THE REPUBLIC OF THE MARSHALL ISLANDS

STATE OF ENVIRONMENT REPORT

2016

An initiative of the African, Caribbean and Pacific Group of States funded by the European Union

UNEP

SPREP
Secretariat of the Pacific Regional Environment Programme

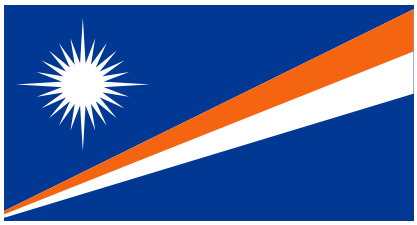
ACP MEAs 2

our world
our dignity
our future

2015 European Year for Development

REPUBLIC OF THE MARSHALL ISLANDS STATE OF ENVIRONMENT REPORT

2016



An initiative of the African, Caribbean and Pacific Group of States funded by the European Union

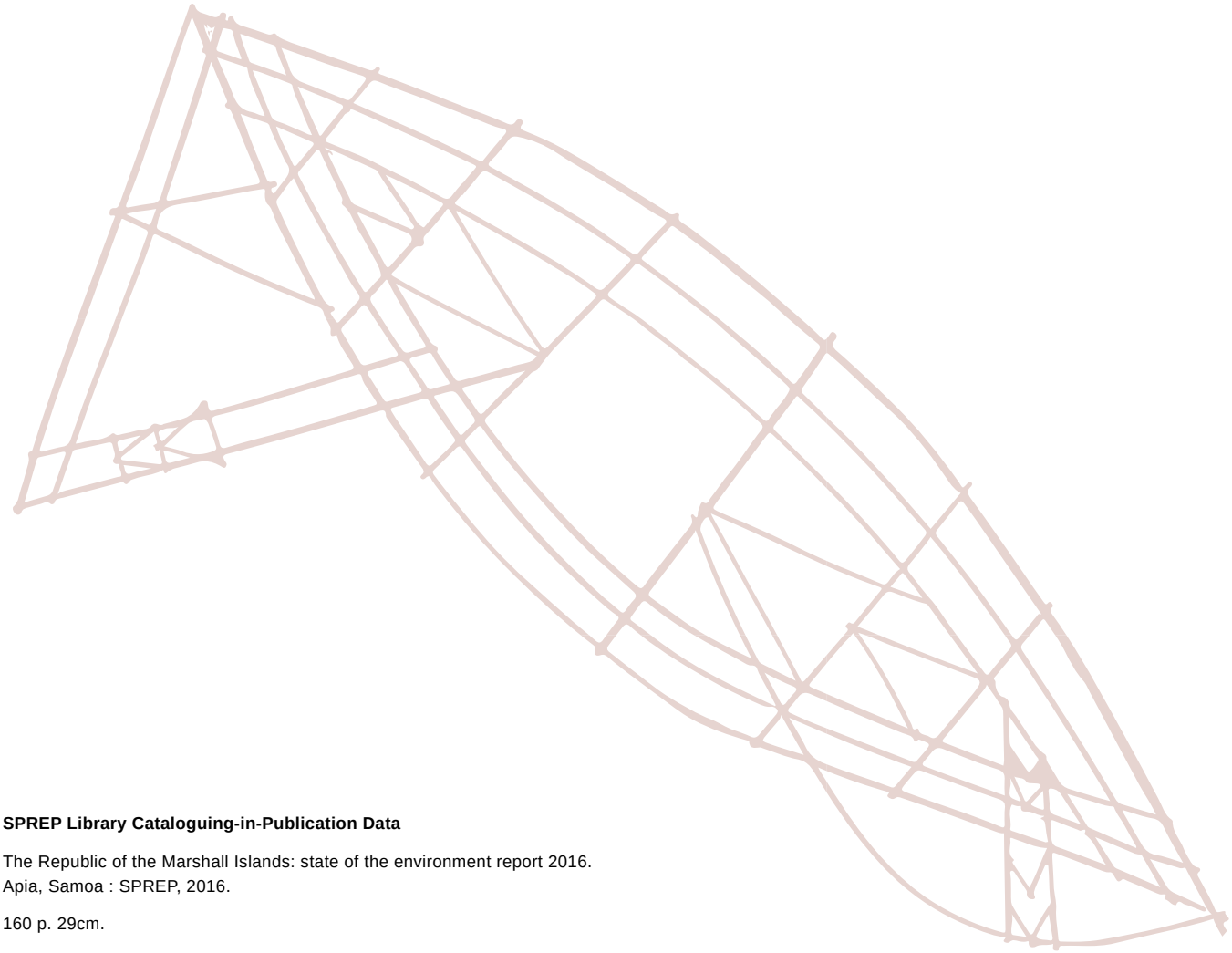
UNEP

SPREP
Secretariat of the Pacific Regional Environment Programme

ACP MEAs 2

our world
our dignity
our future

2015 European Year for Development



SPREP Library Cataloguing-in-Publication Data

The Republic of the Marshall Islands: state of the environment report 2016.
Apia, Samoa : SPREP, 2016.

160 p. 29cm.

ISBN: 978-982-04-0619-3 (print)
978-982-04-0620-9 (e-copy)

1. Environmental policy – Marshall Islands.
2. Environment protection – Marshall Islands.
3. Conservation of natural resources – Marshall Islands.
I. Pacific Regional Environment Programme (SPREP). II. Title.

363.7099683

Cover photo: Benedict Yamamura
Other photos: Unless otherwise acknowledged, all photographs were taken by SPREP staff.

Designed by: The Little Design Company, Wellington, New Zealand.

An initiative of the African, Caribbean and Pacific Group of States funded by the European Union.

This document has been produced with the financial assistance of the European Union and the United Nations Environment Programme. The views expressed herein can in no way be taken to reflect the official opinion of the European Union or the United Nations Environment Programme.

SPREP
Secretariat of the Pacific Regional Environment Programme

PO Box 240, Apia, Samoa
+685 21929
sprep@sprep.org
www.sprep.org

The Pacific environment, sustaining our livelihoods and natural heritage in harmony with our cultures.

REPUBLIC OF THE MARSHALL ISLANDS STATE OF ENVIRONMENT REPORT

2016

FOREWORD FROM THE PRESIDENT OF THE REPUBLIC OF THE MARSHALL ISLANDS

Despite being one of the world's smallest nations, the Republic of the Marshall Islands (RMI) has emerged as one of its strongest climate change advocates. The Pacific Small Island Developing State was one of the driving forces behind the 'High Ambition Coalition', which aims to keep global warming below 1.5 degrees and has been credited as instrumental to the success of the Paris Agreement. As the RMI continues to uphold its demands for progressive climate change agreements at the international stage, we also strive to continuously improve our own standards at home. The Marshall Islands State of Environment Report 2016 is a long overdue step on the ladder towards best-in-class environmental governance at the national level.

This report updates the 1992 State of Environment report with the latest findings from the Marshall Islands. Environmental reporting is defined as a requirement for RMI in the 'Office of Environmental Planning and Policy Coordination (OEPPC) Act 2003'. The present report results from a concerted effort of all national stakeholders with OEPPC being the lead agency working with the Secretariat of the Pacific Regional Environment Programme (SPREP) in gathering information from national stakeholders to compile this report. I would like to use this opportunity to thank all the parties involved for their commitment and hard work in creating this document and a special komol tata to SPREP for their continued support to the Marshall Islands.

Recognizing the Marshall Islands' unique vulnerability to both climate change and our nuclear heritage, the report is an assessment of the status and conditions of the major environmental resources in the Republic. The SOE uses the DPSIR[1] reporting model to create a comprehensive account of the environment in RMI. It identifies Driving Forces and Pressures that result in the current State of Environment while also examining the Impact resulting from the preceding analysis and suggesting a potential Response strategy. It concludes with a set of actionable recommendations for future legislative or other actions.

I recommend that all government agencies, all our development partners and donors, and civil society representatives use the State of Environment 2016 report to inform their actions related to the seven areas covered in this document: Atmosphere and Climate, Land, Marine, Biodiversity, Culture and Heritage, Built Environment, and Nuclear Legacy. I invite you to help us address the problems that were identified, thereby bringing us one step closer to a more sustainable future. While we are proud to have created this comprehensive report, we know that our journey does not stop here. We commit to producing regular updates by tracking and evaluating the progress we have made. Only by knowing what is happening on the ground can we make sure to fulfil our international obligations and help the international community transition into a 1.5 degree world.

Hilda C. Heine, Ed.D

President
The Republic of the Marshall Islands

1 Drivers, Pressures, State, Impact and Response.

FOREWORD FROM THE DIRECTOR GENERAL OF THE SECRETARIAT OF THE PACIFIC REGIONAL ENVIRONMENT PROGRAMME

The Pacific environment is an integral part of the Pacific island culture. It has shaped and influenced our way of life over the centuries and as the chief provider for our Pacific communities, it has fed, clothed and kept us safe over the years.

Sadly, despite its immense value, our environment is under threat from growing pressures due to economic development and population expansion, and exacerbated by the threat of global climate change. Therefore, it is important that we continue monitoring and maintaining the quality of our environment for future generations.

The 2016 Republic of the Marshall Islands State of Environment (SOE) report updates the information provided in the last report completed in 1992. The 2016 SOE Report provides an assessment against the seven environmental themes identified in the Report itself as well as the baseline information for the new and emerging environmental challenges today.

Four new themes are introduced in this report: Atmosphere and Climate, Biodiversity, Culture and Heritage, and Nuclear legacy along with other thematic areas including Land, Built-environment and the Marine environment. Improving on the 1992 RMI SOE, this report places the emphasis on data based conclusions and presents supporting evidence for all indicators.

The 2016 SOE will be able to serve as a new baseline for future SOE Reports and can help the Marshall Islands with national, regional and international reporting obligations including multi-lateral environmental agreements. In addition, this report has already informed environmental planning and decision making, and has guided the development of the National Environmental Management Strategy.

SPREP is pleased to have partnered with the Office of Environmental Planning and Policy Coordination of the Marshall Islands in developing this document, as well as the many RMI agencies and Civil Society Organisations that contributed to the consultative process.

I would like to sincerely thank the individuals and all the government ministries and departments for their contributions. It is important that regular updates to this SOE are conducted to assess RMI's environmental conditions and encourage you all to use this report to help track, manage, plan and report on its natural resources and environment.

Kosi Latu

Director General
Secretariat of the Pacific Regional Environment Programme

EXECUTIVE SUMMARY

The 2016 State of Environment (SOE) Report for the Republic of Marshall Islands (RMI) updates the 1992 SOE report. It uses the DPSIR model (Drivers, Pressures, State, Impact and Response) and aims to:

- Document the key drivers and pressures behind the changing environment.
- Assess the RMI environment since 1992, using the best available information on the state of RMI's environment in seven key themes: Atmosphere and Climate, Land, Marine, Biodiversity, Culture and Heritage, Built Environment and Nuclear Legacy.
- Document the impacts of environmental changes on the society, economy and environment from changes in the state of the environment.
- Document current responses to protect and better manage RMI's natural resources.
- Provide recommendations for RMI to address key challenges and link them to actions in the National Environmental Management Strategy (NEMS) and other key policy documents.

This report is comprised of three discussions:

1. **Drivers and Pressures in Marshall Islands:** A summary of the main points discussed in the Pressures and Drivers section of the report.
2. **The State of RMI's Environment and Impacts on the Society, Economy and Environment:** Key findings for each of the seven themes.
3. **Responses and Recommendations – Challenges in Moving from Policy to Action:** This presents key responses, opportunities, challenges and recommendations.

DRIVERS AND PRESSURES IN RMI

RMI is rapidly changing and the environment is changing along with it. Activities that are changing the environment are driven by broader social, economic, technological and cultural forces referred to as "drivers". Population growth, urbanisation, tourism, increased access to external markets, a growing middle class, the clash of traditional and contemporary values and the increase in technological access are key drivers behind the changes. The drivers of RMI's economic, societal and environmental change can be a source of further pressure on the environment but they can also offer potential solutions to problems. Climate change is one driver that poses the greatest threat to RMI's environment, particularly in areas vulnerable to extreme weather events like flooding and typhoons.

The pressures on the environment are grouped into three main categories for the SOE:

- Land Development (urban, agricultural and coastal),
- Resource Extraction (commercial fishing and mining/ quarrying) and
- Consumption and Waste (energy, solid and liquid waste and water).

Most of these pressures on RMI's environment are steadily increasing with the exception of large scale agricultural expansion which has declined in the past 20 years. However, with the decline in agriculture, new pressures on the environment are being seen, such as the expansion of commercial fishing. This shows that these pressures are linked, and the rise or fall in one pressure type can lead to changes in another.

THE STATE OF RMI'S ENVIRONMENT AND IMPACTS ON THE ENVIRONMENT, SOCIETY AND ECONOMY

Information was gathered from local stakeholders and experts on the seven major themes to provide a summary of the state, impact and response to 38 key indicators of 19 topics. Each theme begins with a quick review. The following provides a summary of each major topic covered in the SOE:

Atmosphere and Climate

OZONE DEPLETING SUBSTANCES: Ozone depleting substances (ODS) have been slowly phased out since 2000. In 2004, RMI banned the importation of chlorofluorocarbons (CFCs) and committed to phasing out hydrochlorofluorocarbons (HCFCs) by 2030.

GREENHOUSE GASES: Greenhouse gases (GHGs) increased particularly in the energy sector. From 2000 to 2010, total national GHG emissions increased by 27.8 percent, GHG emissions from the energy sector increased by 37.4 percent and GHG emissions from the waste sector decreased by 3.4 percent. However, this area is lacking data and systems to determine the actual GHG emission rates, as well as the contributions to emissions from transportation and waste, representing gaps in data gathering.

PHYSICAL CLIMATE: Rainfall varies greatly from the northern to the southern atolls. However both the northern and southern atolls have become dryer and warmer over the observing period.

CLIMATE ADAPTATION: RMI has five priority areas to address issues related to climate change impact. The challenges serving both the urban centres and the rural communities represent one of the greatest challenges RMI faces. These include: Water Security, Food Security, Human Health, Land Use and Flood Risks.

Land

FOREST: RMI has about 70 percent total forest cover, which includes native forest, agro-forest, and coconut plantations. These forest ecosystems are in fair condition and stable, without any noticeable changes in the last few decades.

LAND UNDER CULTIVATION: Agricultural activities have reduced by more than half, as shown in the RMI census report 2011. This is primarily due to changes in lifestyle and increased dependence on imported food. RMI has never conducted an agricultural census, leading to a major data gap for agricultural policy development or sector enchantment.

Wetlands: RMI has two declared Ramsar sites in Namdrik and Jaluit which have been managed by the local government with support from the RMI EPA (Environmental Protection Authority). However, there is little data available to determine their current status.

Marine

OFFSHORE MARINE ENVIRONMENT: The RMI tuna fisheries has experienced dramatic increases in total tuna catch, thereby putting more pressure on these natural resources. There is some evidence that the tuna species have exceeded their maximum sustainable yields, particularly with regards to bigeye tuna. Recognising the global decrease in all shark species, RMI was the first country to introduce a shark fishing ban in its EEZ in 2011.

INSHORE MARINE ENVIRONMENT: The inshore reef system and fishery is relatively healthy and stable' although widespread coral bleaching and the ensuing proliferation of macroalgae in recent years combined with localized overfishing is creating uncertainty over the future of these resources in their ability to support fisheries habitat and coastal protection.

MARINE MANAGED AREAS: There are 63 declared marine managed areas covering about 70 percent of reef area in the RMI. However, most of the managed areas do not yet have official management plans developed or implemented.

MARINE WATER QUALITY: Lagoon water quality has deteriorated over the last decade mainly in the urban centres. The three most contaminated sites in 2014 were in eastern Majuro. Bacteria counts in the three sites were over 24,000MPN/100ml: the safe standard for lagoon recreation is 104MPN/100ml.

MARINE MAMMALS AND TURTLES: RMI has two turtle nesting populations, both of which are globally endangered. While there is limited data available to indicate the true state of turtles in RMI, the global population has continued to decline, thus conservation efforts in RMI are critical. Marine mammals and turtle represent a data gap in biodiversity managed in RMI.

Biodiversity

THREATENED AND ENDEMIC SPECIES: The RMI threatened species list, which includes the vulnerable, endangered and critically endangered, is dominated by marine species. The IUCN Red List, the global list of endangered species, has only assessed 1130 or 19 percent of the 5821 species found in RMI. The IUCN has identified 101 species that are vulnerable to extinction. RMI has identified an additional 61 species that are a high priority for conservation. Only 18 species overlap with the IUCN Red List, this means that RMI must expand its assessment of the 5821 species list and prioritise its conservation efforts.

ENVIRONMENTAL INVASIVE SPECIES: Invasive species are one of the biggest threats to biodiversity in RMI. Impacts include those on economic revenue, e.g. lower crop productivity, reduced export potential, and habitat change. Social impacts include increased human labour costs, reduced aesthetic value, loss of culturally important species including traditional medicines, and increased erosion affecting water cycles and supply.

KEY SPECIES OF CONCERN: Many of RMI's endangered species are endemic which occur nowhere else on earth. The general consensus is that RMI's biodiversity is deteriorating, with the decline of the coastal and near shore areas forming the biggest threat. Some recovery plans exist but are generally poorly supported, and there is a very low state of knowledge about RMI's threatened species.

Culture and Heritage

HISTORICAL SITES: There are 118 prehistoric sites and 212 historic sites in RMI. Most have general management plans except for Jaluit Atoll. Currently management plans and implementation of these sites are lacking due to limited funding.

LANGUAGE AND KNOWLEDGE: Nearly all residents speak Marshallese. This is a good indication that the local language is intact and will be used into the future. However, like most Pacific island countries, there is continuing pressure from changing lifestyles which affect the traditional and cultural aspects of Marshallese language and customs.

TRADITIONAL DIETS: A recent study shows a shift towards imported foods, with an 80 percent increase in imported food use and a corresponding drop in traditional food production and preservation. This is partly due to changing lifestyles and labour saving food preservation techniques and technology.

Built Environment

ENERGY CONSUMPTION, AVAILABILITY AND RENEWABLES: Per capita energy consumption has decreased slightly over the past ten years, partly due to increased energy efficiency. Much of the current demand is met by non-renewable resources. However, domestic and commercial energy efficiency has increased and plans are in place to increase renewable sources of electricity above the current low levels.

SOLID WASTE: Waste management, recycling and collection is improving but the collection and recycling rates do not keep up with the generation of waste. Only about 70 percent of Majuro, and 76 percent of Kwajalein, urban waste makes it to landfills. The landfills on Majuro and Ebeye lack facilities for separation of recyclables and hazardous waste, and, in many cases, waste is still burnt. A total of 668 illegal or unauthorized dumpsites were recorded in 2011 in Majuro (Majuro Infrastructure Survey Report, 2011). Unregulated dumpsites are putting pressure on the surrounding areas which can lead to other social and health issues. On the outer islands, most waste is burnt or buried. Of the eight outer islands for which data is available, seven burn more than 80 percent of their waste, and Utrik buries it in unlined unofficial pits.

WATER AND SANITATION: Access to improved drinking water and sanitation has improved over the past 30 years. However, access to sanitation in some rural areas remains an issue in addition to the untreated nature of the sewage discharge. Majuro has been discharging in the shallows on the reef flat since at least 2008, leading to nutrient loading and macroalgal growth, and likely other reef and human health issues. Both Majuro and Ebeye sewage outfall inneeds to be fixed.

Responses and Recommendations Challenges in Moving from Policy to Action.

While gaps exist, RMI has many strong laws, policies and regulations that promote sustainable use and protection of its environmental resources. Since the 1992 SOE report, RMI has had a plethora of assessment reports which recommend actions on biodiversity, agriculture, water, marine management, climate change, and others. However, the national implementation and enforcement of these efforts is inconsistent and, in some cases, non-existent. Activities and initiatives are largely dependent on external funding from donors and international sources, many of which are short-term and determined by current international priorities.

A good example is the case of endangered species, where the implementation (and in some cases development) of protective policies are left to NGO's. For example, the successful Mule restoration project that was led and implemented by the Marshall Islands Conservation Society (MICS).

The best examples of environmental management in RMI are where traditional practices have been combined within a modern legislative framework. One such example is the Reimaanlok process, where modern and traditional management of terrestrial and inshore marine areas are incorporated. This successful model has been adopted by the national and local governments and the communities.

On their own, traditional practices are not enough to protect the environment from modern day pressures, such as deep sea mining, the demand for shark fins, whole-scale resource extraction and population growth. Traditional practices of environmental management need to be integrated into, and supported by, a strong legislative framework of environmental protection for overall success.

The RMI government has ample policies and regulations to support the sustainable use and protection of the environment. The challenge for the next five years will be implementing these policies while balancing development pressures with sustainable use and conservation.

ACKNOWLEDGEMENTS

The RMI 2016 State of Environment report was led and developed by the Office of Environmental Planning and Policy Coordination (OEPPC), and the Secretariat of the Pacific Regional Environment Programme (SPREP). Content contributions were made by numerous representatives from government, College of the Marshall Islands and NGOs listed below. There are many others not listed who also helped in the data gathering, analysis and design whom without their assistance, it would not have been possible to develop a report of this complexity and scope. Their contribution is greatly appreciated.

