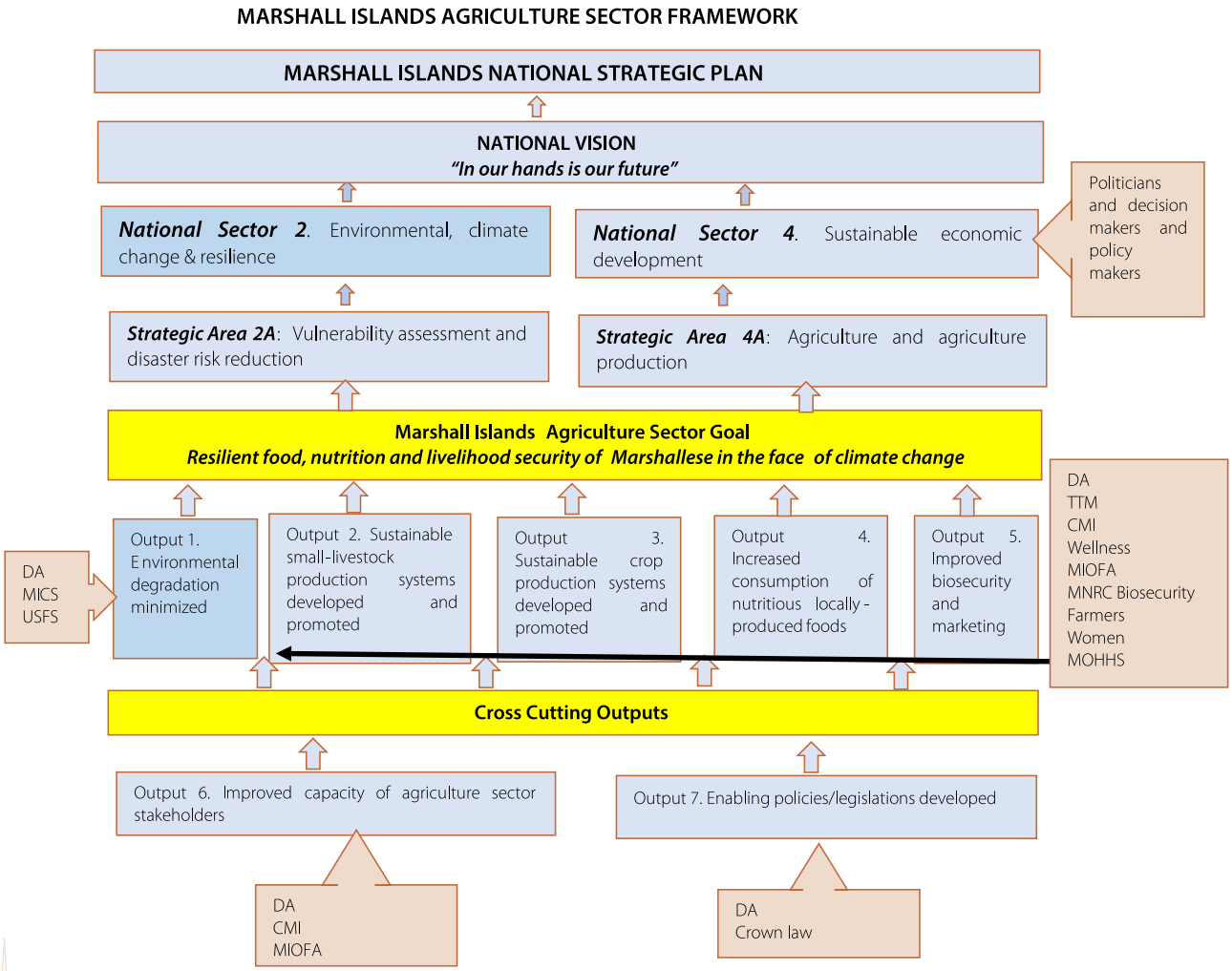
Sustainability: Sustainable agriculture is that form of farming that produces sufficient food to meet the needs of the present generation without eroding the ecological assets and productivity of life-supporting systems of future generations.

1. INTRODUCTION

Agriculture was traditionally a key component of the Marshall Islands' economy, mainly permanent crops and plantations. Nearly all families were once involved in agriculture. There has been a steady decline and loss of engagement in the agricultural sector with about less than half of households currently involved. In 2006 there was only 0.3% of the labor force engaged in agriculture and forestry activities as their main economic activity. In 2011 64% of the total land area of the Marshall Islands was considered arable. And in 2014, the agriculture and forestry export value as a proportion of the total export was only 1.2%. The country is now at a juncture where an agriculture sector plan is needed to raise the involvement of the communities and increase national domestic food production.

Agriculture development was identified as one of the priority areas driving the Sustainable Economic Development Sector of the Marshall Islands (NSP 2015-17) with the overarching objectives: "Implement the RMI Food Security Policy and Agriculture Strategies Linked to Targeted Policy Goals". And together with the food security policy, the National Trade Policy, the National Export Strategy, MIOFA Strategy and the Forest Action Plan (FAP) are calling for the development of the Agriculture Sector Plan, and development of a partnership model for these plans to better integrate and address food production, food security and deliver ecosystem services. Figure 1 shows the linkages between the national sector objectives, strategic areas and the 7 outputs of the agricultural sector plan.

Figure 1. Linkages between the Agriculture Sector Plan and the Marshall Islands Strategic Plan



The sector plan was developed in a participatory manner with inputs from all major stakeholders in the country. Participatory rural appraisal tools were used to ensure the involvement of all stakeholders and to start building partnerships at the beginning of the process. This approach also ensured that the stakeholders shared a feeling of empowerment and ownership right from the planning phase, which should follow through to implementation and participatory monitoring and evaluation of the work plans.

1.1 Guiding Principles

In developing the sector plan, the stakeholders were guided by the following principles.

1.1.1 Contribution to Food Security

Investment in agriculture supports the Marshall Islands' obligations regarding the progressive realization of the right to adequate food in the context of national food security, and all intended users' responsibility to respect human rights. Responsible investment in agriculture contributes to food security and nutrition, particularly for the most vulnerable, at the household, local, and national level, and to eradicating poverty.

1.1.2 Contribution to Economic Sustainability

The sector plan must find ways to deliver real economic benefits to the rural sector and the entire economy

1.1.3 Contribution to Social Sustainability

The sector plan also must improve the economic well-being of lower-income groups and other disadvantaged groups, including women. The strategy will encourage the economic development of rural atolls to reduce the internal migration of people to Majuro and Ebeye.

1.1.4 Contribution to Environmental Sustainability

Agricultural innovations should be developed to bring about sustainable management of forests, soil, and water resources and their adaptation to climate change impacts and reduce agricultural pollution to manageable levels.

1.1.5 Public-Private Partnership

Primary production, processing, storage, and marketing are essentially private sector activities; the role of the private sector should be to take advantage of the improved enabling environment provided by the public sector for profitable primary sector investment.

On the other hand, the government and other service providers should be creating an enabling environment for effective sector performance. Hence, promoting an effective partnership amongst all stakeholders including governmental, non-governmental and community-based organizations with links to regional and international networks, where appropriate, is critical to promote agricultural growth and thus food security in the Marshall Islands.

1.2 Role of the Sector

Agriculture in the Marshall Islands may not be the backbone of the economy but still, it plays some vital roles for the overall development of the country.

1.2.1 Contribute to national income

In the Marshall Islands agriculture and forestry export was only 1.2% of total export in 2014 as reported by SPC National Development Minimum Indicators (NDMI). The National Export Strategy (NES) examined the potential for exports in the five identified sectors of fisheries, pandanus, coconuts, handicrafts, and tourism. The opportunity to raise the sector contribution to national income is huge and the Agriculture Sector Plan is expected to play a key role in this aspiration.

1.2.2 Source of food supply

It is estimated that currently 20% of the food supply is produced locally. This reliance on imported foods for the diet of Marshallese is a priority issue that the sector plan will address by increasing locally grown foods and improve the engagement of households in agricultural activities. An increase in locally produced food will ensure a healthier diet for the household and in the long term contribute to decreasing incidence of NCD.

1.2.3 *Raw materials for value-adding industries*

The agriculture and forestry products from the sector will supply raw materials to some of the value-adding industries. Examples from agriculture production are breadfruit for flour making and pandanus for the fruit juice. And from Forestry production are wood for carvings and construction.

1.2.4 *Disaster reliefs*

DA has vital roles in disaster reliefs – from assessing the degree of damages to responses to food needs after a disaster and coordination of crop and livestock rehabilitation after a disaster.

1.2.5 *Employment opportunities*

When one thinks of agriculture, farming may come to mind. However, there are other types of agriculture employment. Agriculture employments may also be in agribusiness, agricultural science, or agricultural specialists like agronomists, plant or animal breeders, or soil scientists. The opportunity, however, is not much in the Marshall Islands but the sector plan will raise the image of agriculture including employment opportunities.

1.2.6 *Addressing Regional and International Convention and SDGs*

The agricultural sector has roles to ratify regional and international conventions with initiatives related to agriculture and forestry development.

The Micronesia Challenge

The Challenge is a commitment by the Federated States of Micronesia, the Republic of Palau, Guam, and the Commonwealth of the Northern Marianas Islands to preserve the natural resources that are crucial to the survival of Pacific traditions, cultures, and livelihoods. The overall goal of the Challenge is to effectively conserve at least 30% of the near-shore marine resources and 20% of the terrestrial resources across Micronesia by 2020. The sector plan will link to the Challenge in areas related to food security, biosecurity and resilience, and invasive species.

Regional Biosecurity Plan (RBP) for Micronesia and Hawaii

Because of US Department of Defense relocation of some 4000 marines from Okinawa to Guam, the Regional Invasive Species Council (RISC) and the countries party to the Micronesia Challenge developed the RBP initially to assess the impacts of the relocation of the military personnel and has graduated to analyze the risks and coordinate enhancements in biosecurity. This initiative provides opportunities for capacity building in pests and disease management and improved biodiversity.

The DA will also ensure the Marshall Islands' contribution to the following Sustainable Development Goals (SDGs):

SDG 2 – Zero Hunger

Goal 2 seeks sustainable solutions to end hunger in all forms by 2030 and to achieve food security. The aim is to ensure everyone everywhere has enough good quality food to lead a healthy life

SDG3 – Good Health and Well-Being

Goal 3 seeks to ensure health and well-being for all, at every stage of life. The aim is to improve reproductive and maternal-child health; end the epidemics of HIV/AIDS, malaria, tuberculosis and neglected tropical diseases; reduce non-communicable and environmental diseases; achieve universal health coverage; and ensure universal access to safe, affordable and effective medicines and vaccines.

SDG 12 – Responsible Consumption and Production

Sustainable growth and development require minimizing the natural resources and toxic materials used, and the waste and pollutants generated, throughout the entire production and consumption process.

SDG 13 – Climate Action

Climate change presents the single biggest threat to development, and its widespread, unprecedented effects disproportionately burden the poorest and the most vulnerable, Goal 13 calls for urgent action not only to combat climate change and its impacts but also to build resilience in responding to climate-related and natural hazards and disasters.

In addressing SDG 13, the plan will be also guided by the Kyoto Protocol and the Paris Agreement in setting mandatory limits on greenhouse emissions, guidance on mitigation, adaptation and climate change finance. The ridge to reef or whole of an island approach will guide the design and implementation of mitigation and adaptation measures.

The DA will coordinate the Koronivia Joint Works on Agriculture (KJWA) - the global initiative from the 23rd Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC) with agricultural actions to minimize vulnerabilities of agriculture to climate change

SDG 15 – Life on Land

Preserving diverse forms of life on land requires targeted efforts to protect, restore and promote the conservation and sustainable use of terrestrial and ecosystems. Goal 15 focuses specifically on managing forests sustainably, halting and reversing land and natural habitat degradation, successfully combating desertification and stopping biodiversity losses.

2. STAKEHOLDERS AND THEIR ROLES

Agriculture in the Marshall Islands supplies local foods and other ecosystem services. The agriculture sector goods and services are distributed across the whole nation, and any issue relating to agriculture ultimately affects a large and scattered range of consumers. The complexity of agricultural land use and food production systems also means that many different organizations have commercial or regulatory interests in farming and its possible effects on health. All these organizations need to be considered as potential participants in the implementation of the Agriculture Sector Plan. Table 1 shows the interests, perceptions, resources stakeholders have and mandates they have to support agricultural development.

Table 1. Stakeholders who are potential partners to DA

Stakeholders	Interests in the core problem of the agriculture sector	Perception of the problem	Resources	Mandate
Farmers and communities	• To grow local foods • Incomes from farming	• Poor soil conditions • Climate change	• Land • Labor	• Grow enough food
Landowners	• To grow local foods • Incomes from farming • Incomes from land lease	• To grow local foods • Incomes from farming	• Land	• Grow enough food
CMI Agriculture Department	• Help local communities grow their foods • Community awareness • Economic security	• Lack of agriculture knowledge • Lack of employment in the sector	• Outreach extension program to educate the local community • Greenhouse and seedling supplies	• 3 month of yearly check-up on farmers
Taiwan Technical Mission	• Enhance food security in the outer islands - Transportation - Promotion - Adoption and marketing	• Soil management and materials (for compost, etc) • Farmer organization	• TTM projects • Budget and technical supports • Cooperation with Local Government, NRC, and MICS	• Support from Government (National and local), TTM, NRC • By-Laws
Wellness Center	To increase food security and improve nutrition in the Marshall Islands	• Poor soil condition • Dependence on imported processed foods • Rural atolls difficult to maintain sustainability	• Technical skills • Professional knowledge • Determination and passion • Existing projects	• To increase the use of fresh fruits and vegetables throughout the Marshall Islands

MNRC Agriculture Divisiont	• Capacity building • Livestock/horticulture development • Agriculture curriculum for schools • Stakeholder partnership • Increase home gardening • Soil & water management training • Hydroponics	• Capacity • Funding • Lack of interest • Poor transport systems • Weak sector • Climate change	• Staff • Technical advice • Traditional crop expertise • Farming communities • Landowners • Relevant Partners	• Food Security Policy • Promotion of agricultural development • Provide agriculture production, plant and animal health services • Develop agriculture policies and planning
Local Government	• Preservation of local foods • Health and poverty • Climate change • Transportation • Crop resistance	• NCD and poverty • Climate change • Sustainability • Imported food • Population migration	• MNRC • TTM • Council land • Women groups • Youth groups	• MOU with health and education • NSP • Food security policy
Ministry of Health & Human Services	To provide nutritious foods to communities	High incidences of obesity and NCDs	• Technical staff • Projects and program	• To address food security and lifestyle diseases

Given the multiple stakeholders involved in agricultural growth, it is vital to ensure good communication between the diverse group of stakeholders to build consensus on strategic actions and investments.