COORDINATION AND PLANNING

Office of Environmental Planning and Policy Coordination

Lowell Alik-Director
Warwick Harris – Deputy Director
Benson Langidrik – Chief of Administration and Finance

SPREP

Paul Anderson
Jope Davetanivalu
Dr. Melanie Bradley
Anama Solofa
Moriana Philips
Kilom Ishiguro

WRITING, ANALYSIS, DESIGN AND COMPILATION

Kilom Ishiguro – SPREP
Paul Anderson – SPREP
Jope Davetanivalu – SPREP
Dr. Melanie Bradley – SPREP
Anama Solofa – SPREP
Sefanaia Nawadra – UNEP

KEY CONTRIBUTORS

Atmosphere and Climate

Kino Kabua – Office of the Chief Secretary
Jennifer Debrum – Office of the Chief Secretary
Lani Milne – EPA
Hemline Ysawa – OEPPC
Lee Jacklick – Weather Services
Nover Juria – Weather Services
Dr. Riyad Mucadam – OEPPC
Mark Stege – MICS
Lowell Alik – OEPPC
Espen Ronneberg – SPREP

Land

Rebecca Lorennij – Secretary MRD
Karness Kusto – MRD
Foster Lanwe – CMI Land Grant
Chris Yanckello – EPPSO
Kathryn Relang – WUTMI
Mark Stege – MICS
Warwick Harris – OEPPC

Marine

Samuel Lanwi – MIMRA
Florence Edwards – MIMRA
Emma Kabua – MIMRA
Melba White – MIMRA
Benedick Yamamura – MIMRA
Tonie Kalena Debrum Kattil – MIMRA
Abraham Hicking – EPA
Tuvuki Ketedromo – EPA
Don Hess – CMI
Karl Fellenius – CMI and UHSG
Michael Donoghue – SPREP

Biodiversity

Lani Milne-EPA
Benson Langidrik-OEPPC
Warwick Harris – OEPPC
Karl Fellenius – CMI and UHSG
Mabel Peter – HPO

Culture and Heritage

Josepha Maddison – MOIA
Dolores Debrum – Kattil – MRD
Mabel Peter – HPO
Kazutoyo Wase – HPO
Foster Lanwe
Kathryn Relang – WUTMI

Built Environment

Angeline Heine – MRD
Walter Myazoe – MRD
Dolores Debrum-Kattil – MRD
Ned Lobwij – MRD
Lani Milne – EPA
Abraham Hicking – EPA
Halston Debrum – MWSC
Joralik Tibon – MAWC
Dahlia Kaneko – EPPSO
Karl Fellenius – CMI and UHSG
Tim Hartley – SPREP

Nuclear Legacy

Jack Ading – Senator, Enewatak Atoll
Jackson Ading – Mayor, Enewetak Atoll
James Matayoshi – Mayor, Rongelap Atoll
John Kaiko – Mayor, Utrok Atoll
Nishma Jamore – Late Mayor, Bikini Atoll
Bill Graham – Advisor on Nuclear Issues, Ministry of Foreign Affairs

CONTENTS

Foreword from the President ii
Foreword from the Director General, SPREP iii
Executive Summary v
Acknowledgements viii
Glossary x

SECTION 1 INTRODUCTION TO THE 2016 STATE OF ENVIRONMENT (SOE) REPORT 1

Introduction and background 3
Approach to the 2016 SOE 5
A Reader's Guide to the 2016 State of Environment Report 8

SECTION 2 DRIVERS AND PRESSURES 11

Five main drivers for environmental change in RMI 13
Three major pressures with national indicators 23

SECTION 3 THE STATE OF THE ENVIRONMENT 35

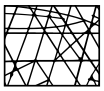
Atmosphere and Climate 37
Land 53
Marine 63
Biodiversity 87
Culture and Heritage 101
Built Environment 111
Nuclear Legacy 131

SECTION 4 SUMMARY AND RECOMMENDATIONS OF THE 2016 SOE 143

Conclusion 144
Recommendations 144

GLOSSARY

ABS	Access and Benefit Sharing
ADB	Asian Development Bank
AusAID	Australian Agency for International Development
CFC	Chlorofluorocarbons
CMAC	Coastal Management Advisory Council
CMI	College of the Marshall Islands
CITES	Convention on International Trade in Endangered Species
DSM	Deep Sea Miing
DPSIR	Drivers, Pressures, State, Impact and Response
HCFC	Hydrochlorofluorocarbons
HPO	Historical Preservation Office
EEZ	Exclusive Economic Zone
EPA	Environmental Protection Authority
EPPSO	Economic Policy, Planning and Statistics Office
FAO	Food and Agriculture Organization of the United Nations
FFA	Forum Fisheries Agency
FSM	Federated States of Micronesia
GEF	Global Environment Fund
GHG	Greenhouse Gases
IAS	Invasive Alien Species
ITCZ	Inter-Tropical Convergence Zone
INDC	Intended Nationally Determined Contribution
IRENA	International Renewable Energy Agency
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
JIRCA	Japan International Research Centre for Agricultural Sciences
JNAP	Joint National Action Plan
MAWC	Majuro Atoll Waste Company
MC	Micronesia Challenge
MEA	Multilateral Environmental Agreement
MEC	Marshalls Energy Company
MICS	Marshall Islands Conservation Society
MIMRA	Marshall Islands Marine Resources Authority
MIVA	Marshall Islands Visitors Authority
MMA	Marine Managed Areas
MNRD	Ministry of Natural Resource and Development
MOIA	Ministry of Internal Affairs
MWSC	Majuro Water and Sewer Company
NCD	Non-Communicable Diseases
NEMS	National Environmental Management Strategy
NGO	Non-Government Organization
NRAS	Natural Resources Assessment Survey
ODS	Ozone Depleting Substances
OEPPC	Office of Environmental Planning and Policy Coordination
PACC	Pacific Adaptation to Climate Change
PNA	Parties to the Nauru Agreement
RMI	Republic of the Marshall Islands
SEA	Strategic Environmental Assessment
SOE	State of Environment
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
TREDS	Turtle Research and Monitoring Database System
UHSG	University of Hawaii Sea Grant
UNDP	United Nations Development Fund
UNEP	United Nations Environment Programme



INTRODUCTION AND READER'S GUIDE

INTRODUCTION AND BACKGROUND

ENVIRONMENTAL REPORTING IN THE REPUBLIC OF THE MARSHALL ISLANDS

The planning and reporting requirement for RMI's SOE is in the OEPPC Act 2003. "The Office of Environmental Planning and Policy Coordination (OEPPC) Act, 2003; stated in Title 35-Environment, section 405 in Chapter Four in the RMI revised code: Duties of the Environmental Policy and Planning Unit: (h). Prepare annual reports on the state of environment in the Republic". This requires an annual State of Environment report, which up until this point has proven impractical. A five-year SOE cycle is a reasonable proposal for an alternative.

PURPOSE OF THE STATE OF ENVIRONMENT REPORT

The aim of the SOE is to present a basis for effective environmental management planning. The report looks at the major drivers of change in the environment which emerge from global, regional and national factors. The SOE evaluates the main pressures and the ways they impact on the environment, national economies, and the lifestyles and well-being of citizens (Figure 1). The main focus is to analyse the state and trends of key environmental indicators in seven thematic areas.

FIGURE 1: Objectives of SOE reporting.

SOE reporting is an internationally accepted method of assessing the condition of the ecosystems and associated natural resources of a given area or jurisdiction. SOE reports bring together both quantitative and qualitative data from various local, regional, national and international sources. The data is compiled and analysed to provide an holistic picture of the current state of the environment, and trends and patterns in relation to the natural world and human activity.

The most important aspects of the environment are given priority along with emerging issues. SOEs typically include accounts of the flora and fauna species, habitats such as native forests, marine and soils, and vegetation cover. The reports also address key aspects of highly modified agricultural and built environments.

Many SOEs predict emerging issues and future scenarios. This is particularly important with the need to devise strategies to adapt to the impacts of climate change. Increasingly, SOE reports can provide well-researched information for planning in areas such as natural resource management, urban planning, and tourism and resource development.

AUDIENCES

The main audiences for the SOE are:

- RMI Government personnel, particularly in areas relating to the Environment, Planning and Infrastructure, Health and Education and Tourism.
- Individual citizens and community groups.
- Donor organisations.
- Non-government organisations.
- Researchers of SOE report themes.
- Research institutions and university personnel.
- International conventions including multilateral environmental agreements.

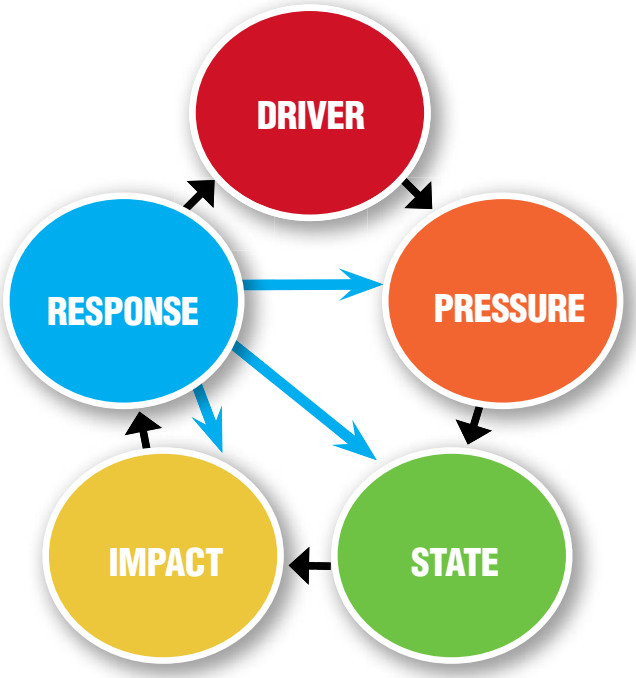


FIGURE 2. DPSIR model for SOE reporting.

COMPARING THE 1992 AND 2016 SOE REPORTS

The RMI 1992 State of Environment report highlighted several key issues, including:

Population growth – this grew over four percent per year.

- Urban shift – most people live in urban areas, leading to environmental challenges.
- Lack of data – there is no data in the 1992 SOE on native and endemic species.
- Need to develop Marine Resources – RMI is an ocean state and needed to develop fisheries management.

Many of the issues identified in 1992 remain, with new issues emerging. The collection of better data has helped to clarify some problems. Population growth rate average has slowed from 3.7 percent in 1999 to 2.8 percent per annum. Urban migration is still taking place with well over 70 percent living in urban areas. There is still a data gap, although a smaller data gap than in 1992, regarding biodiversity and endemic species. In the intervening 24 years, some marine resources have been extensively developed leading to increased foreign exchange and increased pressures on the marine environment.

Beyond an observation of similar problems, it is difficult to make quantitative comparisons between the two reports. In 1992, there was little data to determine baselines or trends. Much of the assessment was based on the opinions of experts, some of whom have contributed to this report. The 2016 SOE contains a summary of the actions required to protect the environment, and the best available data and information on each theme. The 2016 SOE provides a baseline and a foundation for assessments in the future.

Significant data gaps remain. The 2016 SOE sought the best data available to determine the state and trends. If important issues contain data gaps, the report looks for proxy data to provide a clue to the state. For example, for air quality, vehicle registration data was taken as a proxy for urban and rural air quality. A confidence level was developed, as proxy data for indicators typically have lower confidence for the assessment.

APPROACH TO THE 2016 SOE

THE DRIVERS, PRESSURE, STATE, IMPACT, RESPONSE (DPSIR) MODEL IN SOE REPORTING

The DPSIR model (Figure 2) is used in the SOE reporting as part of a systems approach. This takes into account the social, political, economic and technological factors, as well as forces associated with the natural world e.g. climate variability. The social and other factors may overlap. Climate change is an example, where a natural driver, climate, is linked to social drivers including economics, population growth and policy. Such drivers result in pressures which bring about changes in the natural environment (and social and environmental impacts). One good example is the water rationing on Majuro where water is available twice a week for four hours (Figure 3).

FIGURE 3. Weekly schedule for public or city water in Majuro (Photo: Paul Anderson, SPREP).

THEMES FOR THE 2016 SOE

Seven themes have been adopted for the 2016 SOE, as detailed below. Indicators were developed under each theme according to sub-topic. For example, the theme of the Marine Environment is in three parts – the Inshore Environment, the Offshore Environment and Marine Managed Areas.

Each sub-topic or area has indicators to assess the state of that area. For example, the Inshore Environment has four key indicators: Coral Cover, Marine Water Quality, Reef Fisheries and Fish Biomass and Density. All the indicators are rated for state (good, fair, poor), trend (deteriorating, stable, mixed or improving) and confidence in the data (low, medium, high). For more information, refer to 'A Guide to Interpreting State, Trend and Confidence Symbols'.

TABLE 1. Themes, sub-topics and indicators for the 2016 RMI SOE.

THEME	SUB-TOPIC	INDICATOR(S)
Atmosphere and Climate	Climate Adaptation	Water Security Adaptation Actions
		Food Security Adaptation Actions
		Health Adaptation Actions
		Climate Proofing Infrastructure and buildings
	ODS and GHGs	ODS consumption trends and reduction efforts to date
		GHG emission trends and mitigation efforts to date
	Physical Climate	Mean, Max and Min Temperature trends
		Mean, Max and Min Precipitation trends
		Sea Level Rise over time
		Cyclone frequency and intensity
		Flood and drought occurrence over time
Land	Forests	Area and types naturally vegetated areas and trends over time
	Agriculture	Percent of Land under cultivation or other agricultural use
	Wetlands	Wetland areas and trends over time
Marine	Offshore Environment	Tuna, Tuna-like species and sharks harvested
		Sharks
	Inshore Environment	Percent live coral cover
		Reef fish biomass
		Reef fisheries
		Lagoon water quality
	Protected Areas	Status of Inshore and offshore Marine Protected Areas
	Marine Mammals and Turtles	Turtle, Dolphins and Whales
Biodiversity	Endemic and Native Species	Status of endemic and native species
		Status of special species of concern Islands
	Invasive Species	Status of spread and control of invasive species
	Protected Area	Status of terrestrial protected areas
Culture and Heritage	Traditional Knowledge	Traditional spoken language
		Consumption and Production of Traditional Foods
	Traditional Sites	Historical and Mo sites status and protection
Built Environment	Water and Sanitation	Access and quality of drinking water
		Access and quality of sewage treatment
	Solid Waste	Collection, Recycling and Waste Separation
		Management and Collection of Hazardous waste
	Energy	Energy Consumption, Availability and Renewables
Nuclear Legacy		Loss of land/islets
		Soil productivity
		Nuclear waste storage
		Coral species presence and diversity

TABLE 2. Lead government ministries and agencies for the thematic areas.

NO	THEMATIC CONTENT	THEMATIC LEAD
1	Atmosphere and Climate	Office of the Environmental Planning and Policy Coordination (OEPPC) and Environmental Protection Authority (EPA)
2	Land	Ministry of Resources and Development (MRD)
3	Marine (Inshore and offshore)	Marshall Islands Marine Resources Authority (MIMRA)
4	Biodiversity	Office of the Environmental Planning and Policy Coordination (OEPPC) and Environmental Protection Authority (EPA)
5	Culture and Heritage	Ministry of Internal Affairs
6	Built Environment	Ministry of Resources and Development (MRD) Ministry of Public Works (MOPW) Marshalls Energy Company (MEC) Majuro Water and Sewer Company (MWSC) Majuro Atoll Waste Company (MAWC)
7	Nuclear Legacy	Ministry of Foreign Affairs The 4 Atolls local governments

A READER'S GUIDE TO THE 2016 STATE OF ENVIRONMENT REPORT

HOW TO READ THE REPORT

An SOE report can be read as a whole, or, by themes, which are linked.

Symbols have been designed for each indicator, to allow for a summary of the state, trend and confidence in the assessment. Symbols were also designed for groups of indicators that described a sub-topic or area within a theme. For example, the theme of Land is broken into Naturally Vegetated Areas and Agriculture. Symbols were not designed for each theme because the variety of states limits a meaningful statement.

A GUIDE TO THE SYMBOLS USED

An SOE considers many data sources, expert opinion and other information. Despite more data since 1992, there is not enough information to make quantitative assessments (e.g. an index of 1–10, or a threshold) to compare themes. Therefore a "good, fair, poor" colour index was developed to account for expert opinion and data.

The assessment symbols (Figure 4) provide a quick summary, based on the data available and expert opinion for each indicator. This helps to 1) provide a synopsis, and 2) establish a baseline for future assessments. The symbol includes a "state" rating, "trend" rating and "confidence" rating. Table 3 interprets the symbols and shows how they were derived.

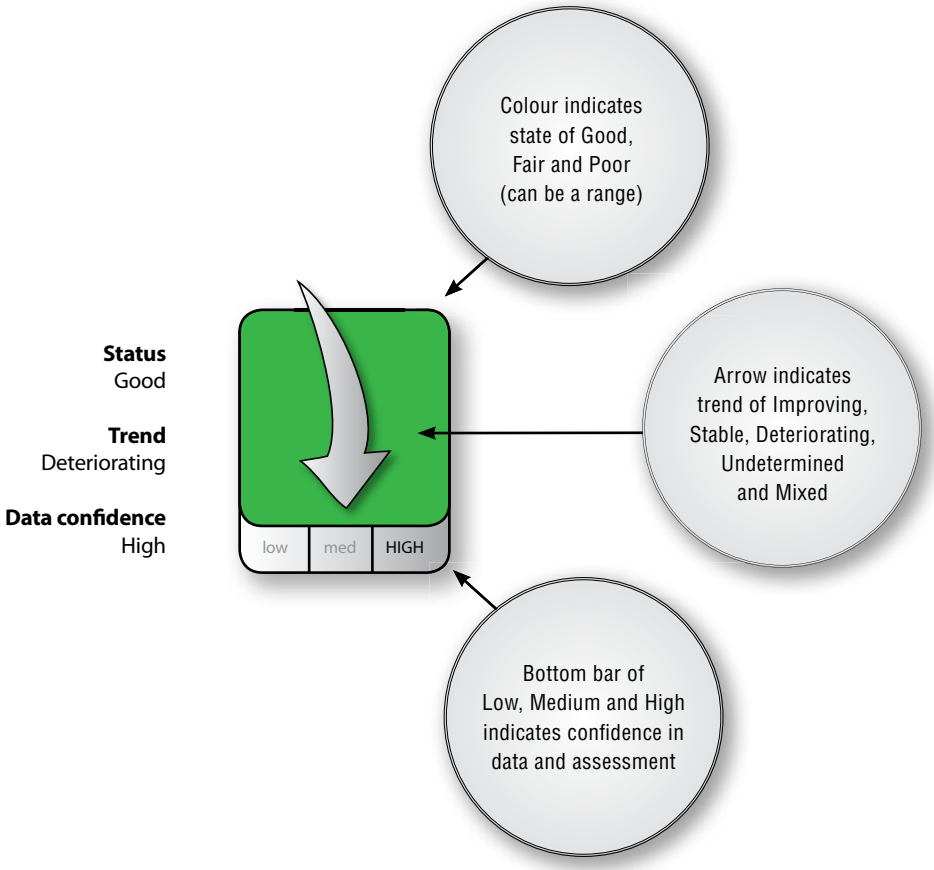
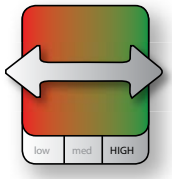
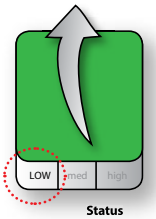


FIGURE 4. Breakdown of the Indicator symbol.

TABLE 3. A guide to interpreting the symbols

	CATEGORY	DESCRIPTION	HOW IS IT DERIVED?	EXAMPLE
STATE (CAN BE A RANGE)	**GOOD** **FAIR** **POOR**	The level to which the indicator meets or exceeds (good), is close to meeting (fair) or is well below (poor) a given standard for healthy ecosystems, habitats, species, airsheds, watersheds or an urban environment.	Assessment is based on : • recent trends; • comparison with similar jurisdictions; and • comparison with "healthy" habitats and systems. Where little data exists to make an assessment based on these criteria, expert opinion is used.	
TREND	**IMPROVING**	The state of the environment related to this indicator is getting better.	Trends show a significant increase or based on weight of evidence indicators are improving.	
	DETERIORATING	The state of the environment related to this indicator is getting worse.	Trends show a significant deterioration, or based on weight of evidence that indicators are worsening.	
	STABLE	The state of the environment related to this indicator shows there is no detectable change.	Trends show no significant increase or decrease or, based on weight of evidence indicators are stable.	
	MIXED	The indicator shows that there is a mixed trend, some worse, some better and some stable.	Used primarily for sub-topics with multiple indicators, or in cases where data shows two distinct trends.	
	UNDETERMINED	Not enough data exists to determine trend.	Not enough data exists to determine trend.	
CONFIDENCE	**HIGH**	Data is of high quality and provides good spatial and temporal representation.	Data is of high quality and provides good spatial and temporal representation.	
	MEDIUM	Data is either lower quality, geographically sparse or limited temporally.	Data is either lower quality, geographically sparse or limited temporally.	
	LOW	Data does not meet any of the above criteria.	Data does not meet any of the above criteria.	**Status** Good **Trend** Improving **Data confidence** Low

DRIVERS AND PRESSURES ON THE MARSHALL ISLANDS' ENVIRONMENT

WHAT ARE THE DRIVERS OF ENVIRONMENTAL CHANGE IN THE REPUBLIC OF THE MARSHALL ISLANDS?

Across the Pacific Islands, human activities such as overfishing and urban development are placing pressure on the natural environment. These activities are driven by broader social, economic, technological and cultural forces. The drivers interact and produce changes in the environment that impact on peoples' lives and well-being. For the 2016 SOE, five drivers have been identified:

1. Population and migration
2. Globalisation and geography
3. Economic and technological development
4. Traditional and contemporary values, attitudes, lifestyles and governance
5. Climate change and variability

TABLE 4. Environmental Drivers and key indicators used in the SOE.

Population Demographics and Migration	Globalisation and Geography	Economic and Technological Development	Traditional and Contemporary Values, Attitudes, Lifestyles and Governance	Climate Change and Variability
Regional and National Population changes	Shipping patterns and connectivity	Access to internet and cell phones	Land tenure system	Global CO_2 emissions
Migration trends	Importation of consumer products	Global and national economic sector trends.	Trends in access to foreign and national education	Global average air temperatures and sea surface temperature
Household Composition	Multilateral Environmental Agreements	GDP per capita and income distribution across the Pacific and RMI	Trends in traditional cooking	Local trends in sea surface temperature and precipitation

Drivers can have diverse impacts on society, the environment and economy – they are not exclusively negative or positive.

DRIVER 1: POPULATION (MIGRATION AND DEMOGRAPHICS)

Population growth is a major driver in changes to the environment, putting pressure on both the built and natural environment. Figure 5 shows the current and expected populations for the Pacific region from 1970 to 2050. Polynesia and Micronesia have higher forecast growth rates compared to RMI, particularly when current birth rates are taken into account.

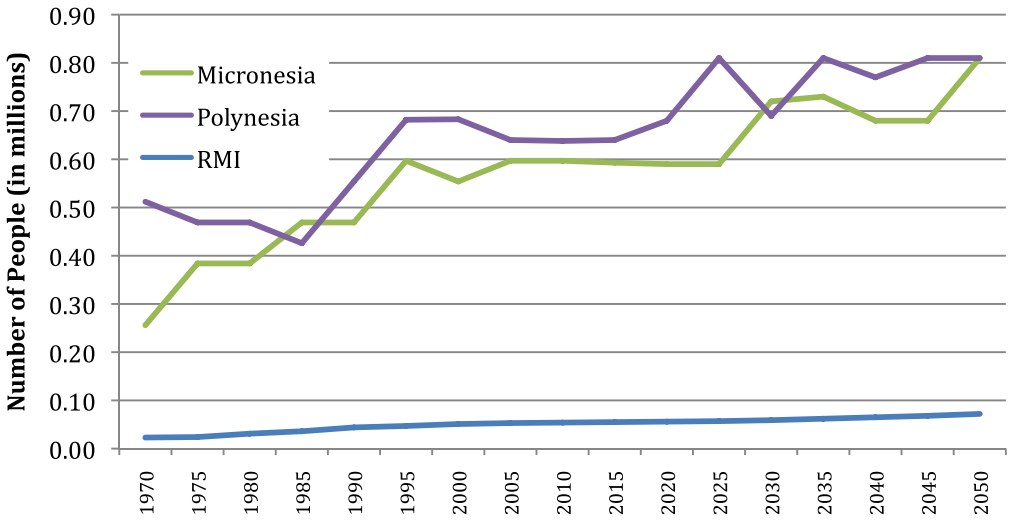


FIGURE 5. Pacific Islands Past, Current and Projected Populations. (Adapted from the Pacific Environment and Climate Change Outlook – PECCO, 2012).