3. CHALLENGES TO AGRICULTURE

Arguably one of the greatest challenges the Marshall Islands now faces is how to produce enough good quality foods to feed its people in Majuro and the outer islands. Successfully addressing this challenge will require making a few hundred small farmers more productive. Food production in the Marshall Islands is influenced by many factors, amongst them are:

Poor soil conditions – The sandy carbonatic soils of Pacific atolls are considered infertile and poorly suited to agriculture. The Republic of the Marshall Islands is comprised predominantly of atolls, and there is scant information on the fertility status of the Marshall Island soils. Most Marshallese soils are limited in nitrogen (N), phosphorus (P), potassium (K), iron (Fe), copper (Cu) and manganese (Mn).

Water availability – The Marshall Islands experienced severe droughts in the last few years and with increasing sea level rise the freshwater supply is dwindling. United Nations Development Program (UNDP) has reported that the 34 islands that comprise the country are in danger of being inundated by rising sea levels and dwindling freshwater supplies. This signals a major challenge to agriculture development to develop water management strategies for producing crops in the face of this potential crisis.

Narrow genetic base – Some of the varieties of species like pandanus, taro, breadfruit, coconuts, dwarf banana, traditional fruits and sources of traditional medicines are now endangered. The major challenge is protecting the genetic diversity of the crops from introduced pests and diseases and the effects of extreme weather events like droughts and severe cyclones.

Pests and diseases: A major problem with introduced crops is their susceptibility to pests and diseases. Traditional crops like coconuts and breadfruit also threatened by pest and disease problems. The most serious of these include insect pests such as the breadfruit mealybug, coconut scale, and spiraling whitefly, which cause severe damage to many food crops and seriously affect crop productivity and overall food security. To show how serious this problem is, twenty-one new pest species were introduced to Jaluit and Majuro in 1975 of which twelve species were new to the country.

Costs of farm inputs: Farm inputs are generally costly in the Pacific Islands and more on atolls.

Challenges for livestock: There are limited choices for livestock production on atolls. The most common are smaller animals – pigs, poultry, and ducks. The traditional breeds of small animals raised on atolls are disappearing.

Erosion of traditional knowledge: Traditional knowledge of how to farm and care for domestic and traditional plants and animals is also eroding. Even traditional forms of food preparation and preservation are unknown to many young people. Loss of traditional agroforestry knowledge has accompanied the decline in engagement in agriculture activities by Marshallese households.

Climate change: Particularly the danger of sea-level rise. Sea level rise has already encroached landwards, and high tides and frequent storms continue to threaten local homes and property. Recent research indicates that sea levels have been increasing by 3.4 millimeters (0.13 inches) per year. A one-meter rise could result in the loss of 80 percent of the Majuro Atoll, which is home to half the nation's population. Besides, the underwater freshwater supply has been salinated by this influx of seawater.

Efforts will be made to improve the resilience of food production systems to impacts of climate change by improving above-ground biodiversity and below-ground biodiversity.

Trade and Marketing: Currently a shift is taking place away from the traditional copra export in favor of the export of coconut oil. There are opportunities in the domestic market for added value products like breadfruit flour and for selling fresh agricultural produce. There is an opportunity as well for organic produce.

Challenges for forestry: The major challenge for forestry is the disappearance of native forest trees and traditional agroforestry systems. The ridge to reef or whole of an island approach can support initiatives to address this challenge.

4. MARSHALL ISLANDS AGRICULTURE SECTOR PLAN

This AgricultureSector Plan directly supports the NSP with its vision, "In our hands is our future" and links to the national theme "*Ensuring broad-based growth and food security through a cross-cutting approach*" with the national target which focuses on local food security issues and reducing imports. The plan also addresses issues relating to development sectors (2) Environment, Climate Change and Resiliency and (4) Sustainable Economic Development

4.1 Goal: Resilient food, nutrition and livelihood security of Marshallese in the face of climate change

The key performance indicators for the goal are:

Contribution of locally produced foods to diets of Marshallese

Contribution of agriculture to household incomes

4.2 Purpose: Enhanced agriculture development for the Marshall Islands

The key performance indicators for the purpose are:

- Livestock production increased
- Crop production/ quality improved
- Improved biodiversity and resilience
- The appropriate structure for Agriculture Division

4.3 Outputs

The plan will aspire to achieve the goals by achieving the following outputs:

1. Environmental degradation minimized
2. Sustainable small-livestock production systems developed and promoted
3. Sustainable crop production systems developed and promoted
4. Increased consumption of nutritious locally-produced foods
5. Improved biosecurity and marketing
6. Improved capacity of agriculture sector stakeholders
7. Enabling policies/legislations developed

Output 1. Environmental Degradation Minimised

The key performance indicators are:
Number of trees planted traditional and exotic
Soil and water quality improved
The priority areas for forestry in the Marshall Islands from the "State" - Wide Assessment and Resource Strategy 2010 – 2015+ (FAP) are improving biodiversity; improving food security and sustainable livelihoods; coastal reinforcement; and reducing the loss of urban trees. The implementation of the activities under this output will also align with the Reimaanlak Conservation Plan. The activities to be undertaken to achieve this output include:

1.1 Coastal tree planting

The Division of Agriculture will lead and coordinate the planting of salt-tolerant traditional trees along coastal areas to protect the coast and to minimize current erosion along the coast.

1.2 Promote tree planting on farmlands including coconut replanting

Where there is a problem of deforestation and on barren lands, efforts will be made to promote tree plantings including coconut replanting. Surveys will also be conducted and senile coconuts will be selectively logged and replaced.

1.3 Promotion and preservation of the diversity of traditional and cultural plants

Conservation of biodiversity in the Marshall Islands concerns terrestrial native species, especially endemic species. Priority target trees and areas include breadfruit, climax forest (Pisonia grandis, Neisosperma oppositifolium), Pemphis acidula forest, and Mangrove forests.

The Forestry Section of the Division of Agriculture will collaborate with other partners to map more detailed forest ecosystem types; map forest types and conservation values on the atolls and designate 'traditional land use' conservation areas (subsistence agroforestry production and compatible income generation with sustainable practices).

1.4 Support development of appropriate agroforestry systems

This activity will include promoting and increasing the production of agroforestry including high-value market intercrops; community extension and education. The approach will also rehabilitate and replant coconut.

1.5 Promote urban forestry

The activities will include planting trees for the beautification of urban areas and promoting tree planting by schools.

1.6 Monitor potential sources of pollution by agriculture practices

The Division of Agriculture will collaborate with the Division of Quarantine and Marshall Islands Conservation Services, Environmental Protection Authority (EPA) and OEPPC in monitoring pollution by agricultural practices.

Output 2. Sustainable small-livestock production systems developed and promoted

The key performance indicators are:

- Number of improved breeds developed and distributed
- Improved feeds

The delivery of services to achieve this output will comply with the "one health approach" and will be undertaken in collaboration with the Taiwan Technical

Mission. The activities to be undertaken to achieve the output include:

2.1 Improve local breeds

There are limited choices for livestock production in the Marshall Islands. The most common are smaller animals – pigs and chicken. The traditional breeds of small animals raised on atolls are disappearing or become smaller in size because of inbreeding. The recommended strategy is to improve the local breeds by crossing with good breeds that can adapt to Marshall Islands conditions, taking into consideration also the potential impacts of climate change.

2.2 Improve feeds with local ingredients

Livestock feeds are very expensive, making the cost of livestock production too high. There is, therefore, a need for the Division of Agriculture to seek capacity building in making livestock feeds from local ingredients or making the feeds locally with a combination of local and imported materials. Recommendations should also be developed on good diets to be given to pigs and chickens using ingredients available to households.

2.3 Appropriate livestock management practices developed and promoted

The Division of Agriculture in collaboration with TTM will seek support for capacity building in the development and promotion of sustainable improved small livestock management practices, including animal pest and disease control, appropriate housing and waste management strategies. Many of the challenges facing the Division of Agriculture are interwoven, and significant benefits can be gained from closer integrated efforts with other stakeholders, including the Secretariat of the Pacific Community (SPC) and the United Nations Food and Agriculture Organization (FAO).

2.4 Livestock waste management improved

Piggery waste is a problem in the Marshall Islands, especially along with the coastal areas. This activity is linked to Output (soil management). Piggery waste should be used as one of the ingredients for composting to be used in crop production. The Agricultural Division should explore spearheading a national campaign on waste management for a cleaner environment and better crop nutrition.

Output 3. Sustainable crop production systems developed and promoted

The key performance indicators are:

- Soil quality
- Water use
- Number of crop varieties used in agriculture production
- The resilience of agroforestry systems

The following activities will be implemented to achieve this output

3.1 Improve soil conditions

The soils are calcareous, shallow, alkaline and coarse-textured. Any sustainable soil management technologies workable on soils of the Marshall Islands will need to improve the soil's physical, chemical and biological properties. This means that the efforts will be on improving soil organic matter by the use of composting, adaptable cover crops, and any other intervention that will recycle organic matter back to the soil. With the soils being multi-nutrient limiting, an effort should be made to develop targeted compost.

3.2 Improve water use

With the increasing incidence of droughts recently causing dwindling freshwater availability in the Marshall Islands and competition from other sectors, water use in agriculture will have to be very efficient. The use of bucket drip irrigation, wicking systems, and mulches will be promoted. Fullstops will be used to assess the vertical movement of water and potential polluting of the groundwater.

3.3 Develop pests and diseases control methods

There is a need to strengthen the capacity of the Division of Agriculture in the area of biosecurity so that it can manage plant and animal pests and diseases and weeds on a day-to-day basis. The diagnostic skills of both DA staff and farmers and their ability to test solutions on-farm must be strengthened. The investigation into the potential development of a new pest and disease regime addressing impacts of climate change should be undertaken with capacity support

from SPC and FAO. Since the Marshall Islands advocates no use of inorganic pesticides, it should develop organic food production systems in collaboration with MIOFA.

3.4 Crop diversity improved, conserved, and utilized

Improving crop diversity, especially among traditional crops including coconuts that are less demanding in terms of production inputs compared to improved exotic crops, will result in the production of cheaper food as well as rising incomes. Selecting varieties that are more adaptable to harsh atoll conditions and potential climate change impacts of increased temperature, drought, and seawater intrusion will ensure the development of more sustainable production systems that are more environmentally friendly. DA will initiate activities to ensure that the genetic diversity of crops is conserved.

3.5 Develop appropriate agroforestry systems

With the need to increase traditional food production and improve the biodiversity and resilience of the food production systems, there is a need to introduce trees including coconuts into the farming systems. These trees must serve productive services of producing household requirements of firewood and building materials as well as food; improve the resilience of the systems; and serve as CO_2 sinks. The DA Crop and Forestry Sections will collaborate with other stakeholders to develop appropriate agroforestry systems.

3.6 Develop a package of practices for major crops

Once the DA develops appropriate food production technologies, then a package of practices for producing each crop will be developed for extension and outreach activities.

Output 4. Increased consumption of nutritious locally-produced foods

The key performance indicators are:

- Number of home gardens
- Number of healthy recipes adopted by targeted households

To increase the consumption of locally produced foods the following activities will be carried out. Efforts will be made to link agricultural production to health and nutrition.

4.1 Promote home gardens

The DA through its Urban Farming Section will work with households in the communities, women and youth groups, and schools to promote growing home gardens. These will be a combination of starchy staples and nutritious traditional and exotic vegetables grown in the home gardens.

4.2 Develop recipes

The Urban Farming Section will work with women in households and schools in developing cooking recipes using produce from the home gardens and running cooking demonstrations.

4.3 Preservation of knowledge on traditional food preparation and preservation

The DA will work with elders in the community to collate traditional knowledge on food preparation and preservation and document them. The DA will via workshops and training pass these to the communities to avoid further losses of this traditional knowledge.

4.4 Support schools in proper nutrition

The Urban Farming Section of DA will work closely with other sections of DA, TTM, Wellness Center and Ministry of Health & Human Services in promoting home gardens, cooking balanced meals and proper nutrition to schools.

Output 5. Improved biosecurity and marketing

The key performance indicators are:

- Plant and animal protection program operational (link to Outputs 2 and 3)
- Increase domestic and export trade

The following activities will be implemented to achieve this output

5.1 Develop local and export markets

With the decline in household engagement in agriculture, DA and TTM with support of MIOFA will look at developing domestic markets for improved food access by households who do not produce foods. This will involve developing market structures while supporting current mobile markets.

This activity will be linked to activities 5.3 and 5.4 for product development for overseas markets.

5.2 Develop value chains including organics

DA in collaboration with partners like MIOFA will develop value chains for crops with potential for markets locally and export.

5.3 Source overseas market access for export

DA and partners like MIOFA will work closely with authorities mandated to do trade and international market access agencies to open up overseas markets for potential agricultural fresh produce and value-added products.

5.4 Develop animal and crop protection program

DA and the Division of Quarantine and TTM will work closely to develop an animal and crop protection program. The program will cover pests and disease identification and their control; process for development and control of a pest incursion; sanitary and phytosanitary (SPS) measures. These will also form a capacity-building component of the program.

Output 6. Improved capacity of agriculture sector stakeholders

The key performance indicators are:

- Number of training
- Number of trainees
- % of trainees using skills and knowledge

The following activities will be undertaken to achieve the output.

6.1 Conduct capacity needs assessment

The needs assessment will cover three levels

- Organizational needs which will look at the development of the strategic plan and an operational structure; policy to facilitate organizational cultural change (link to output 7); and development of a monitoring and evaluation framework
- Needs to enhance teamwork which will cover roles of partners; shared interests; planning action together (networking); reporting and evaluation of activities.
- Individual needs will cover attitude; increased knowledge; improved skills; and self-evaluation.

6.2 Develop capacity building program including support to schools (curriculum)

A capacity-building program will be developed to address the following needs identified to improve the performance of individuals from key stakeholders.

Motivation
Engagement
Participatory methods
Training
Soil fertility and water management
Pests and diseases
Diagnostic skills
Decentralization
Communication
Computer skills
Research methods
Climate change vulnerability
Monitoring and evaluation
Reporting

6.3 Conduct training and assess impacts

DA will coordinate the conduct of the training programs over the plan period and the assessment of training in collaboration with experts within the country and from overseas. DA will support CMI to develop a specific curriculum and to offer this training as a regular program at CMI.