The Marshall Islands was one of the fastest growing island nations with an annual growth rate of 4.2 percent from 1980 to 1988. This slowed to 0.4 percent in the last decade. Between 1999 and 2011, only 2318 people were added to the total population (Figure 6).

Like Palau and the Federated States of Micronesia (FSM), RMI has a free association with the United States, whereby Marshallese citizens can freely migrate between the two countries. Much of the population loss is related to emigration to the mainland US and Hawaii. Based on the 2011 census and 1999 projections, it is estimated that over 11,000 Marshallese have migrated.

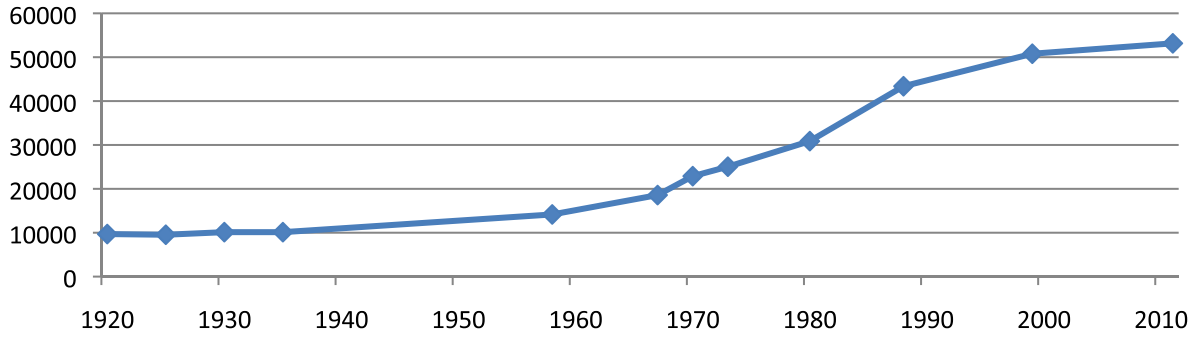


FIGURE 6. Marshall Islands total population 1920–2011 (Marshall Islands Census).

Another factor in declining population is the trend to smaller family sizes, which is a global phenomenon. Internal migration from rural areas to the urban centres has continued. In 2011 Majuro had 27,797 people or a 52 percent share of the total population (Figure 7 and 8). In 1988 Majuro had 19,696 people, or 45 percent of the total population.

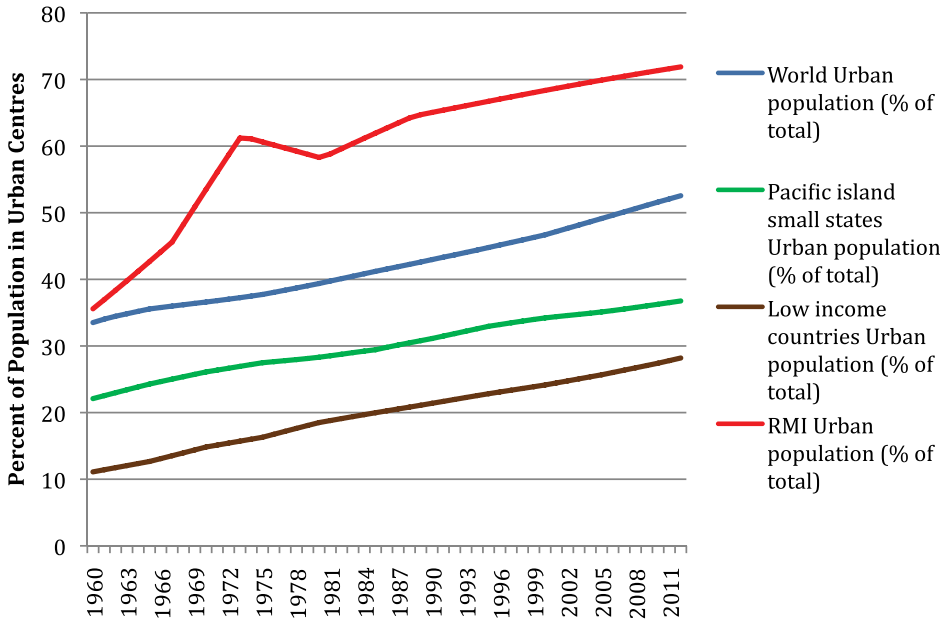


FIGURE 7. Percentage of world and RMI population living in the urban centres (World Bank).

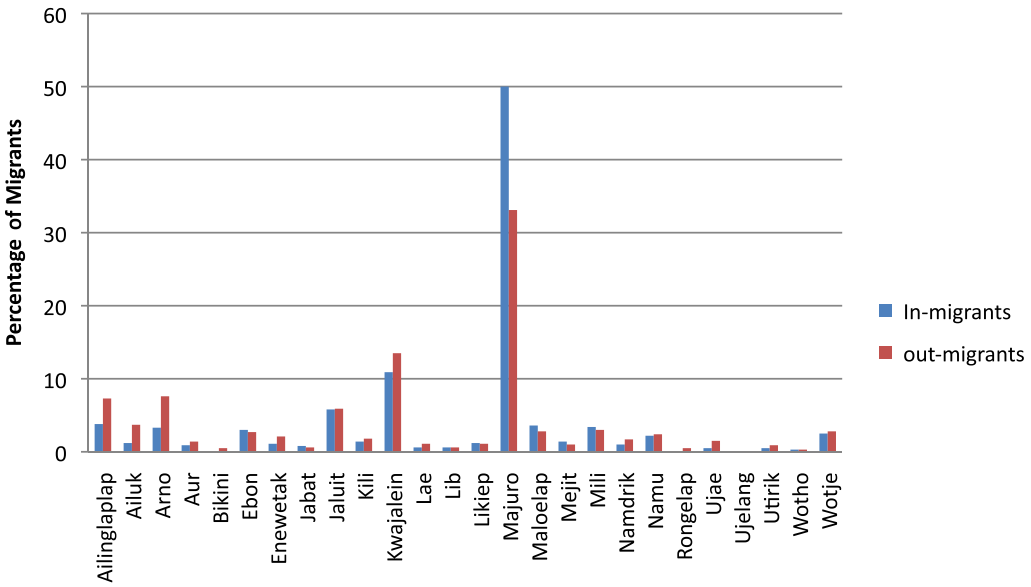


FIGURE 8. Internal migration within RMI for each atoll and island from 2006 to 2011(Census 2011, EPPSO).

The drivers of declining population growth rate, emigration and smaller family sizes, have mixed impacts on the society, economy and the environment of RMI. For example, one consequence has been the reduction in the base of the age pyramid. This may have long lasting effects (Figure 9 and 10). RMI's Exclusive Economic Zone (EEZ) is shown in Figure 11.

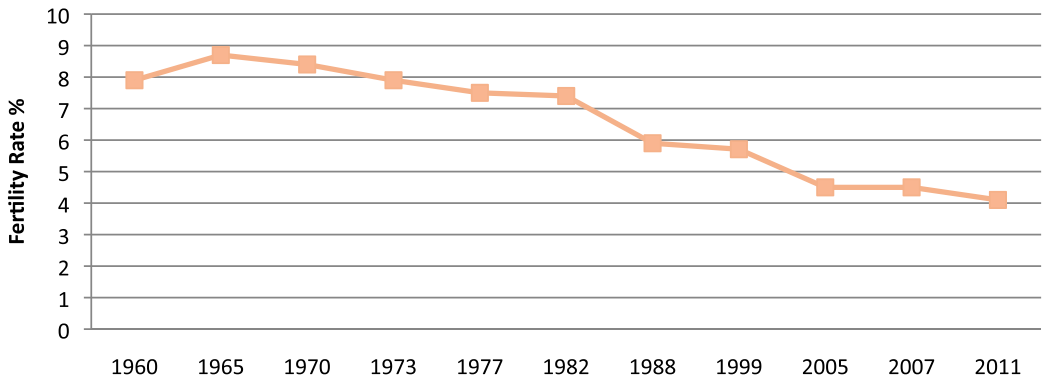


FIGURE 9. Figure 9: Trend in Fertility rate (Marshall Islands Statistics Office).

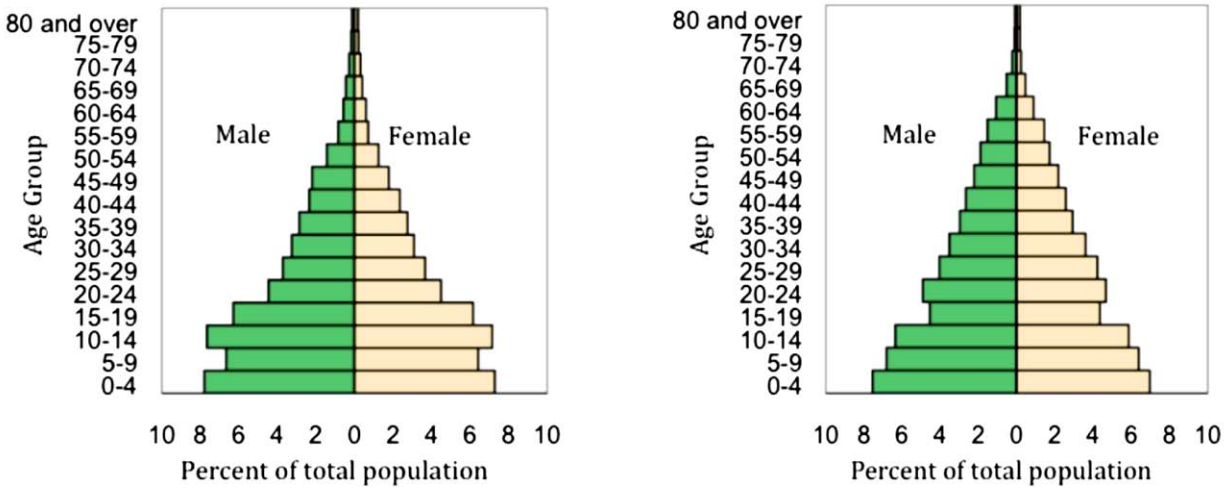


FIGURE 10. Changes in the RMI age sex pyramid between 1999 and 2011 (SPC).

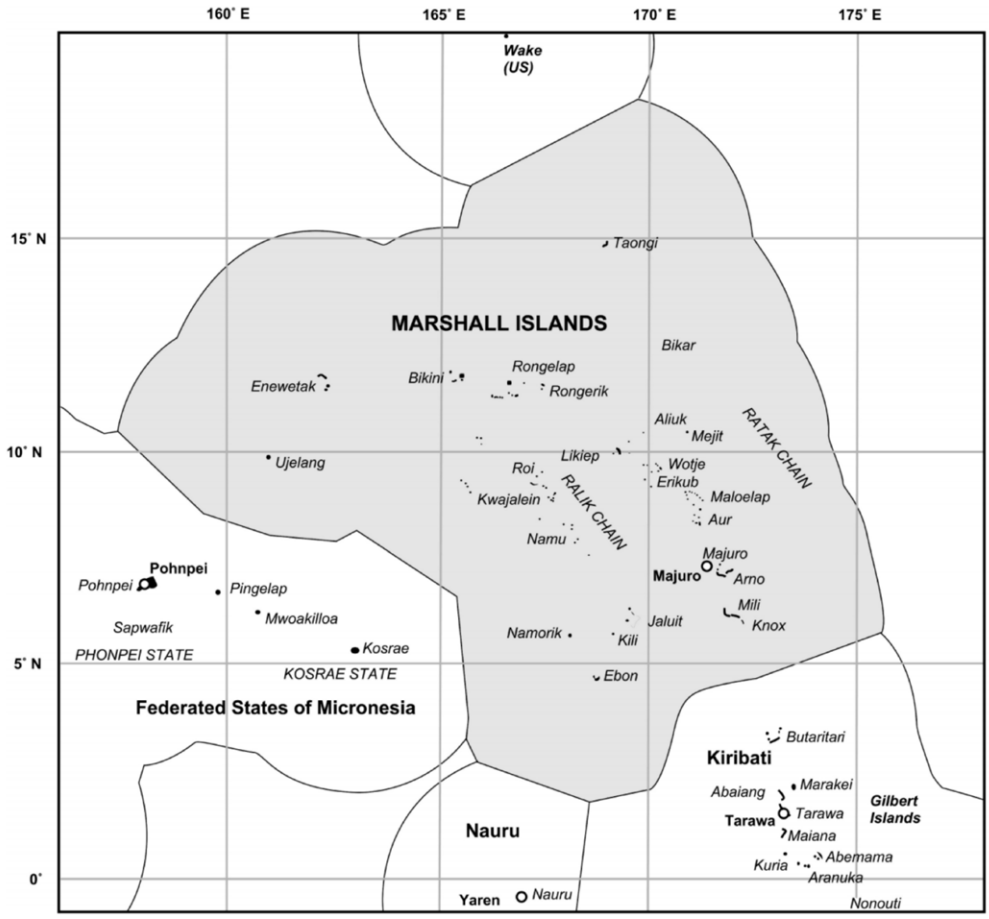


FIGURE 11. Map of RMI EEZ (SPC).

Small island countries have physical limits on growth and infrastructure which can create serious pressures on the environment, for example, waste management and food security. Isolation from other countries means a reduced capacity for cheaper goods and access to markets. Figure 12 shows the shipping links for RMI, the least connected compared to other countries and the Pacific Islands from 2004 to 2012. This index is based on 100 and captures how well countries are connected to global shipping networks.

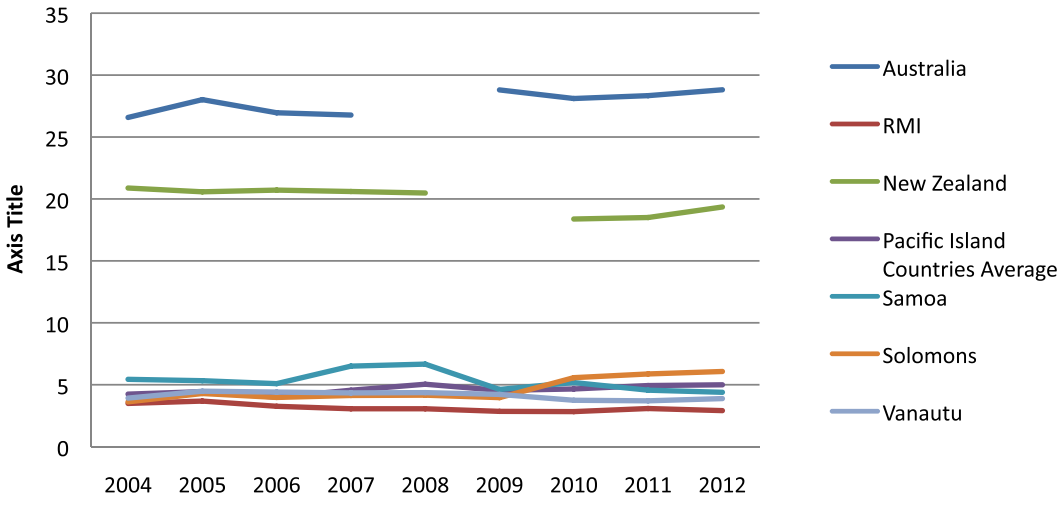


FIGURE 12. Shipping Liner Connectivity for RMI and selected Oceania Countries (World Bank, 2013).

Tourist arrivals in the RMI increased from about 3,000 in the late 1980's to just over 9000 in 2005, and have declined since. The decline in tourism (Figure 13) has led to a less diverse economy, and a reduced impact from tourism on the environment. However, this is offset by increased local demand for imported technology, food and consumer items.

Due to geographic isolation, it is very costly for tourists to visit. Tourist accommodation and infrastructure is limited to about 300 visitors at one time. The average number of visitors per year is about 5000. The current state of tourism causes relative pressure on the environment. As tourism grows, the long term impact needs to be monitored.

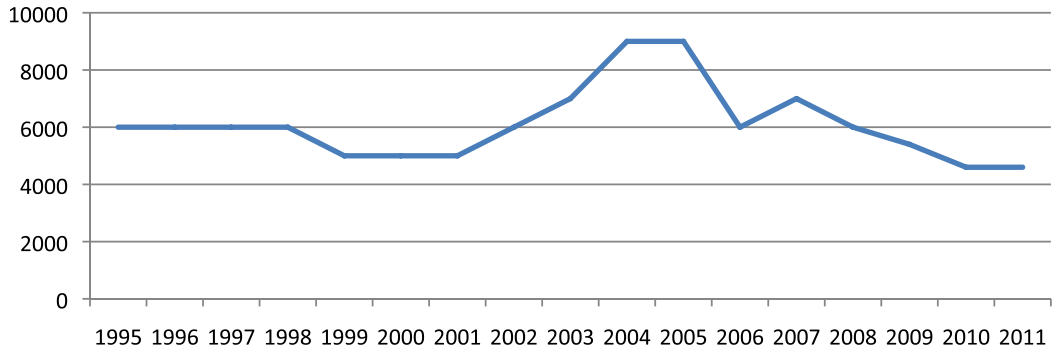


FIGURE 13. Visitor Arrivals to Marshall Islands (1989–2005). Note – no data for 1990 (Marshall Islands Visitors Authority).

DRIVER 3: ECONOMIC AND TECHNOLOGICAL DEVELOPMENT

A demographic driver behind environmental change in RMI is the increase in household income and access to goods. Figure 14 shows GDP per capita for the world, middle income countries and RMI since 1960. In real dollars, GDP has risen worldwide, and although driven by the wealthiest countries overall, low and middle income countries have also increased substantially.

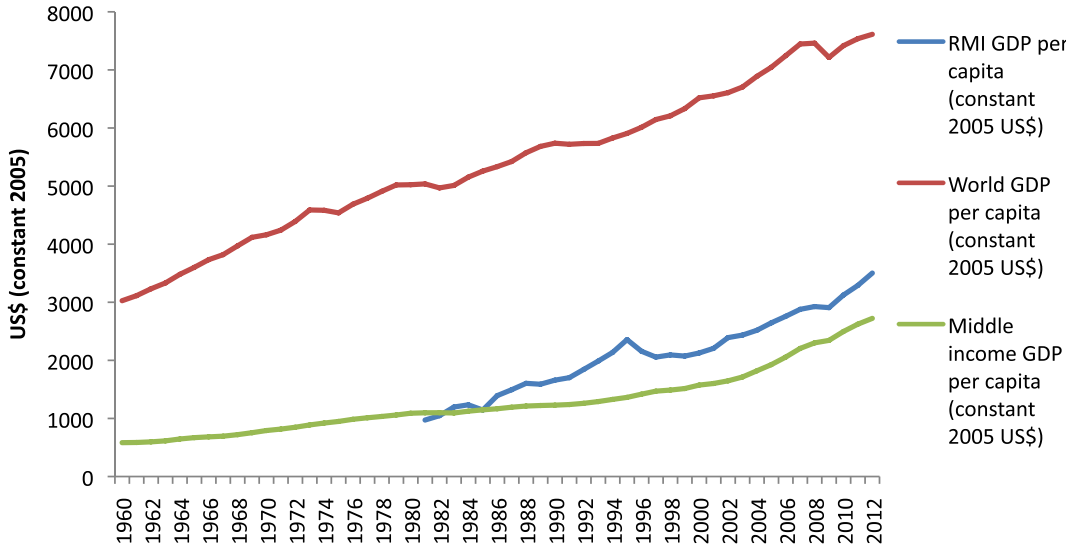


FIGURE 14. RMI, World and Middle Income GDP per capita changes since 1960 (World Bank, 2013).

More access to education and health services allows for a better standard of living, but it can create pressures on the environment by increasing waste and energy demands. Increased income also results in more access to global commodities, often bringing in other outside influences. These are discussed later.

RMI has a low annual GDP rate of increase, averaging less than one percent per year since independence. Foreign aid and the sale of offshore fishing rights are the main source of foreign exchange. The domestic economy is highly dependent on imports, as exports play a minor role in the economy. The dominant role of foreign aid in the economy, as well as low productivity in the public sector, has resulted in low economic growth. As government expenditure cannot grow indefinitely, dependence on government expenditure puts a ceiling on economic growth potential (ADB, 2010).

The main sources of foreign exchange for RMI are the Compact funds which make up about 60 percent of the annual budget. This is a legacy of the US-RMI relationship. Compact annual grants have reduced from a high of $35.2 million to current annual distribution of $32.1 million (as of 2016) and will end with the distribution of $27.7 million in the year 2023. Figure 15 shows the percentage of contribution to the GDP by sector.

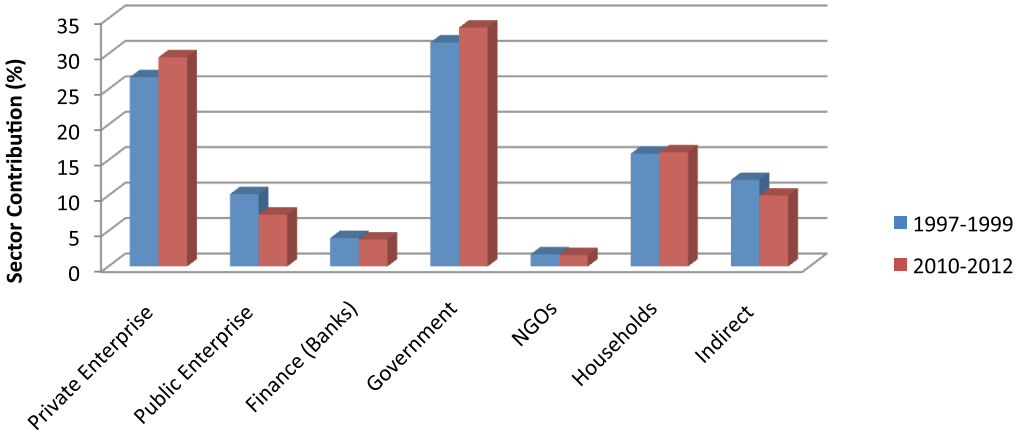


FIGURE 15. Percent of contribution to the GDP by sector in the RMI (World Bank).

The other main economic driver is the sale of fishing rights which represents fourteen percent of the RMI economy. RMI is in the middle class of Pacific island countries, with the average employed person making $6,500.00 U.S dollars per year. Other countries in this income bracket are FSM, Samoa, Tonga and Vanuatu (Figure 16).