Output 7. Enabling policies/legislations developed

The key performance indicators are:

Policy and legislation needs identified

The following activities will be implemented to achieve this output

7.1 Review current policies/legislations

DA will review current policies and legislation and their relevance to the current situations and their ease to implement to guide agriculture development. DA based on the review will assess the requirements for new policies and legislations.

7.2 Develop appropriate policies/legislations

DA might engage experts to develop the required policies and legislations in collaboration with the national Ministry of Justice.

7.3 Develop lobbying strategies and policy briefs on key issues

DA with expert support will develop lobbying strategies and policy briefs on issues like sustainable soil management, pests, and disease management and water use for agriculture.

7.4 Implement and assess impacts

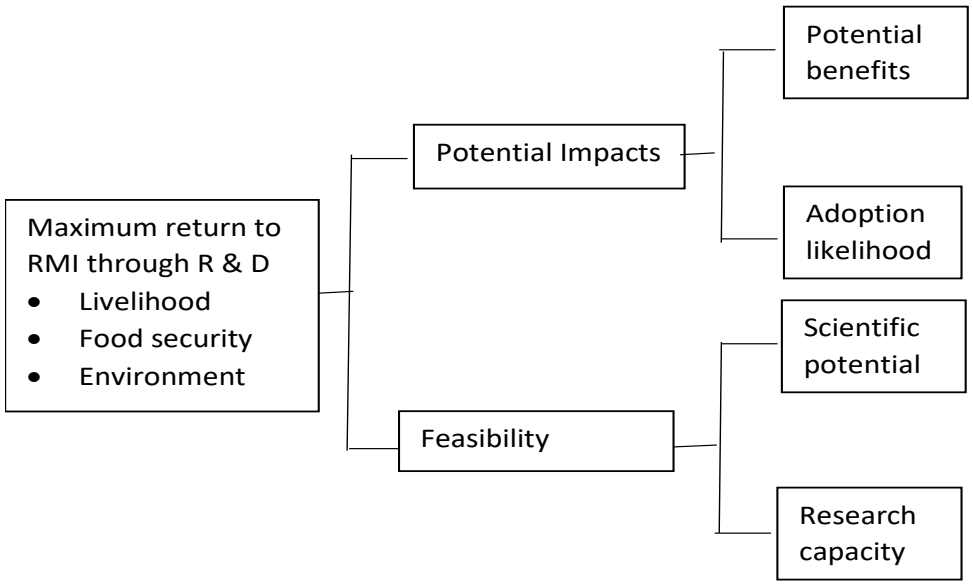
Once policy briefs, policies, and legislations are implemented DA will monitor their impacts on agricultural development, the communities, and the environment.

4.4 Assessing Status of the Outputs of the Agriculture Sector Plan

The assessment criteria for assessing the outputs of the sector plan. The outputs were prioritized using two criteria (Figure 2):

The potential impacts of the outputs are determined by the potential benefits of the outputs and the likelihood that they will be adopted by stakeholders.
Feasibility to implement activities under the various outputs which are determined by scientific potentials of the outputs and research capacity of the Division of Agriculture to facilitate the implementation of activities to attain these outputs.

Figure 2. Framework for evaluation of outputs in the strategic plan.



Potential Benefits

The potential benefits can be in terms of the extent of economic and social impact, the extent of environmental impact and enhancement of research capacity. This will refer to outputs to be addressed, size and scope of the problem /or opportunity to be addressed, and nature of benefits arising. These benefits may or may not necessarily be independent and mutually exclusive, and need to be considered in assessing the benefits and impact of possible research. Contribution of outputs to development may be:

1. increased production/expanded production
2. increased productivity of resources/inputs
3. reduced cost per unit of output
4. increased cash income
5. increased employment and utilization of resources/inputs
6. improved sustainability/reduced degradation of resources, and
7. assured food security/improved nutrition/reduced risk

Adoption Likelihood

This will cover probable users of likely outputs and services (including research results), past performances in adopting similar results, and major impediments and inducements to uptake outputs. Specific points to be covered are the appropriateness of technology, uptake events and directness of impact, the capacity to use/adapt and deliver, the capacity of extension and other service providers, and impediments/incentives to uptake. Some of the strengths and opportunities assessed earlier may become inducement for adoption, while some of the weaknesses and threats may become impediments to adoption.

Scientific Potential

This can consider the availability of tools and techniques/ scientific advances, the existence and availability of relevant disciplines/networks not only in the country but also in the Pacific sub-region, and the probability of success in achieving research results, and time to produce research outputs.

Research Capacity

This accounts for and reflects the research/technical skills/quality and breadth of skills, the critical mass of efforts, financial support and feasibility and quality of research infrastructure and support. This should take into account the capacity and ability of organizations, networks and collaborative arrangements that are/ or may be involved in the country or, to an extent, in the sub-region.

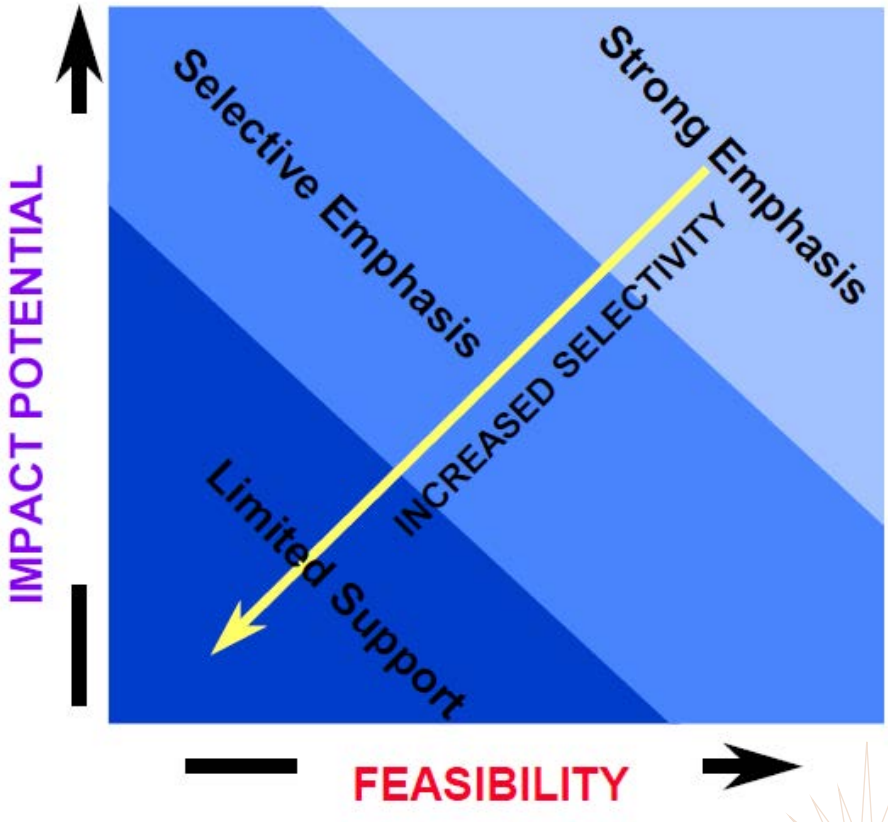
Selectivity in Output Emphasis

The following diagram (Diagram 1) shows the priority setting, as assessed based on two

main criteria, i.e. impact potential and feasibility; and their approximate relationship to the

level of selectivity and emphasis.

Diagram 1. The selectivity of outputs based on two criteria – impact potential and feasibility.



The highest priority is assigned to high impact and high feasibility outputs, and that appears in the right-hand side top corner of the diagram; the lowest priority is assigned to low impact and low feasibility output area and that appears in the left-hand side bottom corner of the diagram. A strong emphasis is then placed on the highest priority areas while more limited support is considered for the lowest priority areas. As one moves from highest to the lowest priority areas, increased selectivity is exercised in deciding on output areas and programs within these lower priority areas; lower priority does not imply lesser importance. Figure 3 gives the priorities of the sector plan as assessed by this tool.

Figure 3. Priorities of Agriculture Sector Plan Outputs

Potential Impacts	Low	Medium	High
High		Improved capacity of agriculture sector stakeholders	Sustainable crop production systems developed and promoted
Medium	Developed enabling policies/ legislations	Sustainable small-livestock production systems developed and promoted Increased consumption of nutritious locally-produced foods	Improved biosecurity and marketing Minimized environmental degradation
Low			

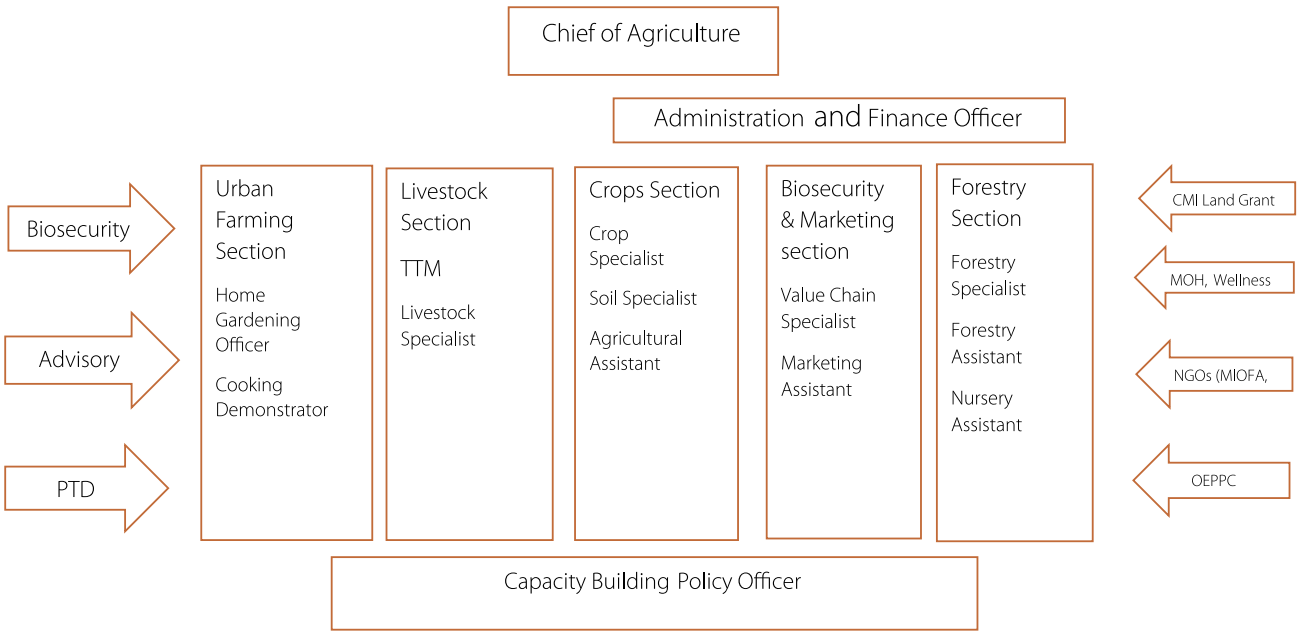
Feasibility

4.4 Organizational Structure

The Division of Agriculture to efficiently deliver its service will have an organizational structure (Figure 4) headed by the Chief of Agriculture who reports directly to the Secretary of the Ministry of Natural Resources and Commerce. The Chief of Agriculture will facilitate and lead the implementation of the strategic plan as well as the capacity building and policy development of the division and monitoring and evaluation of the strategic plan. Under the Chief of Agriculture will be 5 sections:

The Urban Farming Section: This section will be led by a Home Gardening Officer and will have a Cooking Demonstrator.
Livestock Section: TTM will continue to provide support to this section and will continue to have a DA Livestock Specialist based with TTM.

Figure 4. The proposed structure for the operation of the sector plan.



Crops Section will be led by a Crop Specialist and will be supported by a Soil Specialist and an Agricultural Assistant
Biosecurity and Marketing Section will work closely with the Division of Quarantine, Division of Trade and Investment, MIOFA, and TTM and will be led by a Value Chain Specialist and assisted by a Marketing Assistant.
Forestry Section which will be led by a Forestry Specialist with a Forestry Assistant and a Nursery Assistant

There will also be cross-cutting services across all the 5 sections. Parallel to the Agriculture Division, the Division of Quarantine will provide pests and disease control, quarantine and Sanitary and Phytosanitary Services (SPS) to DA. The Advisory services will be provided by the Extension Officers who will be provided information by all the 5 sections and they also will provide priority issues to the 5 sections from the communities and other stakeholders. There will also be a Participatory Technology Development (PTD) Specialist who will advise across all 5 sections and coordinate the on-farm trial activities.

There will also be key stakeholders who will provide support to DA as implementation partners in shared interests. They are CMI Land Grant, MOHHS, Wellness Center, NGOs (MIOFA, MICS, LFA), and OEPPC

5. RISK ANALYSIS AND PARTNERSHIP OPPORTUNITIES

5.1 Risk Analysis

Some issues needed to be addressed or they will pose risks to the successful implementation of the plan. They are described below.

i. Limited human resource capacity for agriculture development: The technical knowledge and skills of agriculture staff are generally poor and needed upgrading to a competent level that they can competently advise farmers. The capacity of other stakeholders for staple and nutritious food crop and livestock production also needed upgrading if the Marshall Islands is to improve food production. Capacity upgrading is both formal and informal training.

ii. Technological risks: The success of this project will depend on selecting the best-adapted varieties of each crop and breeds of each animal to the harsh conditions of the Marshall Islands. To produce good crops will require that there is enough organic matter, plant nutrients and water in the soil. For animals, the best breeds of each animal must be selected and the best husbandry given including the best feed rations. All of these require good technology development and if the technologies developed are not the best then the outputs achieved will be far from what the project wants.

iii. Climate change/ weather risk: The crops and animals, as well as the communities in RMI, are impacted by changes in climate. Temperature increases are likely to change the duration of crop growing seasons; increase the amount of water to produce a unit yield, and conducive to the spread of pests and diseases. Sea level rise affects agriculture crops in two major ways: saltwater intrusion and loss of coastal land due to inundation. Climate change will also affect crops and livestock production through changes in rainfall, particularly during La Niña years when droughts are most likely to occur. To address disaster risk reduction to climate risks the strategy at the farm level is adopting climate-smart practices.

iv. Price risk: For the value chain crops, uncertainty in the market for commodities such as root crops and vegetables, and the challenges of a price move are often different, depending on whether the stakeholder is a farmer or a processor. This may also affect the demand for inputs.

v. High dependency on imported foods: The changing dietary habit of the population has resulted in a high dependency on imported foods. This has resulted in increasing levels of food and nutrition-related noncommunicable diseases and the emerging high incidences of vitamin and mineral deficiencies, which impact negatively the health system, families and national economy.

vi. Introduction of invasive species: Invasive species present significant threats to agriculture in the Pacific Islands including the Marshall Islands, although how the magnitude and distribution of the threats vary between countries and remains unclear. Invasive species are a major cause of crop loss and can adversely affect food security. With increased globalization and connectedness via world trade, the threat from invasive species arriving in countries in which they were previously absent is expected to increase. To quantify this threat and develop effective biosecurity policy requires an understanding of the sources of potential pests and pathogens, their likelihood of arriving at a particular location, their likelihood of establishment upon arrival, and an estimate of their possible impact.

vii. Transportation Systems: Transportation is vital to moving agriculture produce and products within islands and between islands. Transportation within islands can be a problem and affect the movement of agriculture inputs and produce when needed to be marketed. Inter-island ferries can be a problem and can delay supply to islands and moving produce between islands.