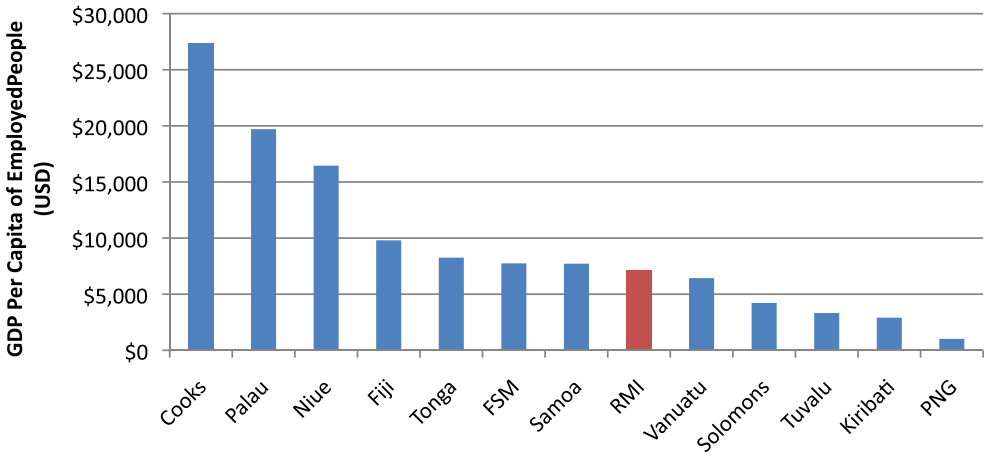


FIGURE 16. Per Capita GDP by number of employed people (NMDI, SPC 2015).

Between 1999 and 2012, GDP per capita has increased by about USD$1,000. GPD per capita is a rough measure for prosperity: higher GDP allows for higher savings, better housing and higher annual imports and consumption of goods and services. Figure 17 shows the trend of imports of goods and services from 1971 to 2014. Higher consumption has potential impacts on the environment including more power usage, higher vehicle ownership and greater demand for imported foreign goods. For example, between 1999 and 2012, households with TV sets increased by 40 percent.

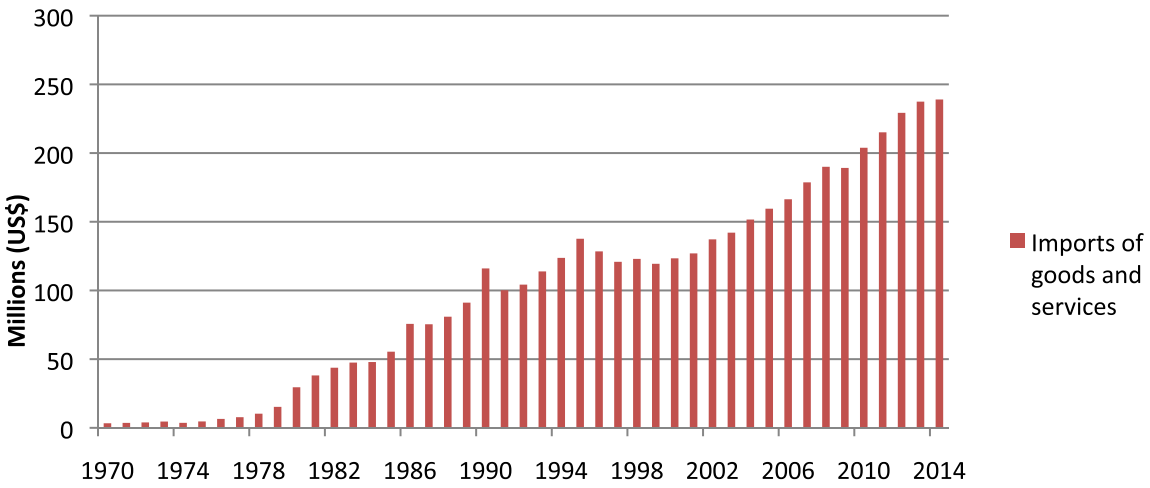


FIGURE 17. Annual imports of goods and services for RMI from 1970 to 2014 (UNdata.org).

Economic growth and a declining private sector have mixed impacts on the environment and society. As economic drivers have shifted from resource-based to services and trade, this has increased the urban economy, where most services are based. The decline in the resource-based economy, has led to an underperforming rural economy. This translates to key differences between the urban centres (Majuro and Ebeye) and the outer islands.

Technological development can have positive and negative impacts on the environment. For example, improved technology can lead to larger fishing grounds with the adoption of power boats over canoes.

It can bring about more environmentally sensitive and efficient extraction, shipping and processing methods. Technology also influences society, bringing access to a global culture. Electronic waste or e-waste can increase the burden of an already challenging waste management situation. Figure 18 shows one example of technological change – the adoption of internet cellular services. The use of cellular phones has increased every year in RMI since 1993.

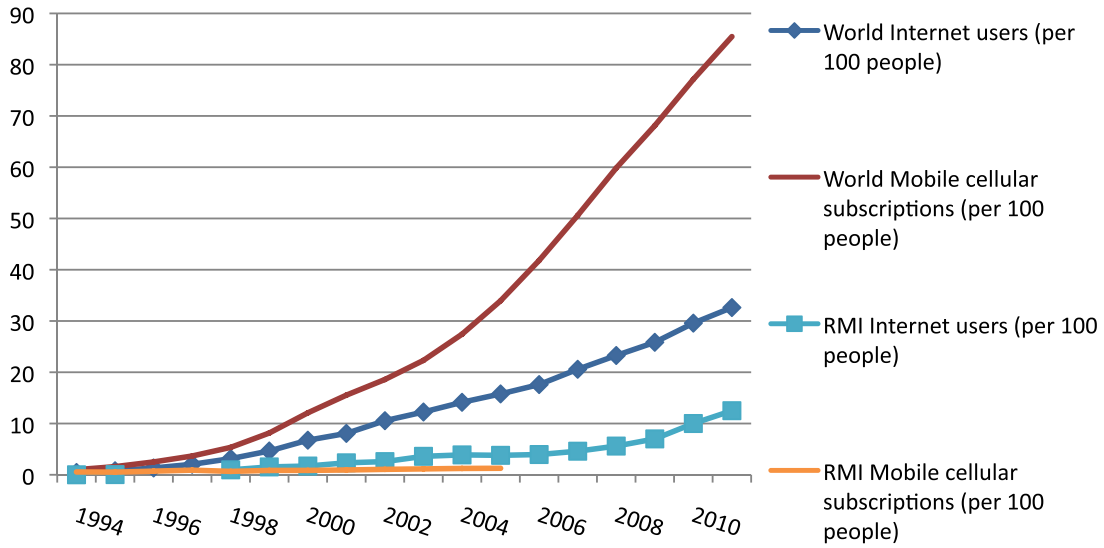


FIGURE 18. Internet users and Cellular Subscriptions per 100 inhabitants 1994 to 2012 (World Bank, 2013).

DRIVER 4: TRADITIONAL AND CONTEMPORARY VALUES, ATTITUDES AND LIFESTYLES

Another driver of environmental change is lifestyle, behaviour and values. Cultural change is strongly linked to other drivers, such as globalisation and income, where more costly items are now within reach. This changes traditional values and behaviours. One indicator of a cultural driver is the reliance on imports. Across the Pacific, including RMI, reliance on imports has increased. More details are covered in the Cultural and Heritage section, Figure 119 and 120.

The cultural change over the past 100 years is evidenced by Marshallese food sources. In the early 1900s, the Marshallese depended on local sources for most of their carbohydrates (taro, breadfruit, banana, pandanus and arrow roots). However, a recent study suggests that the balance has changed to food imports (Figure 19).

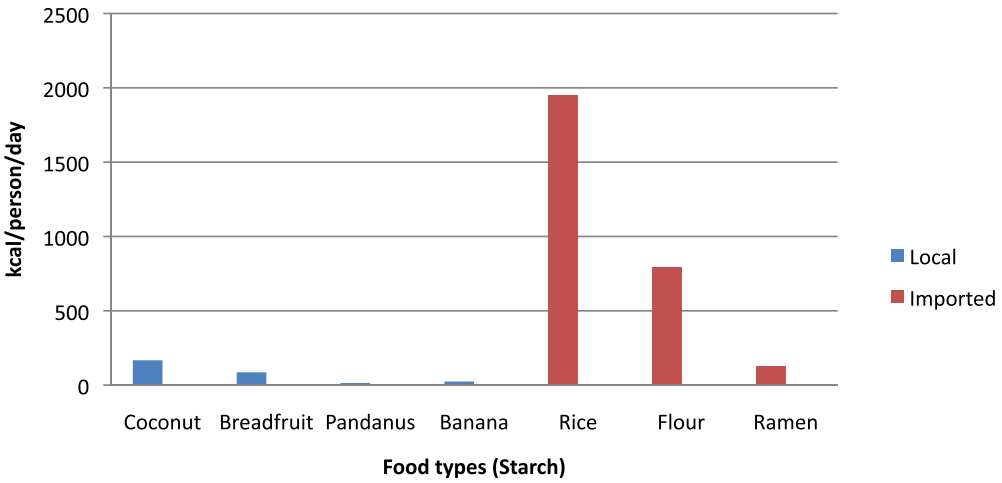


FIGURE 19. Source of local and imported carbohydrates (SPC, 2013).

DRIVER 5: CLIMATE CHANGE

Climate change refers to a change of climate, attributed directly or indirectly to human activity that alters the global atmosphere and is in addition to natural climate variability observed over comparable time periods (UNFCCC). It is now widely recognised that climate change is occurring globally as a result of human activity, in particular from the burning of fossil fuels. Figure 20 shows the latest mean global CO_2 concentrations since 1980.

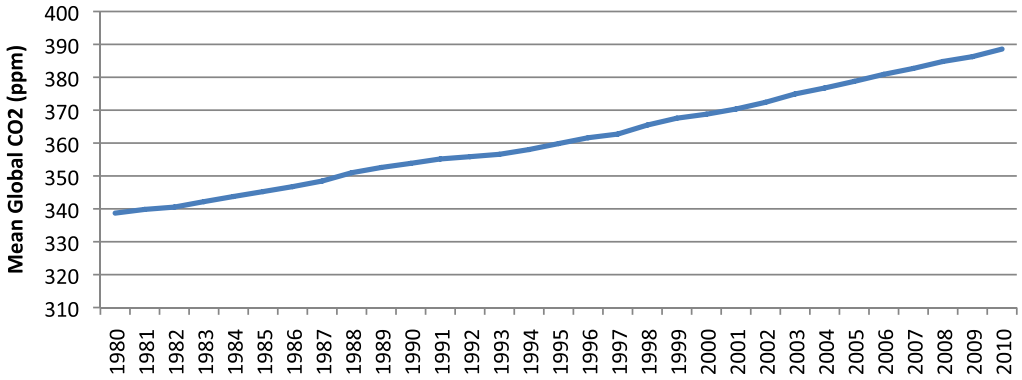


FIGURE 20. CO_2 emissions worldwide. (UNEP Live, 2013).

Climate variability refers to variations in the mean state and other climate statistics such as standard deviations, and the occurrence of extreme weather events. The effects of these variations may be experienced well beyond the timing and scale of the initial weather event. Variability may result from natural internal processes within the climate system (internal variability) or from variations in natural or anthropogenic external forces (external variability). Figure 21 shows the steady increase of average global temperatures over the decades.

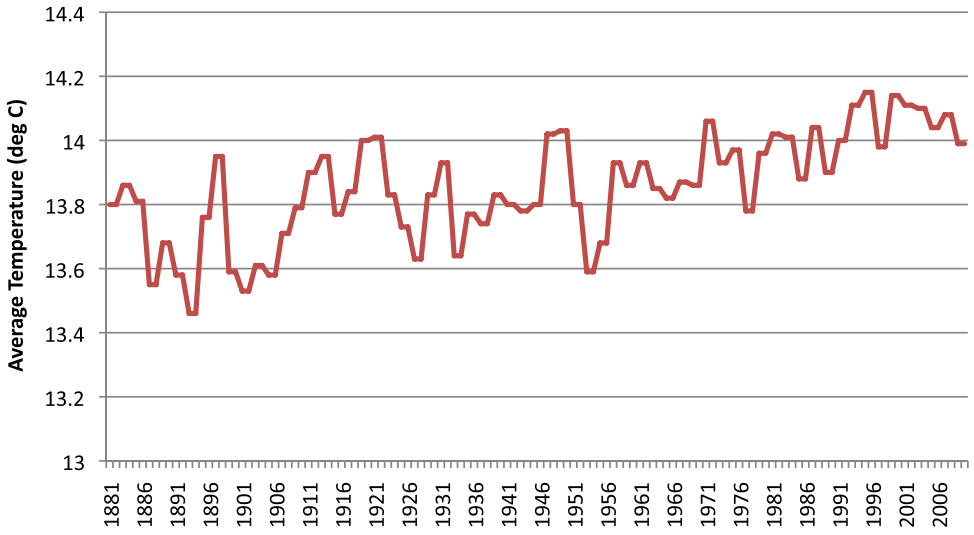


FIGURE 21. Average Global Temperatures 1881–2006 (UNEP Live, 2013).

The effects of climate change and climate variability are being felt in RMI and elsewhere, as a key driver of environmental change. Geographic location, topography and other factors influence the rate and intensity of changes in climatic conditions. Therefore the level of vulnerability can vary. The recent state of emergency declared in April 2016, due to the drought, is related to this variability. RMI is extremely reliant on consistent rainfall for its water supply, given there are few freshwater reservoirs or sources of groundwater. A strong El Niño climate event can fuel drought, and this can be worsened by changes in the climatic pattern.

WHAT ENVIRONMENTAL PRESSURES ARE THE DRIVERS CREATING?

Pressure indicators present data for the main human activities that affect the environment in the RMI. They are linked to one or more drivers (e.g. climate variability and change, population growth, management and demographics, or social, technological and economic systems). The following section highlights several key pressures on the environment and society, created by the overarching driver themes. Some are covered in in the "State" section.

For this report, pressure indicators are in three parts – land development, resource extraction and consumption. Each is linked to one or more drivers identified above.

TABLE 5. Key Pressures on the environment in RMI.

PRESSURES (KEY INDICATORS)		
Land Development	Resource Extraction	Consumption and Waste
Formal Urban Development	Agro-Forestry	Energy consumption
Informal Urban Development	Fishing	Vehicle ownership
Agricultural Contraction		Solid and Liquid Waste Generation
Invasive Species		Water consumption
		Military legacy

Land Development

Urban Development: Increase urban development in Majuro and Ebeye urban centers

Urban development puts pressures on the environment by increasing the removal and fragmentation of sensitive habitats. Also, more development increases waste discharge, in particular, sewage and solid waste. A complicating factor is that there are no building codes, resulting in poorly designed waste and sanitation infrastructure. Sanitation systems are not sufficient to handle the growing population of the urban areas. Over time, expanding the urban areas, without expanding sanitation systems, will lead to overload. Moreover, the existing sewage outfall infrastructure in Majuro is broken, with raw effluent discharging in the shallows on the reef flat, leading to localized eutrophication, poor water quality with very high bacterial levels, and a dominance of macroalgae for several kilometers in both directions away from the outfall.

Urban development is one of the biggest pressures on the environment in RMI and it is increasing. Figure 22 shows an increase in households from 1,824 in 1930 to 9,217 in 2011.

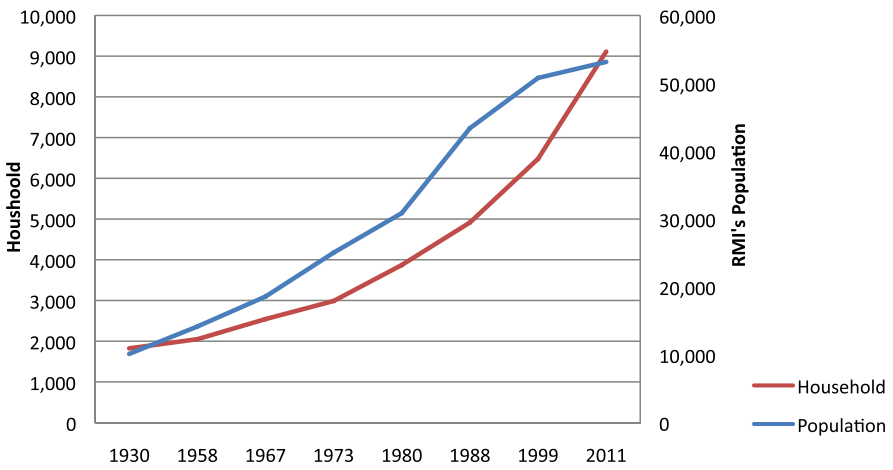


FIGURE 22. RMI's population and households from 1930 to 2011 (RMI Census 1930–2011).

As the population grows, and the economic divide between urban and rural economies widens, the appeal of jobs and a better standard of living drives more people to urban settlements. Many settlements have limited access to sanitation and water. There is also a pattern of residents of urban settlements moving to the outskirts of the town areas, due to overcrowding of the town areas and for lifestyle choice. In Majuro, the sanitation system extends as far as the airport to Rita – the other half of the island does not have a sewage system.

In general, these urban settlements put tremendous pressure on the urban environment, particularly in regard to habitat destruction, waste pollution and burning, and water quality. Figure 23 shows an example of pressure on the urban environment caused by reef aggregate mining on the oceanside reef-flats areas for construction materials.

FIGURE 23. Reef Mining in Majuro. Photo: MSNBC.

Agricultural Development

Agriculture was traditionally a key component of RMI's economy, mainly permanent crops and plantations. Nearly all households were once involved in agriculture. The general lack of data in agriculture reflects the low priority of the sector. Figure 24 shows that of 9217 households less than half are engaged in agriculture, well down from previous years. In addition, the abandonment of historic farmland can led to the spread of invasive species, placing more pressure on the environment and reducing biodiversity.

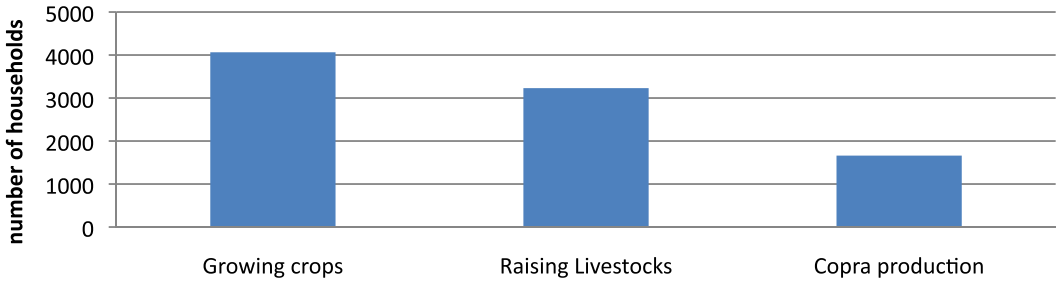


FIGURE 24. Number of households engaged in agricultural production (RMI census, 2011).

Invasive Species

Increased contact with the world brings more invasive species to RMI. However, the primary pathway for spread is infrastructure, related to development such as roads, urban expansion and agriculture. Invasive species compete with indigenous species and habitats with little or no natural predation.

Many of the invasive species arrived over the past century and efforts are underway to prevent their spread. For example, the Mangrove Monitor lizard (Figure 25) was introduced to the RMI as a pet during the Japanese era of colonization and is known to prey on birds and their eggs. However, the data is insufficient to fully document the impacts of monitor lizards on RMI's land environment. Invasive species are also costly to eradicate, control and monitor. Most invasive species are plants (Figure 26).

FIGURE 25: Mangrove Monitor Lizard, *Varanus indicus* (Photo: Peter Bonser).

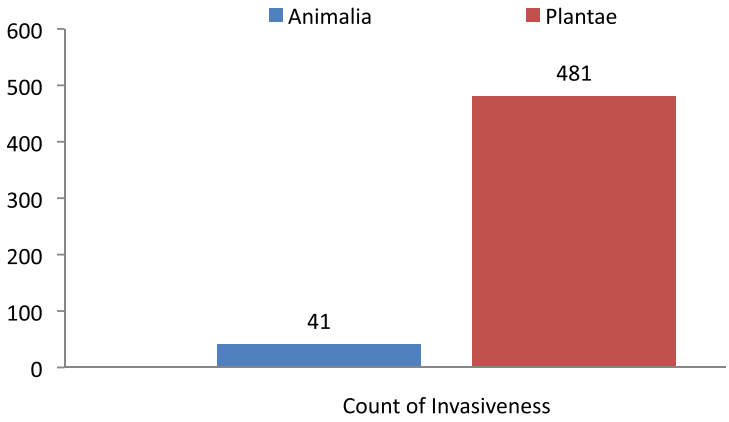


FIGURE 26. Presence of key invasive species in RMI (OEPPC: Clearing House Mechanism web-page).

Resource Extraction

Fishing

Local and industrial fishing creates increasing pressure on the biodiversity and habitats of the marine environment, particularly if harvest levels are unsustainable or unregulated. Figure 27 shows estimates of total fish harvesting in RMI. Industrial harvesting of pelagic fish, primarily tuna and other open ocean species, increased substantially in the early 2000s, and has yet to stabilize. Local fisheries have increased their catch. Local fisheries have seen an increase in catch rates over the last century due to improved transport to major local markets, including Majuro and Kwajalein.

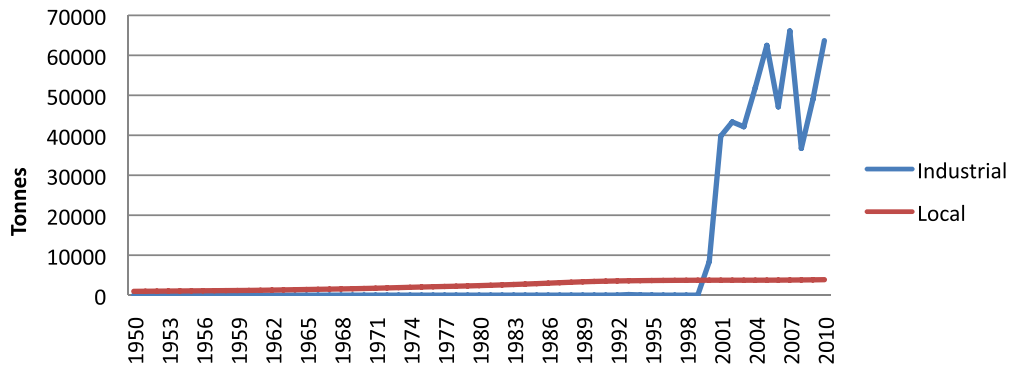


FIGURE 27. Reconstructed historical catch data for RMI (FAO databank, 2015).

In RMI, industrial fishing has increased from very little to over 40,000 tons per year. In 2011 RMI banned the taking of sharks because of the dramatic decrease in their numbers. Regionally, bigeye and Pacific Bluefin tuna are overharvested, while the rates for other tuna species are classified as fully developed, verging on over-developed. The dramatic spike of industrial fisheries applies significant pressure to RMI's marine environment. Given the economic importance of this natural resource, careful management of pelagic fisheries is essential. Another impact from this fishing effort is physical damage to the marine ecosystem, for example, the recent grounding of a purse seiner in Majuro (Figure 28). A total of 26,450 sq.ft. of coral reef was damaged.