5.2 Potential Partnerships

It must be emphasized that the successful implementation of the sector plan will be dependent on the strength of partnerships among the key stakeholders. DA works in partnership with national, regional and international organizations to build synergies and maximize its development outcomes. In many cases, the relationships between DA and its partners will be formalized through memoranda of understanding (MOU). It is therefore essential that the key stakeholders are identified early and engaged in the development, implementation, and monitoring and evaluation of the strategic plan. Critical to the success of this plan will be engaging landowning parties through MOU and invite their support to agriculture and forestry development on their lands.

National Partnership

The followings are national partners and areas of interested partnership

CMI Land Grant on research, technology and extension services

MOHHS and **Wellness** on food and nutrition security

TTM on addressing food security and nutrition issues, livestock, and horticultural production issues.

MIOFA on the value chain and organic food production

MICS assists in the sustainable use of resources, land conservation and protection of biodiversity. Technical assistance in the production of vegetation maps (with an emphasis on crops and food trees), access to emergent technologies for food production (focused on high yield, maximization of space, water, and nutrient), and implementation of adaptive tools to support atoll communities' resilience to climate change.

OEPPC on sustainable management of agricultural production environment

Youth Corp on planting native plants and replacement of senile coconuts

Regional and International Partners

Below are just some of the important areas in which DA is working with regional and international partners:

- **SPC LRD and USP** on 'climate-ready crops' and improved crop diversity, multiplication, distribution and evaluation, and building capacity of countries on taro breeding for tolerance to drought.
- **COGENT and ICC,** on the long-term conservation strategy for safety duplication and regeneration of global and regional coconut collections
- **FAO** on national framework for agriculture development
- **CTA** on value chains, youth in agriculture, information exchange and media/ICT;
- **FAO** and **SPC LRD** on food security, plant and animal genetic resources, control of zoonotic diseases, animal waste management, agricultural data and statistical capacity improvement, agriculture and forest policy development, agroforestry development, forestry information dissemination, and community forestry development, Integrated Pest Management and biological control of agricultural pests and diseases; facilitate ratification/membership of countries to the ITGRFA and the CGRFA
- **IPPC (FAO)** on phytosanitary standards-setting processes;
- **FAO** and **PIFS** on biosecurity issues and trade facilitation;
- **FAO** and **SPREP** on invasive species, forest genetic resources, and agrobiodiversity;
- **United States Forest Services (USFS)** provides training in tree nursery management, arboriculture, inventory, and potentially other topics. The Forest Service provides direct technical assistance in the form of maintaining permanent inventory plots to quantify forest resources, and a continually updated dashboard (website) providing information about ENSO associated agroforestry recommendations. The Forest Service can potentially provide small grants, particularly for urban

& community forestry and agroforestry; forest health, including monitoring and emergency response to agroforest pests (coconut rhinoceros beetle and little fire ants); and forestry & agroforestry extension (currently awarded to CMI Land Grant). The Forest Service may also increase its assistance in the form of vegetation type mapping, and student internships at the University of Hawaii. Priorities for Forest Service assistance should be identified in the Forest Action Plan to be updated in 2020.

- **Micronesia Conservation Trust (MCT)** support through the Micronesia Challenge terrestrial indicators and measures through funding, technical support, and policy development, support for data collection and analysis for conservation areas through the Forest Inventory and Analysis (FIA) by USFS, grant writing and capacity support for USFS funding, capacity support and funding to attend trainings in nursery, data collection, enforcement for PA's and more.
- **SPREP** on the Convention on Biological Diversity (CBD)/Access and Benefit Sharing (ABS) Nagoya Protocol, perspectives and mutual implementation of the protocol in harmony with the relevant treaties, e.g. ITPGRFA

DA is committed to fully realizing its advantage in using a multi-sector, multi-disciplinary approach to address priority challenges such as climate change and food security. DA will continue to strengthen its technical partnerships with other government Ministries in programming, implementation and monitoring activities.

6. PROGRAM DELIVERY

With many agencies, both government and non-government, expected to be involved in delivering Marshall Islands Agriculture Sector Plan outputs, successful implementation will require strong leadership, good coordination, sound processes and effective use of resources. DA is the lead agency for the agriculture sector and thus the Chief of Agriculture is the senior responsible officer to ensure that the sector plan is efficiently and effectively delivered on time and within available budget resources.

The interagency Food Security Committee with the guidance of the Secretary of MNRC will provide oversight, guidance, and support for sector plan implementation.

The agriculture sector plan will use a results-based approach with coordinated participation of all stakeholders, including governmental, non-governmental and community-based organizations. DA will need to develop annual work plans through participatory consultation with relevant stakeholders to guide the implementation of priorities. Development of the sector work plans target the output intervention level and further define specific actions with set timeframes to achieve the identified outputs/strategies. Activity delivery timeframes should be clearly defined with a responsible agency/program. Each annual work plan should be carefully costed which will form the basis to leverage funding from both the Government and other donor-supported programs or projects.

With the current capacity of DA, the implementation of the identified priorities will need to be well-coordinated in a partnership model ensuring the engagement of all relevant stakeholders in the implementation of the plan. This means DA's capacity to facilitate the delivery of the outputs is critical. This should involve effective partnerships with the private sector, relevant NGOs and producer organizations to work in concerted efforts in achieving the desired outputs for the sector strategy. Where possible, contracting out some of the responsibilities outside the current capacity of DA to other stakeholders will also be necessary.

7. MONITORING AND EVALUATION

Monitoring and evaluation (M&E) is a critical part of the Marshall Islands Agriculture Sector Plan's management and implementation cycle. If addressed rigorously it should allow for adaptive management and improvement through the life of the sector plan to support the effective delivery of outputs and services. It will also facilitate reporting and communication of progress to partners and other stakeholders. Effective M&E will require a substantial commitment of human and financial resources, firstly, to ensure that baselines and realistic targets are established for all outputs at intervention onset and then to make sure a workable monitoring process is established and supported throughout the implementation period. Monitoring, evaluation and reporting processes under the sector plan will cover efficiency (program management and administration), effectiveness (delivery of outputs) and impact (development change over time). An appropriate level of budget for M&E, therefore, needs to be anticipated in the sector plan resource mobilization cost.

The sector plan under its policy objective should include activities to strengthen agricultural statistics systems including data collection, systematization, analysis and reporting. These activities should provide a means to supply better indicator data to strengthen the monitoring process. Monitoring will be managed and coordinated by the DA and will rely on good cooperation and support from all agencies that collect and manage data sources relevant to the performance of the agriculture sector and implementation of the sector plan.

The plan includes a detailed logframe (Appendix 1) that sets out the results to be monitored, evaluated and reported against. Key performance indicators with baselines and targets have been set in Appendix 1 which will be used for monitoring and evaluation of sector plan implementation progress.

Appendix 1. Logical Framework Matrix

Narrative Summary	OVIs	Baseline	Intermediate	End of plan	MOVs
Goal: Resilient food, nutrition and livelihood security of Marshallese	• Contribution of locally produced foods to diets of Marshallese • Contribution of agriculture to HH incomes				National Food Balance Sheet Household income & expenditure survey
Purpose: Enhanced agriculture development for the Marshall Islands	• Livestock production • Crop production/ quality • Improved biodiversity and resilience • The appropriate structure for Agriculture Division	X numbers A acres Productivity index Operational Currently USD .. budget is for operational Currently X numbers Currently, X% of extension facilities meet the requirement Currently x vehicle per island X number of nursery per island	Y% increase B% increase in acres The operational budget increased by x% by 2025 The number of staff increased by x in 2025 By 2025 all Majuro extension centers are fully equipped By 2025, x additional vehicles purchased	Z% increase C% increase in acres Improved Improved efficiency The operational budget increased by another x% by the end of the implementation plan The number of staff increased by another x number by the end of the plan By end of the plan, all Outer Islands district extension centers are fully equipped By end of the plan, at least 4 additional vehicles purchased All islands will have nursery facilities	Agriculture Division report TTM report MICS/OEPPC reports
1. Environmental degradation minimized	• Number of trees planted traditional and exotic • Soil and water quality improved	Baseline number Baseline levels	20% increase Relate to output 3	50% increase Relate to output 3	MICS, UISFS reports and AD reports
2. Sustainable small-livestock production systems developed and promoted	• Number of improved breeds developed and distributed • Improved feeds	Number of crossbreds Increase in use local ingredients	30% increase 50% of the local ingredients used	60% increase All local ingredients	TTM and DA reports
3. Sustainable crop production systems developed and promoted	• Soil quality • Water use efficiency • Number of crops used in agriculture • The resilience of agroforestry systems	Use of targeted compost Number of BIS and wicking systems Baseline established Baseline established	20% of farmers make targeted compost 30% increase 2 extra crops	70% of farmers use targeted compost 80% increase 2 extra crops Resilience improved	Soil tests AD reports USFS
4. Increased consumption of nutritious locally-produced foods	• No. of home gardens • Number of healthy recipes adopted by targeted households	Status in the communities Current status	50% increase At least 10 recipes adopted by targeted households	80% increase Extra 5 recipes developed and adopted by targeted households	Wellness Centre reports DA Focus surveys

5.	Improved biosecurity and marketing	• Plant and animal protection program operational (link to 3) • Increase domestic and export trade	Develop a control program Status of domestic markets Value chains for export	Control program operational Mobile market once a week Two crops completed	Program is efficient Mobile market once a week Two crops completed	TTM, MIOFA and DA reports
6.	Improved capacity of agriculture sector stakeholders	• No. of training • No. of trainees • % of trainees using skills and knowledge	Capacity building needs assessment and training program endorsed None None	50% of training conducted 200 trained 50% used knowledge and skills	100% training program conducted 500 trained 80% used knowledge and skills	DA, TTM, CMI, and MIOFA reports
7 .	Enabling policies/ legislations developed	• Policy and legislation needs to be identified	Report on review of policy needs to be completed	A policy brief on voluntary guidelines for sustainable use of soils and pest and diseases management developed and endorsed	Extra 2 policies supporting the delivery of agricultural services developed and endorsed	DA reports

Appendix 2. Organizations and people consulted with during the development of the Agriculture Sector Plan

Ministry of Natural Resources & Commerce (MNRC)	
Sandy Alfred	Minister
Iva R. Roberto	Secretary
Walter Myazoe Jr.	Deputy Secretary
Risa Kabua Myazoe	Chief of Agriculture
Henry Capalle	Chief of Quarantine
Randon J. Jack	Assistant Chief of Agriculture
Lajikit Rufus	Agroforestry Coordinator
Billy Edmond	Agriculture Specialist
Stephen Lepton	Crop Production Officer
Silver Wase	Agroforestry Officer
Joel Bujen	Agroforestry Officer
Thomas Thomas	Agriculture Extension Agent
Elias Isai	Agriculture Extension Agent
Ruby Tojar	Nursery Worker
George Batin	Nursery Worker
Steve Nelson	Livestock Technician
Office of Chief Secretary (OCS)	
Kino S. Kabua	Chief Secretary
Penny Kabua Nimoto	Program & Policy Coordinator
Jacot Des Combes Helene	CCA and DRM Adviser
U.S. Department of Agriculture, Forest Service (USFS)	
Kathleen Friday	Forest Stewardship Program Manager
Ministry of Health & Human Services (MOHHS)	
Francyne Wase Jacklick	Deputy Secretary
Philmar Mendoza Kabua	Director of Health Promotion & Disease Prevention
Shra Kedi	NCD Coordinator
RMI Ridge to Reef Project (R2R)	
Jennifer de Brum	Project Manager
Marissa Note	Finance & Administrative Assistant
Taiwan Technical Mission (TTM)	
David, Yen-Jen Lin	Director
Dr. Kevin, Weichih Lee	Livestock Specialist
Frank Lin, Furn-Wei	Horticulture Specialist
Public School System (PSS)	
Samuel Bikajle	School Garden Coordinator
Majuro Diabetic Wellness Center	
Tanner Smith	Director
Richard Clark	Agriculture Consultant
Gideon Lang	Weed Gardener

Office of Environmental Planning and Policy Coordination (OEPPC)	
Warick Harris	Deputy Director
College of the Marshall Islands (CMI)	
Desmond N. Doulatram	Social Science Instructor/Professor
College of the Marshall Islands – Land Grant (CMI Land Grant)	
Stanley Lorennij	Dean, Associate Director
Vincent Enriquez	Agriculture Researcher
Ted Michael Jr.	Agriculture Extension Agent
Ebon Local Government	
Ione de Brum	Former Mayor
Likep Local Government	
Veronica Wase	Former Mayor
Marshall Islands Conservation Society (MICS)	
Martin Romain	Director
Madeline Cochran	Deputy Director
Environmental Protection Agency (EPA)	
Karl Fellenius	Coastal Resource Advisor
International Organization for Migration (IOM)	
Angela Saunders	Head of sub-office
Marshall Islands Organic Farmers Association (MIOFA)	
Karness Kusto	President
Jabukja Aikne	Coordinator
Foster Lanwe	Secretary
Josepha Maddison	Member
Birney Ishoda	Member
Micronesia Conservation Trust (MCT)	
Tamara Greenstone Alefaio	Conservation Program Manager
Roseo Marquez	Terrestrial Champion
MarTina Corporation	
Fern Lehman Stege	Forest Ecologist
Mark Stege	Director
The Church of Jesus Christ of Latter-Day Saints	
Elder Hartmut Skibbe	Welfare/Humanitarian Missionaries
Sister Sylvia Skibbe	
Laura Farmers Association (LFA)	
Bokmej Bokmej	Member

Republic of Marshall Islands

AGRICULTURE SECTOR PLAN

2021 – 2031