FIGURE 28. Recent grounding of purse seiner Fong Seong 666 on oceanside reef of Majuro's northern islets. (Marshall Islands Journal, 2016).

There is far less monitoring and enforcement of subsistence and artisanal fishing which makes up most of the domestic fish harvest. The invertebrate harvest of marine species constitutes a significant supply for the local diet. However, the inshore fisheries is generally in good condition, with the exception of Kwajalein where historical and current pollution is affecting the fishery (USAPHC, 2014). The historical data on tuna or industrial fishing has increased dramatically since the late 1990s (Figure 28). For a more detailed discussion of fishing in RMI, refer to the Marine chapter.

Consumption and Waste

As household incomes have grown, access to overseas goods has increased. Figure 29 shows the increase in household appliances and TVs in Marshallese households from 1989 to 1999. This has created a growing waste stream and higher home electricity usage. The stable numbers of TVs and refrigerators is partially explained by the urban-rural population split (RMI Census report 1989, 1999 and 2011). The other reason is internal migration from the outer islands to the urban centres. In most cases, families migrate to the urban centres to look after properties belonging to the extended families who have relocated to the US. This often results in no employment.

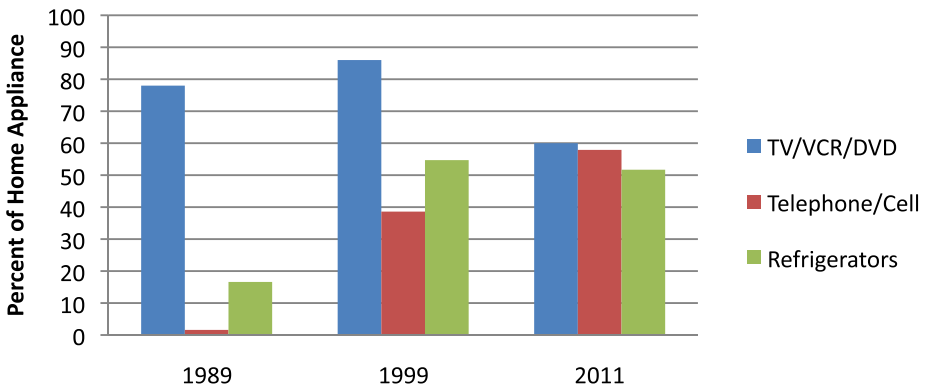


FIGURE 29. Percentage of Households with electric appliances (RMI Census).

After reaching a high point in 2005, electricity consumption has declined by about 20 percent due to more efficient appliances, particularly air conditioning units. Most of the energy produced in RMI comes from diesel power generators, with less than one percent coming from solar power. Reducing electricity consumption (Figure 30) eases pressure on the environment by decreasing air pollution and the waste stream created by diesel power generation.

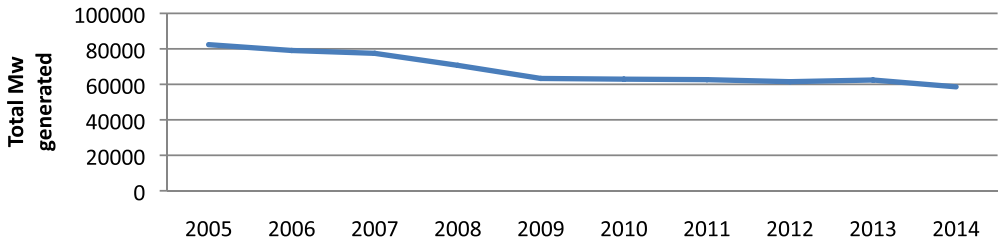


FIGURE 30. Annual Electrical Consumption (Mw) from 2005 to 2014 (MEC).

Solar electricity production has started with three roof top grid-connected solar systems (Figure 31). Over the past 20 years, over 1800 home solar systems have been installed. However, due to the harsh physical environment and the challenges of maintenance, these systems have created a new waste stream of used lead-acid batteries.

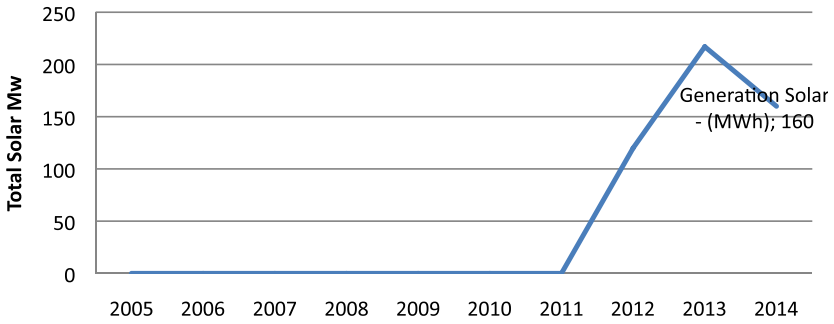


FIGURE 31. Annual Solar consumption (Mw) staring from 2012 to 2014 (Ministry of Resources and Development and Marshalls Energy Company).

Vehicle Ownership

Vehicle ownership has a direct impact on air quality and waste generation through vehicle emissions and the disposal of old cars and tires. There are indirect impacts from roads, which expand impervious surfaces, leading to more flooding, fragmentation of habitats and the spread of invasive species. Figure 32 shows the number of vehicles registered in 1987, 1999 and 2014, including personal use and heavy duty commercial vehicles, reaching the highest number of registered vehicles in 1999.

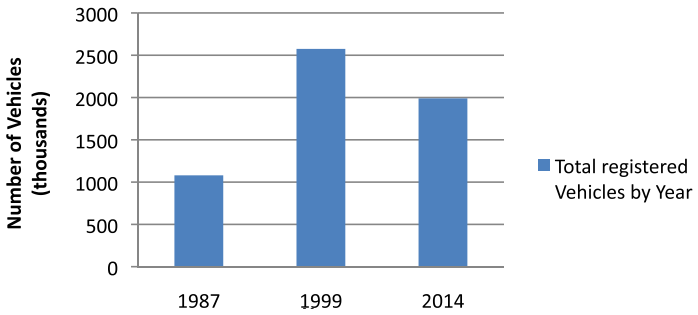


FIGURE 32. Vehicle registration in RMI: 1987, 1999 and 2014 (RMI Customs and EPPSO).

Waste Generation

Solid Waste

Little information exists on historical solid waste generation rates for RMI, until 2008. However, given the rising levels of household consumption and population growth over 30 years, it is probable that RMI has a bigger waste stream. Majuro's per capita waste production is approaching that of the developed countries such as Australia and the USA (Figure 33). When compared to other Pacific island nations, Majuro has the highest per capita waste generation at 0.9 kg/person/day (Figure 34). While the generation of waste on Majuro is growing, the percentage of waste disposed of properly, or recycled, remains much lower. The Environmental Protection Authority (EPA) and Majuro Atoll Waste Company (MAWC) have identified 668 unauthorized dumpsites on Majuro alone. The low recycling rate and unauthorized dumps make it harder for RMI to manage and dispose of waste effectively and to reduce the potential adverse air, marine and freshwater impacts from landfills, garbage burning, littering and disposal of hazardous waste.

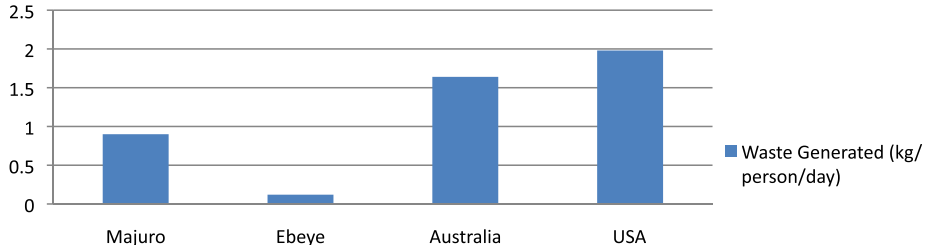


FIGURE 33. Solid Waste Generation and Recycling Estimates (Majuro, Ebeye – JICA, 2013: USA and Australia – World Bank, 2008).

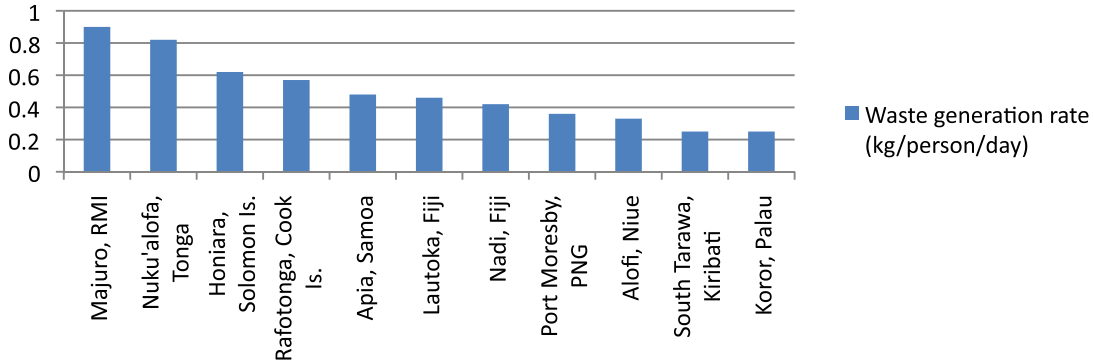


FIGURE 34. Majuro waste generation kg/person/day compared with other Pacific Islands Countries in the region (RMI National Waste Management Strategy and Action Plan 2014–2018).

Marine debris/plastics/oil

The polluting of our ocean and marine life is a growing concern in the Pacific islands region. Plastic and marine debris has a negative impact on marine life and general health of the ocean, and places more pressure on fisheries resources. This is mainly due to illegal dumping of solid and hazardous waste on the coastal areas and marine environment. Figure 35 shows areas in the RMI EEZ where there is reported illegal dumping of waste from local and foreign fishing vessels.

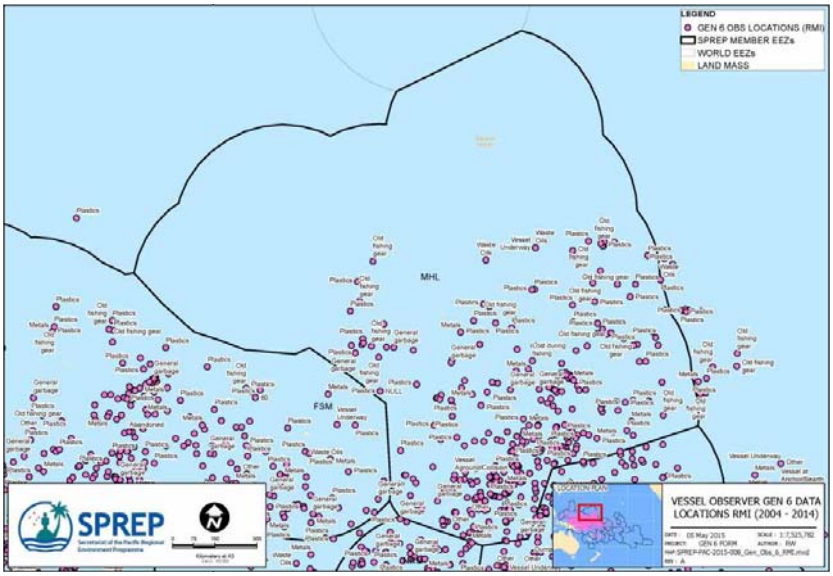


FIGURE 35. Map of RMI EEZ: areas with illegal disposal of waste overboard from fishing vessels (purse seiners) (SPC Observer data).

Water Consumption

Water supply

Fresh water is a very scarce resource in RMI. Piped household fresh water is rationed during non-drought times to four hours of access, three times per week. Notably, 24 hour a day reticulated salt water is available for toilet flushing. Water sources in Majuro are regularly tested for quality – about half the tests return unacceptable results, based on drinking water standards (Figure 36). On outer islands, household catchments are the main source of drinking water, usually water tanks. On recent site visits, EPA tests found that 40 to 90 percent of the tanks contained contaminated water, outside the bounds for safe drinking water (Figure 37). In addition, EPA tests 16 lagoon sites for pathogens to determine water quality (Figure 38). Pass rates for lagoon sites are regularly below half. The scarcity of fresh water, the high and increasing demand for fresh water, as well as the water quality issues, put an increasing pressure on both the population and the environment. Lagoon waters in heavily populated areas are increasingly eutrophic which can lead to macroalgae infestation, like those seen on Majuro recently (Figure 39). The macroalgae infestation on Majuro started since end of 2009 to 2010; is a direct result of broken sewage infrastructure from at least 2008. The other parts of the Marshall Islands such as Kabinmeto (Lae, Ujae and Wotho) the source of pollution are minimal. There the issues are coral bleaching and a different type of macroalgae growth, which were surveyed in June of 2016 showing on average at 15% cover across these atolls with Wotho Atoll experiencing 80 percent of macroalgae growth in some areas. There are otherwise pristine areas, and are likely undergoing a phase shift from a coral to an algae-dominated reef, largely driven by sea-surface temperature rise.

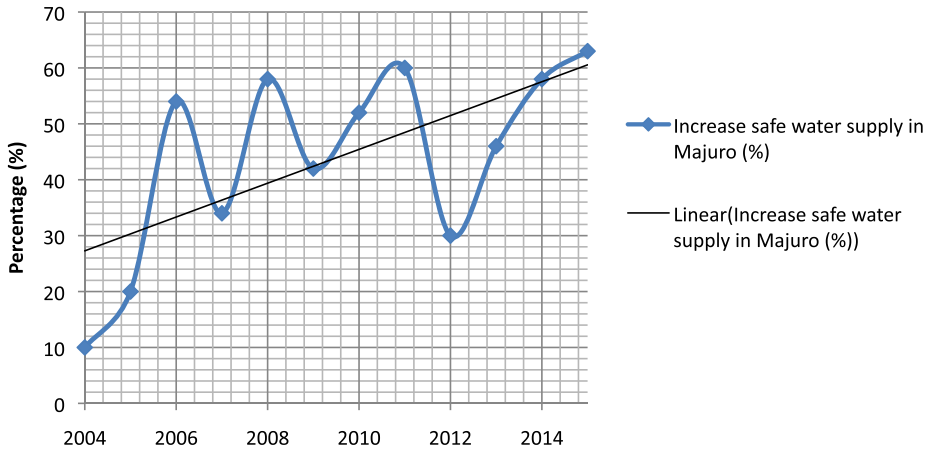


FIGURE 36. Percentage of safe water sampling supply from 2004 to 2015 (RMI EPA dataset, 2015).

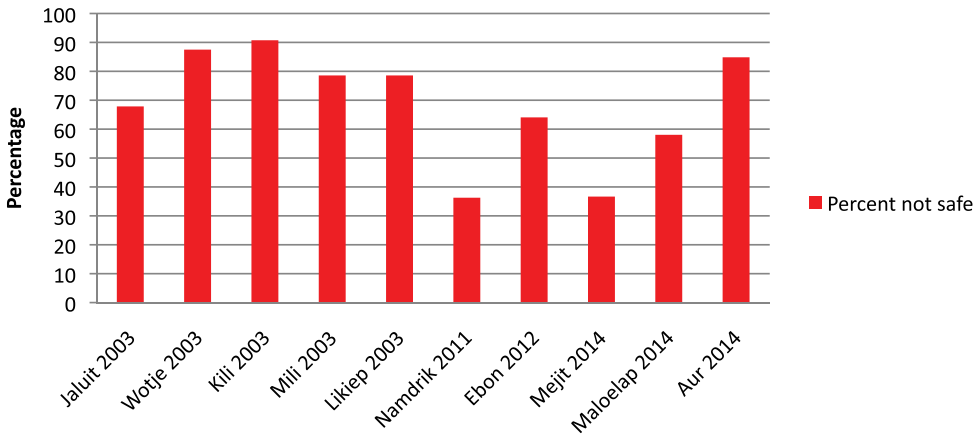


FIGURE 37. Percentage of unsafe water sampling in the outer islands (RMI EPA datasets, 2015).

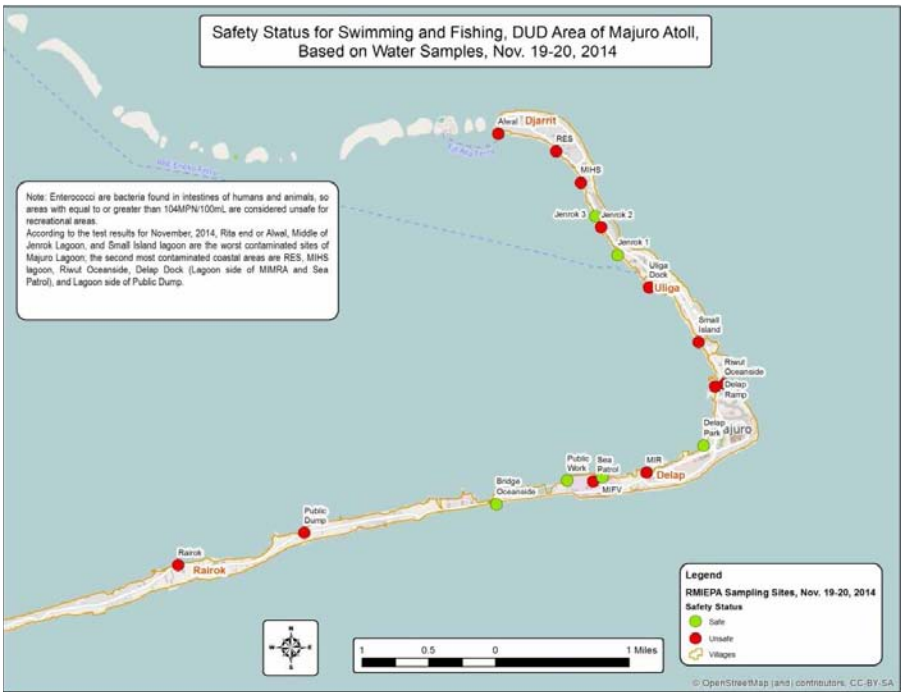


FIGURE 38. Majuro lagoon water quality test sites (RMI EPA, 2014).

FIGURE 39. Photo of algae outbreak on Majuro (Photo by SPREP's Michael Donoghue, 2014).

Over-use of fresh water resources can lead to temporary physical landscape changes, like those seen in the Laura fresh water lenses, with a reduced water storage capacity (Figure 40). According to EPA (Abraham Hicking, 2015), the groundwater lens at sampling site Number Five has the shape of a hump in the centre of the lens. This was confirmed in a study by Japan International Research Centre for Agricultural Sciences (JIRCA) in 2014. The hump appeared during the 1998 El-Nino when the well at site Number Five was used to supplement a water shortage during the drought. The site is located at the centre of Laura (Figure 41). Figure 42 compares the shifting of the lens during June, 1998 and March 2016.

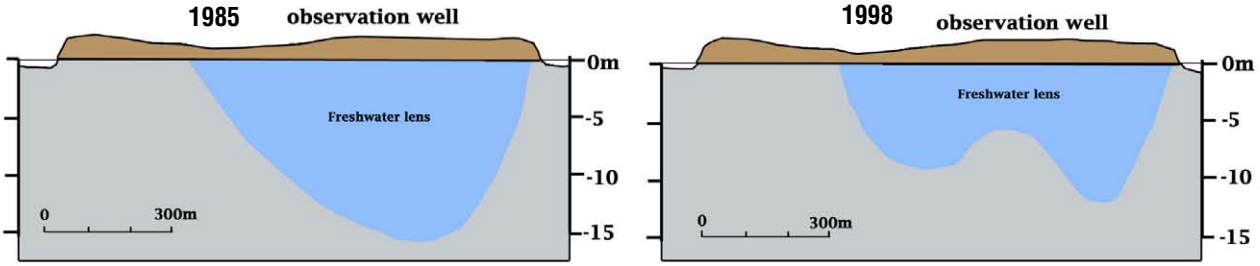


FIGURE 40. Diagram of Laura groundwater lens comparison of well Number Five at cross section C between 1985 and the El Nino in 1998 (JIRCA, 2014).

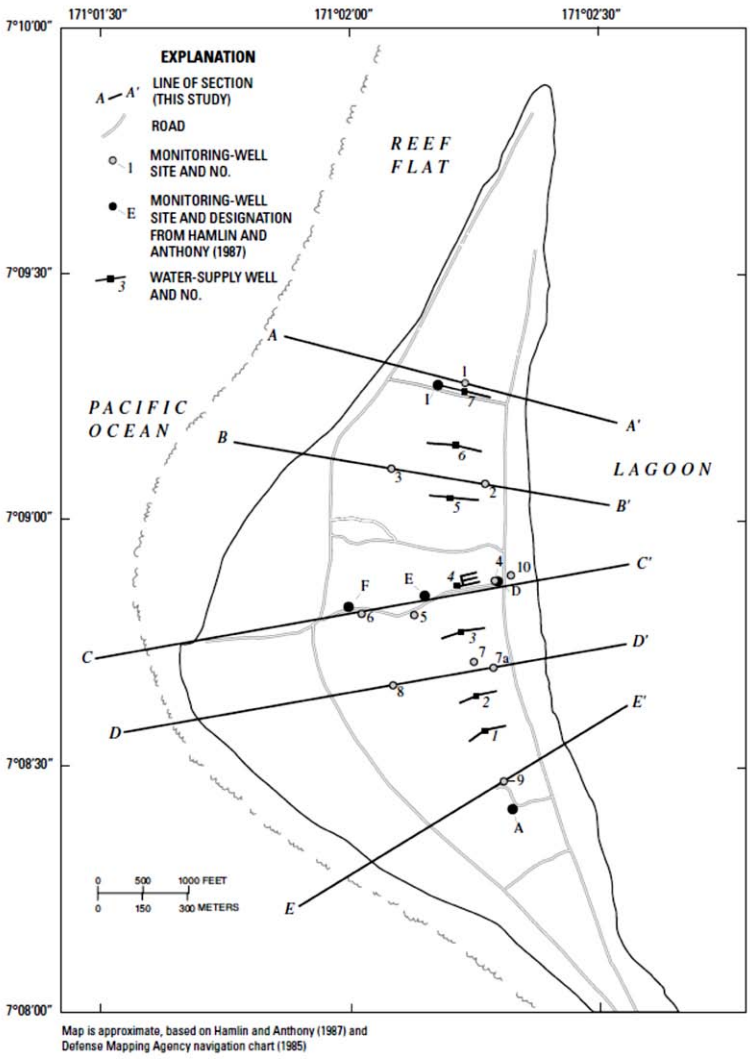


FIGURE 41. Diagram of all water lens monitoring sites at Laura (EPA, 2015).

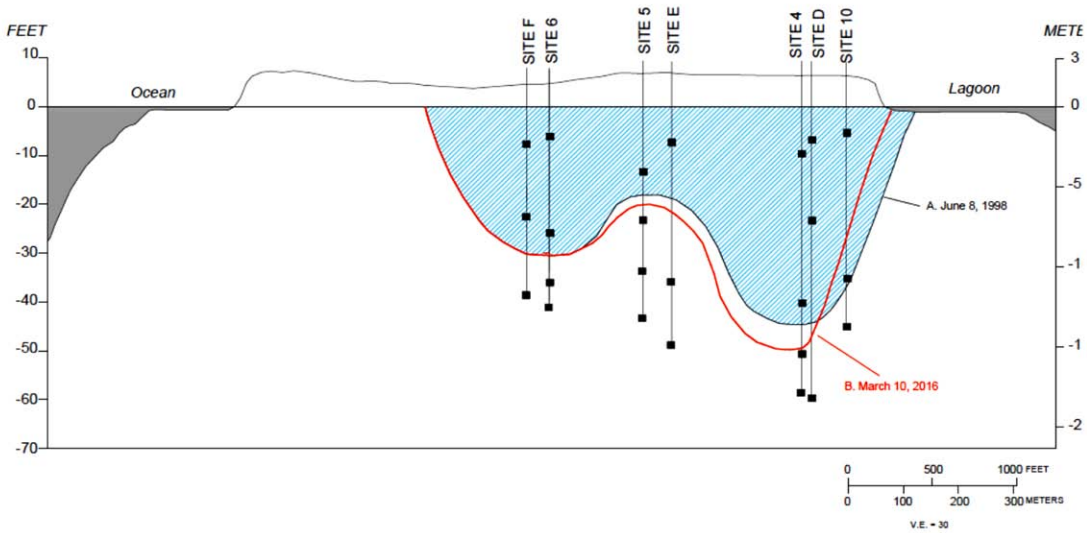


FIGURE 42. Diagram of Laura lens monitoring site Number Five.
Note the shifting of the water lens in 2016 compared to how it was in 1998 (EPA, 2015).

Military Legacy

The RMI has a long history of military impacts, starting with Japanese fortifications prior to World War II, as well as major naval battles in WWII including the direct bombardment of eight islands. Deforestation occurred as a result of fortifications, battles and other troop activities. The impacts are evident today in the reduced plant diversity. Starting in 1946, for thirteen years the US tested 67 nuclear devices, which had major impacts on several northern atolls of the RMI (Figure 43).

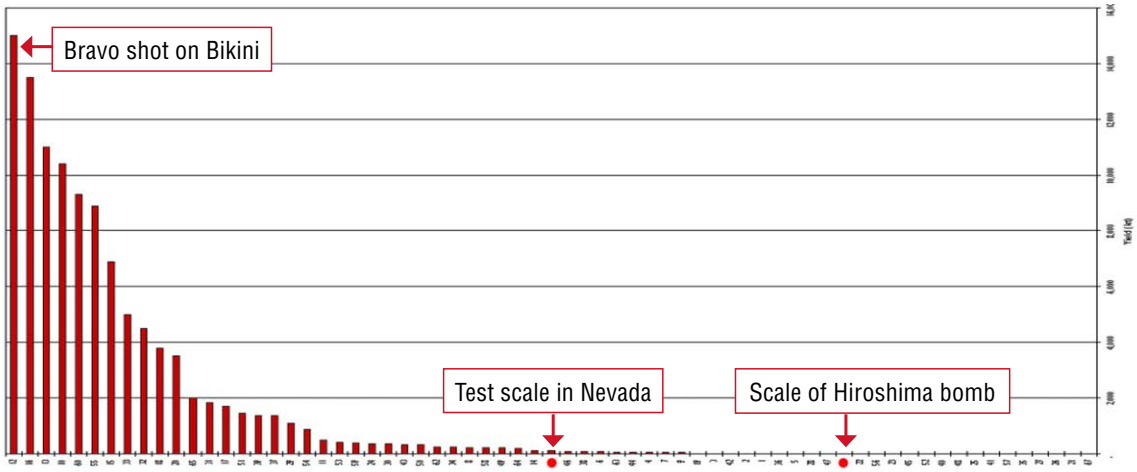


FIGURE 43. Scale of Nuclear explosives carried out by the US in the Bikini and Enewetak-Marshall Islands, Nevada-USA and Hiroshima-Japan (Kilo Tonnes) (http://rmiembassyus.org/).

The impacts included vaporising islets, depositing radioactive debris over entire islands, and destroying whole reef systems and terrestrial ecosystems. There is also the residual effect on the environment from WWII, where unexploded ordinance and shipwrecks pose significant threats to both the population and the environment from explosives and potential oil spills. While some of these ecosystems have visibly recovered, others are still affected. The US military is still active in Kwajalein, including regularly testing intercontinental ballistic missiles. A recently released report from the Army indicated that fish caught in the Kwajalein lagoon have very high toxicity levels of heavy metals and are unfit for human consumption (USAPHC, 2014). These heavy metals may come from either military or civilian sources. However, the high population density on Ebeye is largely a result of the local US military installations and the associated work opportunities. The military activity has lasting impacts and pressures on the environment, including the health of fish and the very structure of the islands.

SOURCES

ADB Economic Analysis 2011: Republic of the Marshall Islands; Public Sector Program.

Marshall Islands Visitor's Authority: Visitor's data 2011.

World Bank data: http://data.worldbank.org/country/marshall-islands#cp_wdi.

UN Data: http://data.un.org/CountryProfile.aspx?crName=marshall%20islands (assessed date: May 17, 2016).

UNEP Data: http://uneplive.unep.org/.

RMI EPA datasets, 2015.

RMI Census Reports, 1930–2011.

OEPPC: Republic of the Marshall Islands Biodiversity Clearing House Mechanism (http://biormi.org/).

Food and Agriculture Organization of the United Nations: FAO databank; 2015 (http://www.fao.org/data/en/).

Marshalls Energy Company data, 2014.

Ministry of Resources and Development data, 2015.

RMI Customs data, 2014.

Japan International Cooperation Agency-JICA-RMI data, 2013.

Japan International Research Center for Agriculture Sciences JIRCAS.

STATE OF RMI'S ENVIRONMENT, IMPACT AND CURRENT AND RECOMMENDED RESPONSES

OVERVIEW

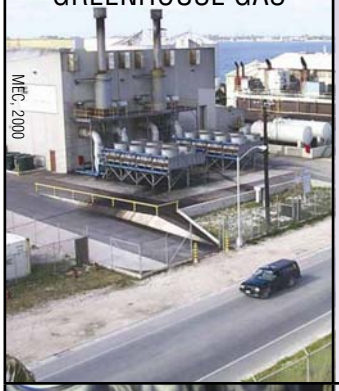
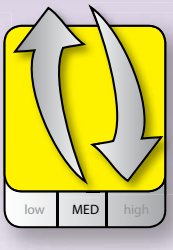
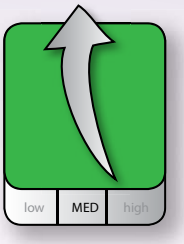
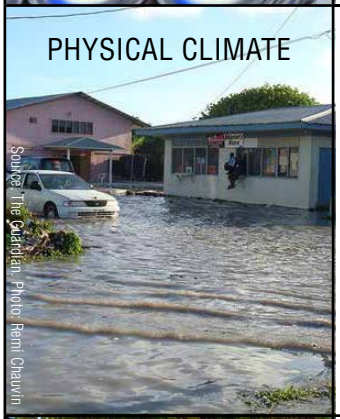
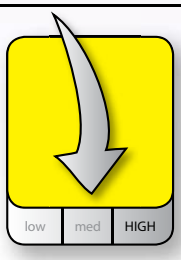
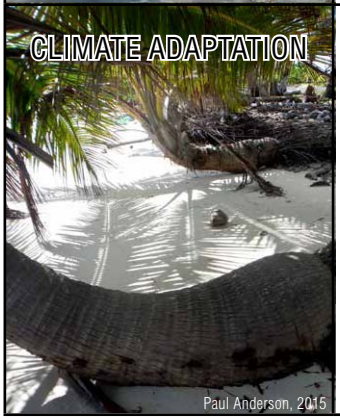
This chapter on the state of RMI's Atmosphere and Climate focuses on four areas: Greenhouse gases (GHGs), Ozone Depleting Substances (ODS), Physical Climate (air temperature, precipitation, and extreme climatic events) and Climate Adaptation (food security, water security, health and flood risks).

Through the greenhouse effect, the increase in concentration of GHGs in the atmosphere has been shown to influence climate change, which results in more intense storms and droughts, and higher sea level and temperatures. The recent drought in 2016 was more extreme than the 1997–1998 drought events. In 2015, an unseasonal storm hit Majuro causing serious property damage. It is important to track emissions of GHGs to 1) understand the national contribution to the global levels of GHGs, and 2) track national progress in reducing GHGs as part of the UNFCCC Framework. Although the GHG emission trend has increased over the last decade, it is negligible compared to developed countries. However, RMI still needs to develop GHG monitoring to better track its GHG emissions.

RMI phased out ODS over the last decade and has fully complied with the Montreal Protocol. In 2004, RMI banned the importation of CFCs and has committed to phasing out HCFCs by 2030.

Karen Earnshaw, 2008

ATMOSPHERE AND CLIMATE HIGHLIGHTS

TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
GREENHOUSE GAS  MEC, 2000	 **Status** Fair **Trend** Mixed **Data confidence** Medium	Urban and rural GHG emissions likely have increased over the past 30 years. However there is insufficient monitoring and data to know the actual state of GHG emissions across all sectors in the RMI.	• Need to establish a monitoring system and continue the enforcement of banned substances to enter RMI's ports. • Monitor the CO_2 from all shipping vessels.
ODS  Skelleftea kommun	 **Status** Good **Trend** Improving **Data confidence** Medium	Ozone depleting substances have been greatly reduced in RMI. RMI has enforcement to stop banned substances from entering RMI ports	RMI should maintain its strong response to reducing ODS.
PHYSICAL CLIMATE  Source: The Guardian, Photo: Remi Chauvin	 **Status** Fair **Trend** Deteriorating **Data confidence** High	Over the past 30-50 years overall maximum and minimum temperatures have increased significantly.	The RMI has strategies in place to help address climate issues. These include plans to enhance emergency preparedness and provide support to outer island communities.
CLIMATE ADAPTATION  Paul Anderson, 2015	 **Status** Poor **Trend** Mixed **Data confidence** Medium	More needs to be done to address the issue of climate adaptation in areas including food security, water security, health, and flood risks.	Need to develop proper strategic plans to carry out effective management of resources and disaster action plans to help address disaster risks.

ATMOSPHERE AND CLIMATE – GREENHOUSE GAS (GHG) EMISSIONS

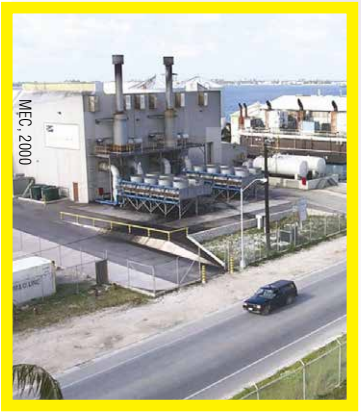
In June 1992 RMI joined world leaders at the Earth Summit in Rio de Janeiro in signing the United Nations Framework Convention on Climate Change (UNFCCC), which was ratified by RMI in 1994. Parties to the UNFCCC are obliged to submit national communications to the UNFCCC Secretariat that include information on national greenhouse gas (GHG) emissions, vulnerability to climate change, and climate change adaptation.

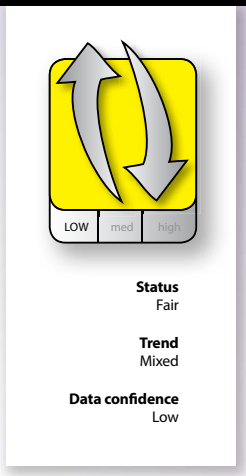
In 2000 RMI prepared its Initial Communication under the United Nations Framework Convention on Climate Change, which included limited GHG emission estimates. The Initial Communication was followed by the more comprehensive Second National Communication to the UNFCCC, which provided estimates for the years 2000 (base year), 2005 and 2010 of:

- GHG emissions from the energy[2] and waste sectors[3].
- GHG emissions for international bunkers[4].
- CO_2 emissions from biomass.
- Direct greenhouse gases emitted, namely, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), and
- Indirect greenhouse gases emitted, namely, oxides of nitrogen (NO_x), carbon monoxide (CO), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2)[5].

Multi-year national inventory data and information provided under the Second National Communication to the UNFCCC is reported below. It is important for RMI to track and report on its GHG emissions so that it can (1) understand its national contribution to global levels of GHG, and (2) track national progress in reducing GHG emissions as part of the UNFCC Framework.

The GHG emissions are a challenge for small island states. It is one of the main factors in global warming which causes stronger and more frequent extreme climate events, such as typhoons and drought, thus adding to the environmental and social problems in the RMI and elsewhere.





Status: Fair **Trend: Mixed** **Data confidence: Low**

To prepare its *Second National Communication*, RMI used non-Annex I National Greenhouse Gas Inventory Software (Version 1.3.1) and followed the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* and the Intergovernmental Panel on Climate Change's (IPCC) *Good Practice Guidance and Uncertainty Management in National GHG Inventories*.[6]

GHG emissions estimates for the energy and waste sectors were combined to produce an estimate of total national GHG emissions (Figure 44).[7] In the base year, 2000, total national GHG emissions were estimated to be 133.53 $GgCO_2e$[8], comprised of 88.66 $GgCO_2e$ from the energy sector and 44.87 $GgCO_2e$ from the waste sector. By 2005, the total national GHG emissions had increased to 145.88 $GgCO_2e$, with sectoral contributions of 106.97 $GgCO_2e$ from energy and 38.91 $GgCO_2e$ from waste. The estimate of total national GHG emissions further increased in 2010 to 184.93 $GgCO_2e$, with emissions of 141.55 $GgCO_2e$ from the energy sector and 43.38 $GgCO_2e$ from the waste sector. In summary, from 2000 to 2010, total national GHG emissions increased by 27.79 percent, GHG emissions from the energy sector increased by 37.37 percent and GHG emissions from the waste sector decreased by 3.44 percent.

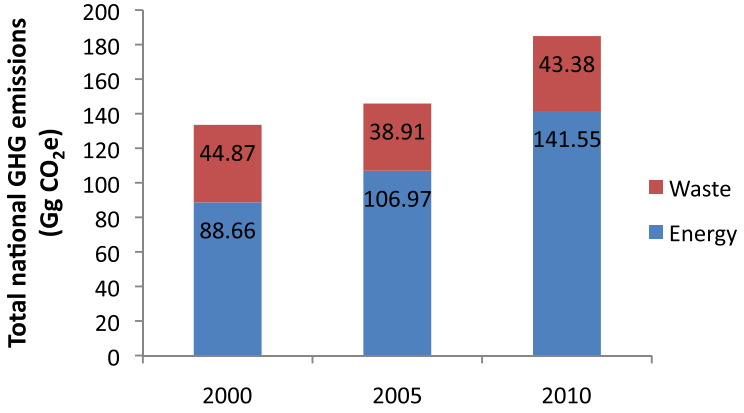


FIGURE 44. The trend in RMI's total national GHG emissions (excluding removals by sinks) from 2000 to 2010, based on emissions from the waste and energy sectors.

2 GHG emissions related to fuel combustion activities, both CO_2 and non-CO_2 emissions.

3 GHG emissions related to solid waste management and disposal on land and wastewater handling.

4 GHG emissions related to fuel use in aircraft engaged in international transport.

5 Indirect GHG emissions are not accounted for in RMI's aggregated national GHG emissions.

6 For further information and details regarding methodology issues, sources of uncertainty etc., refer to the Republic of the Marshall Islands Second National Communication submitted to the UNFCCC.

7 In accordance with 1996 IPCC guidelines, estimates of GHG emissions for international bunkers and CO_2 emissions from biomass were not included in RMI's total national GHG emissions but were reported as separate memo items in the national inventory.

8 Total Greenhouse Gas Emissions / $GgCO_2e$

The energy sector is the biggest source of GHG emissions in RMI. The increase in total emissions between 2000 and 2010 is largely due to the sector's increasing fossil fuel consumption, driven by rising demand for electricity. According to the Second National Communication, petrol, diesel, kerosene and liquefied petroleum gas (LPG) accounted for approximately 88.5% of gross energy supply, the balance being biomass and solar. A report by IRENA (2013) estimated that in 2011, about 92% of energy use was based on petroleum sources, with biomass and solar (on- and off-grid) respectively accounting for two percent and six percent of energy use.

The waste sector's GHG emissions are primarily due to methane emissions generated from the existing open landfills on Majuro and Ebeye. The actual quantity of methane generated from these landfills is modest. However, because the GHG effect of each unit of methane is about 21 times more than a unit of carbon dioxide, the total GHG effect from landfill emissions is surprisingly large (Kumar and Wade 2015).

Figure 45 shows the proportion of GHG emissions contributed by different sub-sectors in 2000. The RMI Second National Communication report stated that the largest sub-sectoral contributor was energy industries (47.14%), followed by waste management (33.60%), road transport, (11.92%), and other (7.34%).

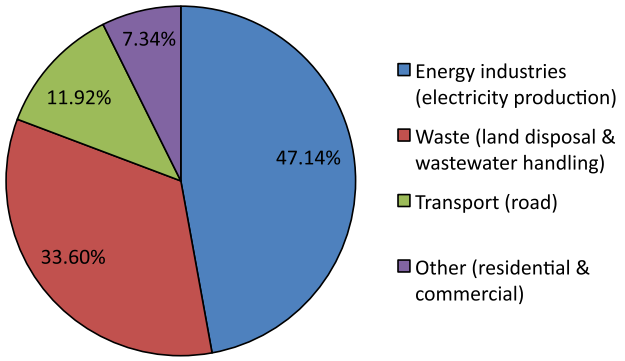


FIGURE 45. The proportional contribution by different sub-sectors to RMI's GHG emissions (GgCO2e) in 2000 (base year).

Figure 46 depicts GHG emissions for the year 2000 for four energy sub-sectors. International bunkers contributed the highest emissions (72.87 $GgCO_2e$)[9], followed by energy industries (62.94 $GgCO_2e$), transport (15.92 $GgCO_2e$) and other (9.80 $GgCO_2e$). Electricity generation is the major source of GHG emissions from the energy industries; combustion of gasoline and automotive diesel oil is the major source of emissions from transport; and use of dual purpose kerosene and LPG for lighting and cooking is the main source of emissions for other.

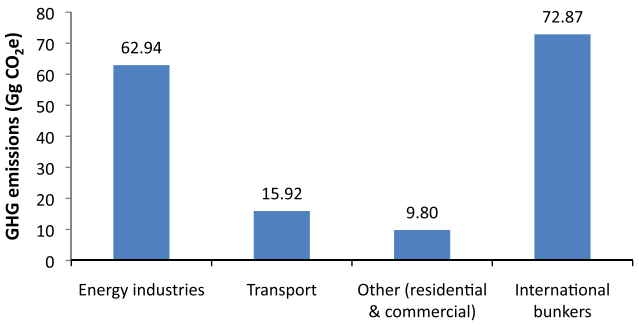


FIGURE 46. GHG emissions from energy sub-sectors for the year 2000.

Biomass is an important energy source, especially for cooking. The Second National Communication estimates that GHG emissions from biomass burning (Figure 47) increased significantly between 2000 and 2010, from 53.13 $GgCO_2e$ to 115.72 $GgCO_2e$.[8] It is thought that biomass use for cooking may have fallen in recent years, being replaced by kerosene and LPG.

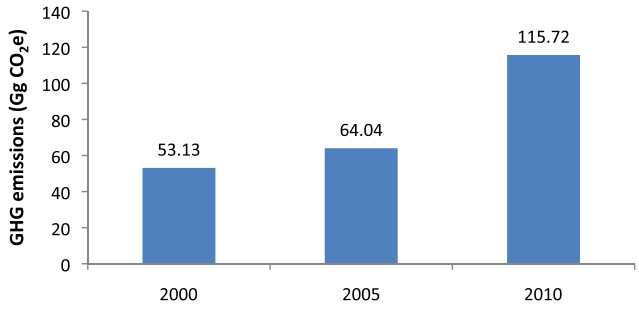


FIGURE 47. The 2000 to 2010 trend in GHG emissions from biomass burning (fuel wood and coconut residue) (Second National Communication to UNFCCC, 2015).

The lack of data is the biggest source of uncertainty for RMI's GHG emissions estimates. There is relatively good data for electricity generation and transport, however, fuel consumption data for other activities is largely based on estimates and past trends. Lack of country-specific emission factors is also a problem. The Second National Communication report recognises that the collection and storage of more detailed activity data, and country-specific emission factors, will reduce uncertainty in future GHG emissions inventories.

9 Note, international bunkers were not included in the GHG emissions total for RMI's energy sector, in accordance with 1996 IPCC guidelines.

IMPACT

On an international scale, the RMI is an insignificant contributor to global GHG emissions (<0.00001%), and hence, to global climate change (Republic of the Marshall Islands 2015b). The nation consists of coral atolls, and global climate change poses a serious threat to RMI's environment, its economic development and to the living conditions of its citizens. Impacts occur by way of more extreme storm events, droughts, and sea level rise. Indeed, the RMI already experiences frequent and serious weather-related impacts, as well as other natural hazard events.

Many important national institutions (i.e. Parliament, Government Ministries and many schools) are found in one of the most vulnerable sections of Majuro that is, on average, four feet above sea level. These would be among the first buildings to be affected by sea level rise, creating a significant problem for the effective functioning of the Government in the face of climate change (RMI EPA 2000).

The heavy dependence on fossil fuels means that RMI is particularly vulnerable to high and volatile fuel prices which, in the past, has led to the declaration of a state of economic emergency (Republic of the Marshall Islands 2015a). There are concerns that if the nation does not reduce its fossil fuel use and, in turn, its GHG emissions, it will lose opportunities to invest in more environmentally-friendly and economically-sustainable forms of development. Without intervention actions, RMI's GHG emissions are projected to rise sharply over the next decade.

RESPONSE AND RECOMMENDATIONS

Although RMI's total GHG emissions are negligible on a global scale, the country is committed to its national motto, "Jepilpilin ke ejukaan" (Accomplishment through joint effort). The RMI has a role to play in the global effort to combat climate change (Republic of the Marshall Islands 2015b).

This commitment is reflected in RMI's Intended Nationally Determined Contribution (INDC), or proposed post-2020 targets, that were communicated to the UNFCCC on 21st July 2015:

- RMI commits to a quantified economy-wide target to reduce its emissions of greenhouse gases (GHG) to **32% below 2010 levels by 2025**.
- RMI communicates, as an indicative target, its intention to reduce its emissions of GHGs to **45% below 2010 levels by 2030.**

RMI's INDC targets cover the energy (electricity generation, land and sea-based transport, cooking, lighting) and waste sectors,[10] and they reflect the country's goal of achieving net zero GHG emissions by 2050, or earlier.

Several initiatives will help towards the post-2020 targets. These include the Joint National Action Plan for Climate Change Adaptation and Disaster Risk Management, the Green Energy Micronesia Initiative, and the Republic of the Marshall Islands National Energy Policy 2016 and its associated Energy Action Plan 2016–2020.

The Green Energy Micronesia Initiative was endorsed in 2010 to promote a clean energy drive for four of the Micronesian island countries: FSM, Nauru, Palau and RMI. The key goals are to achieve 20 percent of power generation through renewable energy by 2020, and improved energy efficiency. Increase energy efficiency in the household, business, government, transport and utilities sectors should be encouraged with support and development of renewable energy sources by the National government.

The Republic of the Marshall Islands National Energy Policy 2016 specifies four goals linked to reducing GHG emissions, as well as associated outputs and outcomes (Table 6). To support the Republic of the Marshall Islands National Energy Policy 2016, a series of strategies and activities have been proposed under the Energy Action Plan. These include the use of cleaner fuels; encouraging the use of energy efficient appliances and vehicles; promoting energy efficient building designs and standards; and increasing the use of renewable energy technologies (e.g. solar photovoltaic systems, solar hot water systems and biodiesel for power generation). There is also a need to upgrade internal systems for monitoring climate change, GHG emissions, and the effectiveness of the actions proposed.

10 Emissions from other sectors are negligible.

RMI will require external financial and technical assistance to successfully implement its GHG emission mitigation plans, to achieve its INDC targets (Table 6), and to move towards a low-carbon economy (Republic of the Marshall Islands 2016).

TABLE 6. Summary of the Republic of the Marshall Islands National Energy Policy 2016

Thematic/key result area	Goals	Expected outputs	Outcomes
Energy efficiency and conservation	• To make households and businesses 50% more energy efficient and government buildings 75% more energy efficient by 2020 • To reduce supply side energy losses from MEC by 20% by 2017	• The reduction of Marshalls Energy Company (MEC) supply-side losses by 20% in 2017, with sound technical and financial criteria to be developed and assessed • The number of efficient electric appliances imported into the country through appropriate fiscal incentives for businesses, households and government sectors • Energy consumption is monitored and improved through energy auditing and demand side management	Smarter use of energy in households, businesses, government and transport sector and power utilities
Transport and energy use	• To achieve a 20% efficiency improvement in transport sector fuel use by 2020	• Increase the number of energy efficient vehicles through appropriate fiscal incentives for business, private sector, households and government. • Government development of a more energy efficient transport network through collaboration with various stakeholders and adopting best practices for the RMI	
Renewable energy	• To provide 20% of power generation through indigenous renewable resources by 2020	• Private sector participation in the electric power supply in RMI shall be allowed under conditions that are fair to MEC and the supplier (i.e. independent power producers agreement) • Available energy modelling shall be done to ascertain the technical and economic indigenous energy sources where practical and economically viable • The technical capacity of government (EPD) and MEC to plan, develop, implement and manage renewable energy systems (small and medium-scale rural, large-scale urban) shall be continuously updated and enhanced. • Economically feasible alternatives to diesel fuel (bio-fuel and LNG) for power generation shall be used	Reliable, sustainable and affordable power supply

RMI is one of the top three countries in the world for registered ships – these would have major CO_2 emissions. However, currently there is no monitoring system in place. Therefore, it is highly recommended that RMI establish a CO_2 monitoring and enforcement system for its registered ships.

SOURCES

RMI EPA (Republic of the Marshall Islands Environmental Protection Authority) 2000. Initial Communication under the United Nations Framework Convention on Climate Change. Majuro, Republic of the Marshall Islands.

IRENA (International Renewable Energy Agency) (2013) Renewable Energy Opportunities and Challenges in the Pacific Islands Region: The Republic of the Marshall Islands.

Energy Planning Division (2016–2020) Republic of the Marshall Islands National Energy Policy, draft. Ministry of Resources and Development.

Kumar M. and Wade H. (2015) Preparation of the Republic of the Marshall Islands Intended Nationally Determined Contributions.

Republic of the Marshall Islands (2015a) Republic of Marshall Islands Second National Communication. Submitted to the UNFCCC. Majuro, Republic of the Marshall Islands.

Republic of the Marshall Islands (2015b) Intended Nationally Determined Contribution. Contributed to the UNFCCC on 21 July 2015.

ATMOSPHERE AND CLIMATE – OZONE DEPLETING SUBSTANCES

Stratospheric ozone is naturally generated at high altitudes (15–50km) above the earth's atmosphere and has a role to play in the global effort to combat climate change. RMI became a Party to the 1995 Vienna Convention on the Protection of the Ozone Layer, the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer and the 1990 London Amendment, on 11 March 1993. It became a party to the 1992 Copenhagen Amendment on 24 May 1993. Accordingly, it is required to control the consumption of chlorofluorocarbons (CFCs), halons, methyl chloroform (1,1,1-trichloroethane), carbon tetrachloride, hydrochlorofluorocarbons (HCFCs), hydrobromofluorocarbons (HBFCs), "other halogenated CFCs" and methyl bromide at this time.

RMI is not a party to the 1997 Montreal Amendment or the 1999 Beijing Amendment to the Montreal Protocol. It is considering ratification of these amendments and is classified as operating under Article 5 of the Montreal Protocol – as such it is entitled to assistance from the Multilateral Fund to comply with its obligations (RMI ODS action plan).

Status
Good

Trend
Improving

Data confidence
Medium

Status: Good Trend: Improving Data Confidence: Medium

Only three types of ozone depleting substances are known to have been imported into RMI in bulk form: (CFCs) and (HCFCs) which are used for refrigeration and air-conditioning, and methyl bromide used for quarantine fumigation. Other than the use of methyl bromide for fumigation, consumption of ODS in RMI is exclusively in the refrigeration and air conditioning sector.

According to the data submitted to the Ozone Secretariat, RMI must freeze its consumption of CFCs at 1.16 ODP tonnes from 1 July 1999. According to the same data, by 2000 RMI had reduced imports of CFCs to 0.53 ODP tonnes (Figure 48). It is therefore in full compliance with its obligations (RMI ODS action plan). As of 2004, RMI has banned CFCs and has committed to phasing out HCFCs by 2030 as part of the Montreal and Vienna protocols (Ozone Layer Regulation 2004) (Figure 49 and 50).

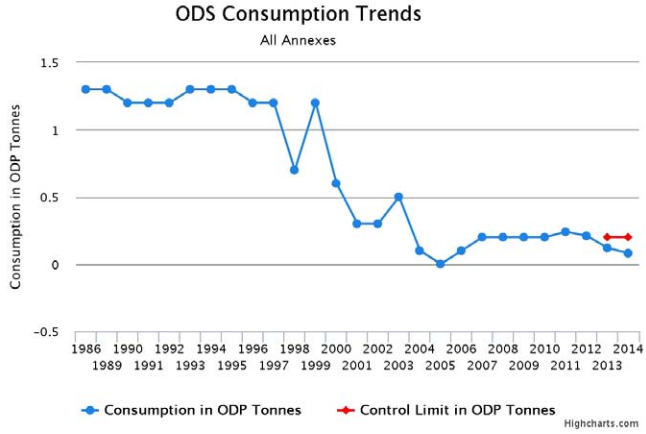


FIGURE 48. Marshall Islands ODS consumption (UNEP Data Center).

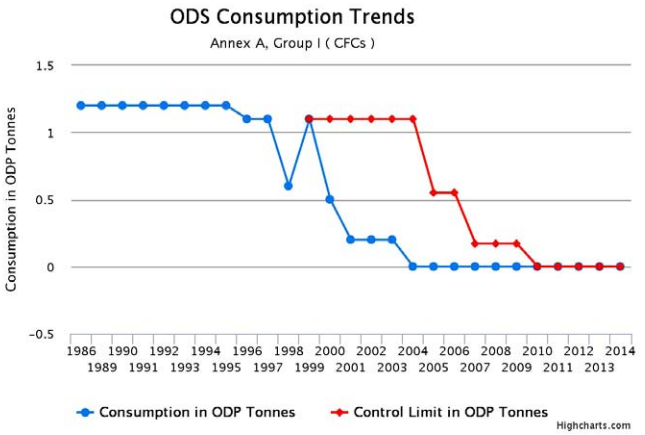


FIGURE 49. Marshall Islands CFCs consumption (UNEP Data Center).

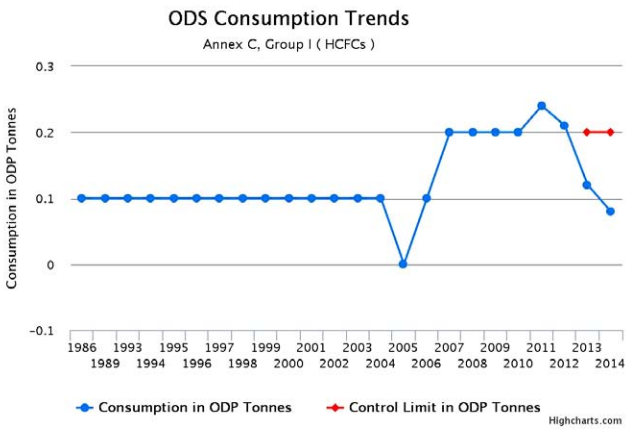


FIGURE 50. Marshall Islands HCFCs consumption (UNEP Data Center).

IMPACT

ODS are harmful to the ozone layer, and are also potent greenhouse gases, with HCFCs having anywhere from 2000 to 3000 times the greenhouse effect of CO_2. Therefore, phasing out ODS has benefits for climate change mitigation.

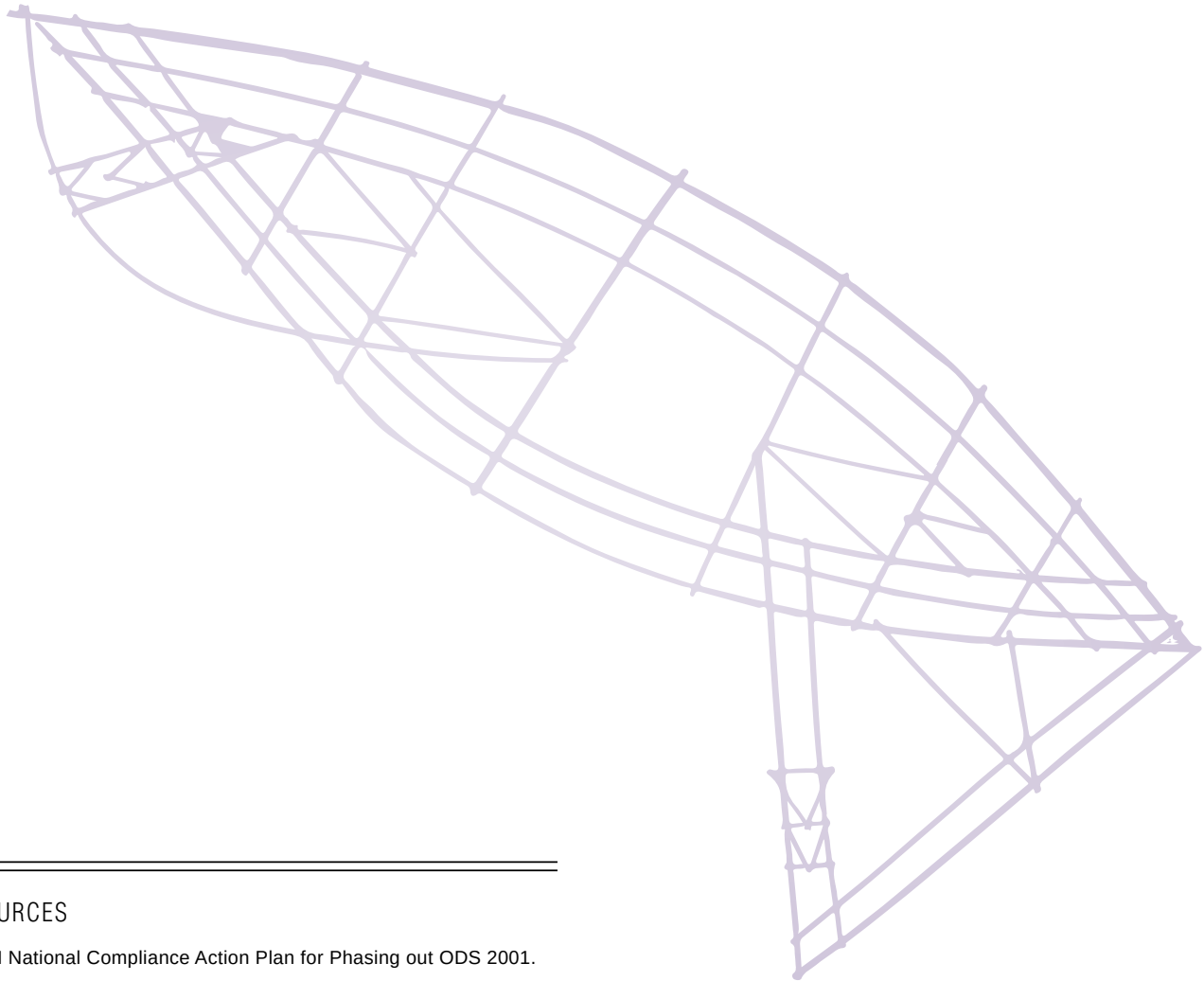
In addition, as a signatory to the Montreal Protocol, there are trade consequences for RMI if it accepts or trades in illegal ODS.

RESPONSE AND RECOMMENDATIONS

In 1999, the most recent year for data, the RMI population was 50,318. The per capita consumption of ODS in 2000 (assuming the same population as 1999) was 0.011kg per capita. This is under the threshold to receive assistance under the Montreal Protocol Multilateral Fund. The RMI does not produce ODS, it is imported.

The monitoring and data collection of ODS imports needs to be improved. A new software product has been developed called CusPac Customs system – which helps track and detect tariff codes for ODS. The proposal for all government offices is to use HFCs in a positive way and to phase out the HCFCs.

It is recommended that records for ODS exported for disposal are maintained. Recording the importation of ODS alternatives, such as HCs and HFCs, and regular refresher courses for training technicians carrying out enforcement and monitoring, are also recommended.



SOURCES

RMI National Compliance Action Plan for Phasing out ODS 2001.

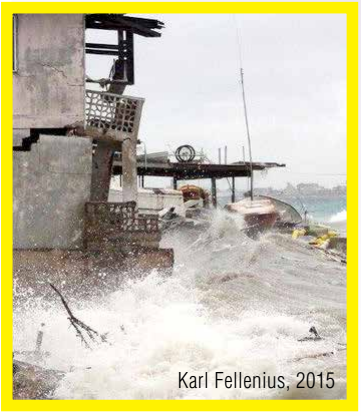
Republic of the Marshall Islands (2015) Intended Nationally Determined Contribution. Communicated to the UNFCCC on 21 July 2015.

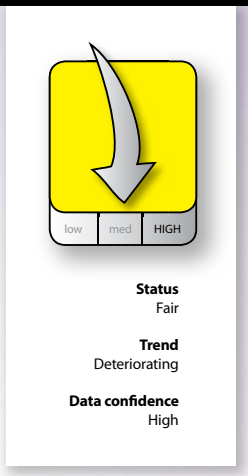
Republic of the Marshall Islands National Compliance Action Plan for the Phasing out of Ozone Depleting Substances (ODS) December 2001.

ATMOSPHERE AND CLIMATE – PHYSICAL CLIMATE

The RMI has a moist, tropical climate, heavily influenced by the north-east trade wind belt. The trade winds prevail in the dry months from December through April, with periods of weaker winds during the wet months from May through November. Annual rainfall varies from north to south within the archipelago, with the southern atolls, including Majuro, receiving between 3,000 to 4,300 mm and the northern atolls receiving between 1,000 to 1,750 mm. Temperatures are an average annual temperature is 27°C, and monthly averages showing minimal variation from 26.9°C to 27.1°C. Major storms do not often impact the country, however, typhoons and hurricanes frequently originate in the area and gather strength as they move away from the equator (RMI UNFCCC 2015). Nonetheless, there have been major storms. One hit RMI in 1905, in which many lives were lost and small islets in some atolls were wiped out (Table 7). The 1918 storm devastated Majuro when storm surges washed over the Southern shores of Majuro (Spennemann, Dirk H.R, 1998). In 2015, an unseasonal storm hit the RMI, causing damage to shoreline properties (Figure 51).

The main meteorological stations are located at Majuro on the southern end of the Ratak chain and at Kwajalein near the centre of the Ralik chain. Observations began at Majuro in 1951 and at Kwajalein in 1945 (Republic of the Marshall Islands, 2015). Data from Majuro provides a reasonable representation of climatic conditions across the southern atolls/islands, while data from Kwajalein provides a reasonable representation of climatic conditions across the northern atolls/islands. Measurements indicate how climatic events impact the environment in RMI.





Status: Fair Trend: Deteriorating Data Confidence: High

Rainfall varies greatly from the northern to the southern atolls. The atolls in the north receive less than 50 inches (1750 mm) of rain each year and become very dry in the dry season (December to April), while those closer to the equator (Figure 52) receive more than 3000 mm of rain each year (Pacific Climate Change Science Program 2011).

RMI's Second National Communication reports that the negative trend in Majuro's annual rainfall is statistically significant at the five percent level. This implies either a shift in the mean location of the Inter-Tropical Convergence Zone, or, a change in the intensity of rainfall associated with the ITCZ (Figures 53 and 54).

TABLE 7. Historical record of Typhoons in RMI

Year	Dates	Name
1998	17–20 November	Gay
1997	15–16 October	Brian (*)
1996	6–12 October	Zack (*)
1995	21–22 September	Val (*)
1994	5–8 August	Kent (*)
1993	5–7 February	Ekeka (*)
1992	7–9 January	Axel
1991	4–5 November	Verne (*)
1991	17–24 November	Yuri (*)
1991	28 Nov–2 Dec	Zelda (**)
1990	5–9 November	Page (*)
1990	14–24 November	Owen
1988	8–9 January	Roy

Year	Dates	Name
1987	20–22 August	Ed
1987	4–5 September	Holly
1986	11–13 August	George
1986	21–23 December	Norris
1982	25–28 November	Pamela
1981	11–15 March	Freda
1979	2–6 January	Alice
1978	19–20 October	Rita
1977	23–27 December	Mary
1972	4–7 October	Marie
1972	12–19 December	Violet
1918	unknown	Unnamed*
1905	30 June	Unnamed*

* Severe/Major tropical storms

** Severe tropical storm, developed into a typhoon after leaving the RMI

FIGURE 51. Unseasonal strong storm hit Majuro, July 2015 (Marshall Islands Journal)

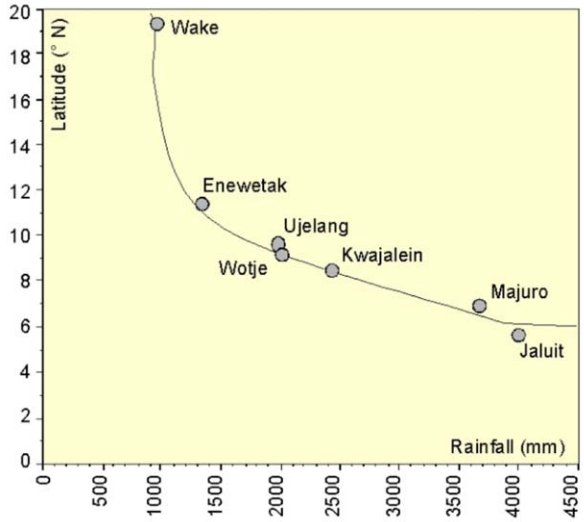


FIGURE 52. Relationship between annual average precipitation and latitude in the RMI area (Spennemann, 1992).

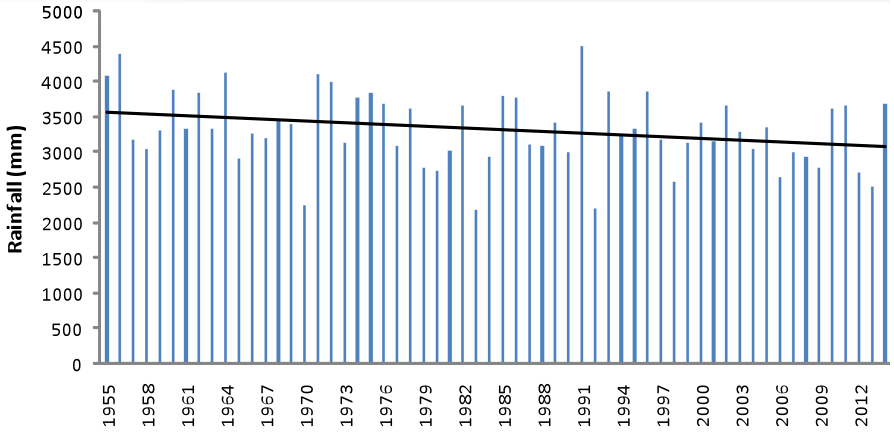


FIGURE 53. Majuro annual rainfall record (http://www.ncdc.noaa.gov/cdo-web/search).

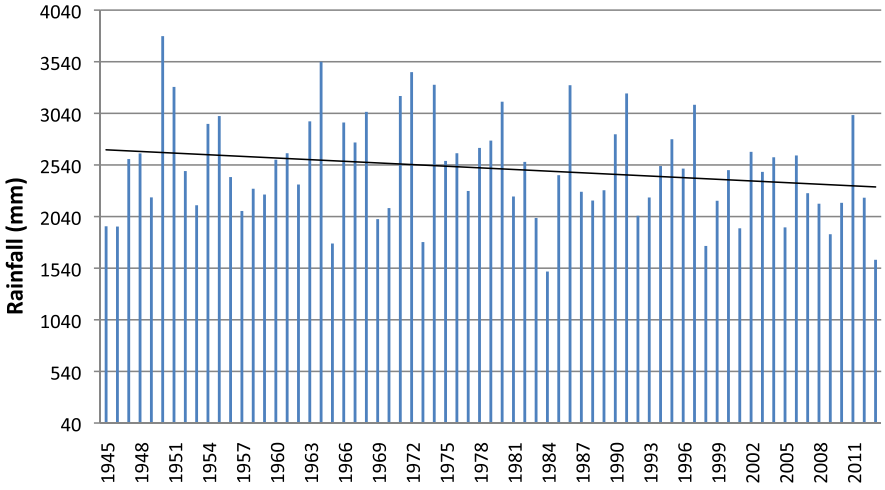


FIGURE 54. Kwajalein annual rainfall record (http://rts-wx.com/).

Warming trends in annual and half-year mean temperatures at Majuro since 1955, and Kwajalein since 1949, are statistically significant at the five percent level (Figures 55 and 56). Maximum and minimum temperature trends at Majuro are much stronger, compared to Kwajalein. The warming temperature trends at both sites are consistent with global warming trends (Second National Communication to the UNFCCC). Changes in RMI's average temperatures are strongly tied to changes in the surrounding ocean temperature (Pacific Climate Change Science Program, 2011).

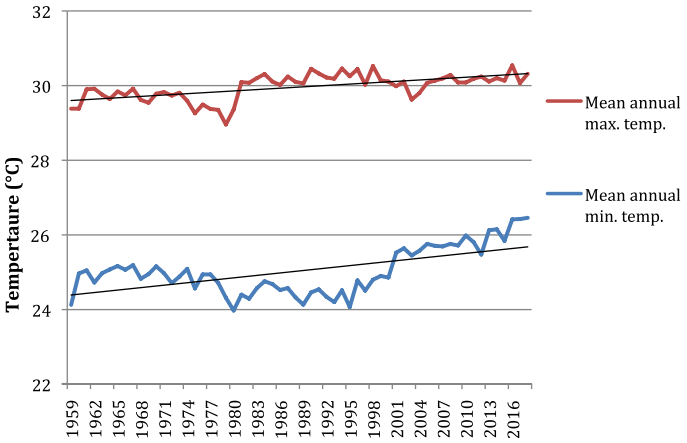


FIGURE 55. Majuro mean annual maximum and minimum temperature record (http://www.ncdc.noaa.gov/cdo-web/search).

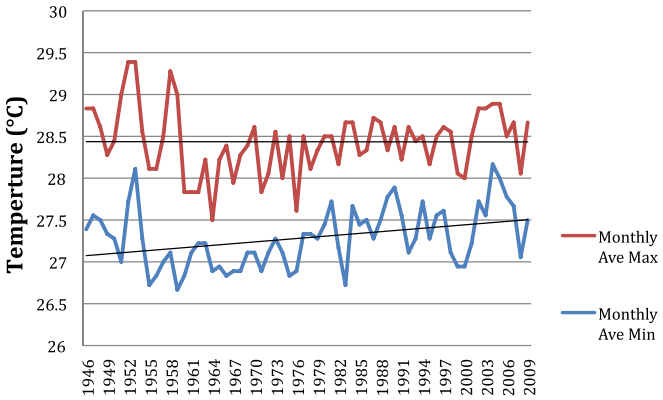


FIGURE 56. Kwajalein mean annual maximum and minimum temperature record (http://rts-wx.com).

Warming trends are evident in both annual and half-year mean air temperatures at Majuro (southern Marshall Islands) since 1955, and at Kwajalein (northern Marshall Islands) since 1952.

The frequency of warm days has increased, while the number of Cool Nights has decreased at both Majuro and Kwajalein (shown on Figure 56).

On Majuro, a decreasing trend in annual rainfall is evident since 1954. There has also been a decrease in the number of Very Wet Days since 1953. Other than the shifting ITCZ and the general increase in min and max temperatures, the historical seasonal trends and extreme events in Majuro and Kwajalein show little change (Second National Communication to the UNFCCC).

IMPACT

Adaptation methods to shoreline protection (e.g. breakwaters, vegetated berms, revetments, and seawalls) may not withstand extreme weather events, sea level rise, or erosion, due to stronger currents, (higher swells, and increasing salination of soils).

The annual rainfalls, along with more frequent droughts, are the main factors which affect the availability of water for drinking, agriculture and industry. There has been a recorded drop in rainfall for RMI, which results in a higher incidence of drought. The reduced rainfall has affected reservoir water levels. For more than five years, stringent water restrictions have been in place in Majuro – they only used to be in place during drought periods. Now, the city water supply can be accessed by households only three times a week.

The country has never been more vulnerable to extreme climate and weather events. Global warming is threatening the very existence of the nation with storms that produce more frequent and stronger waves. El Niño–Southern Oscillation (ENSO) events act on this increasing sea level baseline, ranging between 10cm below neutral for an El Nino and 30cm above neutral for La Nina. The last decade up until 2014 has seen La Nina dominance, exasperating shoreline erosion. A good example is the old cemetery at Jenrok Village ocean side (Figures 57 and 58).

FIGURE 57. Huge storm surges washing over graveyard 2008 (Marshall Islands Journal).

FIGURE 58. After storm surges, back row have been swept out to sea (Marshall Islands Journal).

RMI's hazards and vulnerabilities are linked to both physical and social factors, in addition to ongoing unsustainable development practices (RMI JNAP, 2014–2018). The physical factors that are putting more pressure on the land include:

- Climate change impacts including sea level rise, which may increase vulnerability and exposure to shocks and stresses, as well as increased intensity of extreme events, particularly when occurring in combination;
- Sparse and scattered islands and atolls, making communication and transportation to outer islands more difficult, with infrequent and at times unreliable transport links.

RESPONSE AND RECOMMENDATIONS

The main response in RMI to climate change will be adaption. However, the key step in addressing physical changes in climate patterns is mitigation. RMI will mitigate CO_2 emissions by increasing renewable energy production and using improved technology. These actions are set out in the 2016 National Energy Policy and Energy Action Plan. Recommendations include:

- Implementing the national energy action plan
- Better monitoring of CO_2 emissions, including shipping
- Enhance implementation of urban planning through the EIA process.
- Promotion of low carbon technology such as the traditional outrigger canoe to help reduce CO_2 emissions locally.

SOURCES

Pacific Climate Change Science Program (2011) Current and future climate of the Marshall Islands. Marshall Islands National Weather Service Office, Australian Bureau of Meteorology and CSIRO.

Republic of the Marshall Islands Joint National Action Plan for Climate Change Adaption and Disaster Risk Management, 2014–2018.

Republic of the Marshall Islands (2015) Republic of Marshall Islands Second National Communication. Submitted to the UNFCCC. Majuro, Republic of the Marshall Islands.

RMI EPA (Republic of the Marshall Islands Environmental Protection Authority) 2000. Initial Communication under the United Nations Framework Convention on Climate Change. Majuro, Republic of the Marshall Islands.

Spennemann, D.H.R. (1990) Cultural Resource Management Plan for Majuro Atoll, Republic of the Marshall Islands. 2 Vols. Report prepared in fulfilment of U. S. Department of Interior, Office of Territorial and International Affairs Technical Assistance Grant MAR-42. Report submitted to the Historic Preservation Office, Majuro, Republic of the Marshall Islands. August 1990, (printed 1992).

ATMOSPHERE AND CLIMATE – CLIMATE ADAPTATION

Climate change adaptation refers to activities that safeguard infrastructure, people and resources against climatic variability and events such as rising sea levels, floods, droughts and storms.

Adaptation is a priority for RMI which has gone through planning and pilot projects to find the best way to adapt to the impacts of climate change. These are cross-cutting issues which often overlap with other development activities around energy, drinking water, resource and infrastructure development and land use at all levels – community, country, regional. The RMI is also part of the Micronesian Challenge Initiative which includes building resilience to climate change and sea level rise as a top priority.

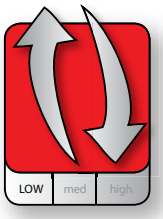
The following priority areas are important for assessing RMI's capacity for climate change adaptation:

1. Water security – Water storage capacity and condition of capacity
2. Food security – particularly food production in the outer islands and Laura
3. Health – specifically efforts to reduce vector borne diseases, such as dengue.
4. Land use – Particularly the need to develop a land-use planning strategy and building codes.
5. Flood risk – new indicator, see below.

These priority areas only evaluate the level of national emphasis – not the level of effectiveness of the activity to reduce risks from climate change.

Karl Fellenius, 2014

Paul Anderson, 2015



Status
Poor

Trend
Mixed

Data confidence
Low

Status: Poor **Trend: Mixed** **Data Confidence: Low**

1. Water Security

RMI is preparing for climatic conditions and weather-related events that affect fresh water supplies. For example, in the first half of 2013, the RMI experienced a drought and then a high sea level/wave over-wash event which, together, severely compromised the quantity and quality of fresh water supplies (Finucane et al. 2014).

Some outer atoll residents are concerned about their lack of access to reliable fresh water supplies. However, they are reluctant to migrate elsewhere because of their desire to sustain a connection with a defined place and its associated customs, beliefs and languages, and also their wish to avoid the challenges of relocating and settling into a new community (Finucane et al. 2014).

To address the key issue of water security, the Pacific Adaptation to Climate Change (PACC) demonstration project focused on improving the catchment and reservoir system on the main island of Majuro. The island uses its largest paved area – the airport runway – to collect rainwater, and then diverts it to a series of storage tanks where it is treated and piped to communities. However, increasing population and outdated infrastructure, compounded by unpredictable and challenging weather, meant that the system was becoming inadequate (Second National Communication to the UNFCCC).

The PACC project carried out a vulnerability and adaptation assessment of the water sector in Majuro, and a cost–benefit analysis, to identify the best options for investment. Following recommendations from these analyses, PACC activities focused on repairing the reservoir, including relining the tanks and installing a cover to reduce evaporation. The renovated reservoir was officially opened on 2 April 2014. The reservoir is now able to hold up to 36.5 million gallons, compared with 31.5 million gallons prior to the improvements. Evapo-transpiration has also been decreased through the covers on the reservoir, which

also acts as an additional catchment area through pumps installed in the cover. The higher capacity means greater water security for the people of Majuro (Second National Communication to the UNFCCC).

2. Food Security

Food security is one of the most challenging problems. The impacts of climate change and human activity are the main contributing factors to the declining production of food and food security. The Marshallese people have long been cultivating the land for food, medicinal and other traditional purposes. Today people depend on imported goods, which have reduced land cultivation and traditional practices of producing local food and medicine. In fact, a recent study conducted on Arno Atoll, indicates that well over 80 percent of carbohydrates are being imported (Figures 122 and 123 in the Cultural and Heritage section).

The Ministry of Resources and Development (R&D) has a programme to restock livestock and food crops for national food security. A total of 628 piglets and over 2,800 types of plants were distributed on most of the outer islands, as well as Majuro. Figures 59 and 60 show the number of livestock and plants distributed during the fiscal year 2014–2015.

The Government's latest agriculture planning documents are the R&D Strategy and Action Plan 2005–2010 and the RMI State-Wide Assessment and Resource Strategy 2010–2015+. Documents are available on the US Forest Service website.

3. Health

Climate change-related health issues are a concern, particularly Non-Communicable Diseases (NCDs) such as diabetes. In addition, loss of a clean water supply can result in water contamination, which will have significant medical concerns. An increase in atmosphere and sea temperatures could also intensify risks in water and vector-borne diseases, such as diarrhoea, dengue fever, disaster-related fatalities, injuries and illnesses, heat stress and conjunctivitis (pink-eye).

4. Land Use

In RMI there are currently no formal housing codes. Land use planning is done on an ad hoc basis and there is no government mandated land-use planning. In addition, agricultural, foreshore areas and forest resources are being progressively lost due to unplanned development. The cumulative impacts of this unplanned development are unknown due to the limited capacity the national government has to carry out monitoring and evaluation.

5. Flood Risks

The President of RMI has declared that all government facilities need to be climate-proofed, and the Ministry of Public Works is developing a suitable building code for government facilities. In effort to synergize with mitigation objectives buildings are being retro-fitted to be more energy efficient at the same time e.g. Ministry of R&D, EPA, CMI, USP, Ezy Price (private sector). There are recommendations for ideal flood-proof structures, and it is in the form of a homeowners handbook in English (Hess et. al 2015). A Marshallese language verision of this document is being prepared for printing. However, this guidance should be formalized in building codes. The EPA has been working with the Ministry of Public Works to develop recommendations for coastal protection structures. A grant awarded to CMI and UH Sea Grant by the US DOI Coral Reef Initiative program for the development of technical guidelines for coastal protection is now in effect, on which RMI-EPA is a major partner. This involves the application of design features to about 15 soft/hard/hybrid options for protection, based on an assessment of fortified vs. non-fortified areas and wave energy settings. There are few studies of coastal hydrodynamics/coastal energy profiles before fortification structures are put in place.

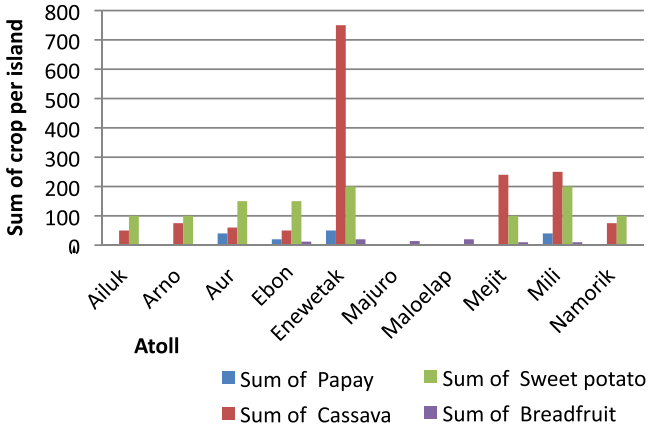


FIGURE 59. Number of crops distributed by R&D (R&D, 2014).

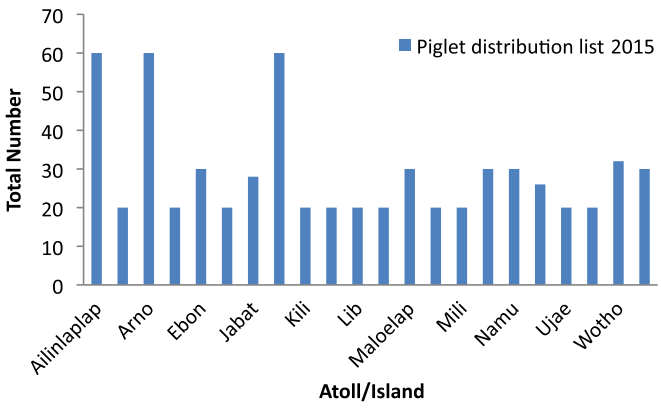


FIGURE 60. Number of piglets distributed to the outer islands by R&D (R&D, 2015).

IMPACT

Climate change adaptation measures by RMI can strengthen its resilience to the negative impacts of climate change, and build its capacity to better adapt. The costs of adaptation can be expensive, especially for shoreline protection measures. Climate change adaptation does not have to be expensive. There are affordable measures available such as the protection and sustainable management of coral reefs, replanting of native trees and plants in riparian areas, and investing in rainwater catchment tanks for households. Appropriate water management systems will help to control water borne-diseases. Some of the social drivers for these impacts include:

- Rapid population growth and over-population in urban centres;
- Low elevation and small atoll islands;
- Unsustainable development;
- Localised pollution (including contamination of water supply), poor waste management and sanitation and environmental degradation;
- Limited resources (particularly food, water and fuel);
- Limited economic potential due to small size and remoteness;
- High exposure to external market shocks (demonstrated by the State of Economic Emergency declared in 2008, following unprecedented increases in costs of imported food and fuel – see RMI, 2009a); and

RESPONSE AND RECOMMENDATIONS

In 2011, the RMI Government adopted the National Climate Change Policy Framework (NCCPF), which sets out RMI's commitments and responsibilities to address climate change (Second National Communication to the UNFCCC, p.18) which includes:

- Improve coordination of disaster risk management/ climate change adaptation in the RMI. (Adaptation measures cannot be adopted without a thorough assessment of different thematic areas i.e. coastal, water, energy, food, infrastructure, health, education, social, and governance). There are five strategic sectors for development in the National Strategic Plan (NSP). RMI should align the SOE with the resilience language already in place in the NSP.
- Public education and awareness.
- Enhanced emergency preparedness and increased response support to outer islands during extreme events, such as droughts and topical storms. Improved energy security, working towards a low carbon future.
- Enhanced local livelihoods and community resilience.
- Integrated Approach to development planning including consideration of climate change and disaster risks.

The Micronesia Challenge (MC) is an example of a regional partnership that has been translated into local action through the RMI's community-based conservation area management framework, called Reimaanlok. As part of the MC/Reimaanlok, the RMI is preserving its cultural heritage through the conservation of natural resources, thereby enhancing resilience to the impacts of climate change (Second National Communication to the UNFCCC, p. 18).

It is recommended that spatial analysis capacity be developed within government to support coastal protection planning – this can provide island height and wave energy profiles for each atoll to produce guidelines for coastal protection initiatives. Currently, there is limited information and guidance available to the public on vulnerable areas. On rural islands, such assessments along with shoreline change analysis inform high versus low risk areas, and therefore where people can live. It does not justify building fortification, as it does in more urban settings. Rural islands need to be allowed to erode and accrete naturally.

The RMI has no building codes or land-use planning. It is recommended that RMI develop regulations and guidelines for proper housing codes and land-use planning to reduce the impacts from extreme climate events. This could be complemented by regulations that require developments in highest risk areas to include some protective measures.

SOURCES

Finucane M. L., McIntosh R. D. And Keener V. W. (2014) Developing a Drought Dashboard for the Republic of the Marshall Islands: Preliminary report on stakeholders' climate-sensitive decisions and climate-information needs. Summary of initial interviews. East-West Center, Honolulu.

Ministry of Resources and Development, Agriculture Division, 2014–2015; Crops and livestock distribution data.

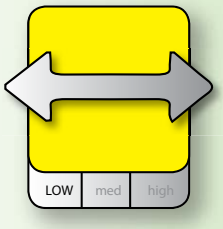
RMI Second National Communication to the UNFCCC, 2015.

OVERVIEW

The land ecosystem of RMI is made up of forests, agriculture and wetlands which have been shaped by local land management practices. This theme talks about the status and management of these critical resources. The main use of forest and agriculture resources includes timber products, food security and cultural uses.

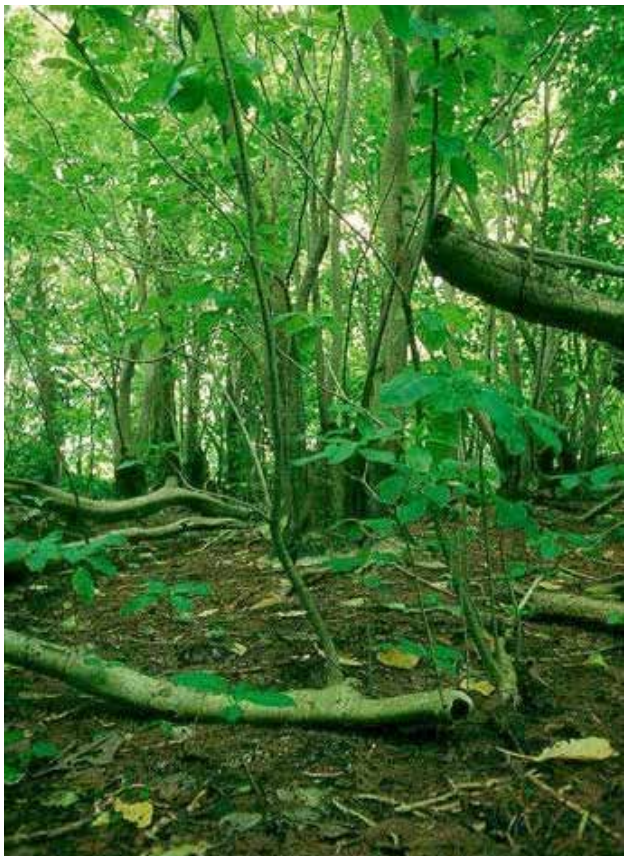
Ebon air strip. Photo: Benedict Yamamura

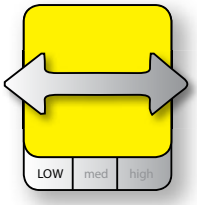
LAND HIGHLIGHTS

TOPIC	STATUS & TREND	JUSTIFICATION	RESPONSE & RECOMMENDATIONS
	 **Status** Fair **Trend** Stable **Data confidence** Low	RMI has about 70 percent total forest cover, which includes native forest, agro-forest, and coconut plantations. These forest ecosystems are in fair condition and stable.	Botanical surveys of the smaller islands, which were omitted in the 2008 survey, are needed. It is likely they contain the most intact examples of native forest.
	 **Status** Fair **Trend** Deteriorating **Data confidence** Low	Agriculture activities have reduced by about half, as shown in the RMI census report 2011. This is mainly due to the increased dependence on imported food.	A key recommendation is to conduct a nationwide agricultural census on land cultivation, farming demographics and the variety of crops being grown.
	 **Status** Good **Trend** Unknown **Data confidence** Low	RMI has two declared Ramsar sites in Namdrik and Jaluit which have been managed by the local government with support from RMI EPA. However, there is no data available to determine their current status.	RMI EPA and the local government of Jaluit and Namdrik atoll should revisit the Ramsar sites to assess their status. Also, put in place management plans if none exist.

FORESTS: NATURAL FORESTS AND COCONUT PLANTATION

The original forests have been replaced by agro-forestry to support human settlements. Only a few atolls hold the last remaining native forest ecosystems. Pisonia grandis is one of the main forest ecosystems found throughout the RMI (Figure 61). Today, the agro-forest is a mixture of trees, shrubs and herbaceous species such as coconuts, breadfruits, pandanus and bananas. Other fruit trees were introduced to diversify food crops. Due to low soil fertility, there are few crops that can be grown in an atoll soil.





Status
Fair

Trend
Stable

Data confidence
Low

Status: Fair **Trend: Stable** **Data Confidence: Low**

RMI has a stable forest cover, which has changed very little in the last 25 years. This indicator measures forest cover as a percentage of land area. There are 34 atolls and islands, of which the largest ten islands make up 74 percent (13,403 hectares) of the land area. Land cover mapping has been carried out on these larger atolls. RMI has about 70 percent total forest cover, which includes native forest, agro-forest, and coconut plantations (Figures 62 and 63). Fourteen percent of land cover area is listed as barren lands, which includes coastal areas and sand spits. About twelve percent of the landscape is urban land including roads and infrastructure, mostly on Kwajalein and Majuro, and about four percent is non-forest vegetation including rangeland and agricultural lands.

FIGURE 61. Kanal – Pisonia grandis forest (Photo: Mark Merlin).

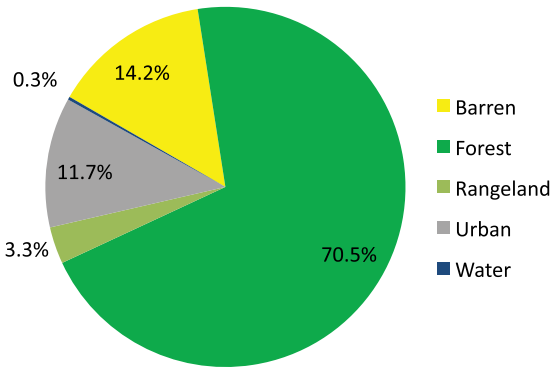


FIGURE 62. The graph represents the ten largest islands, 70 percent of which is estimated to be forested in a mixture of agro-forest and native species. Urban lands account for twelve percent of the land cover (Donnegan et al, 2008).

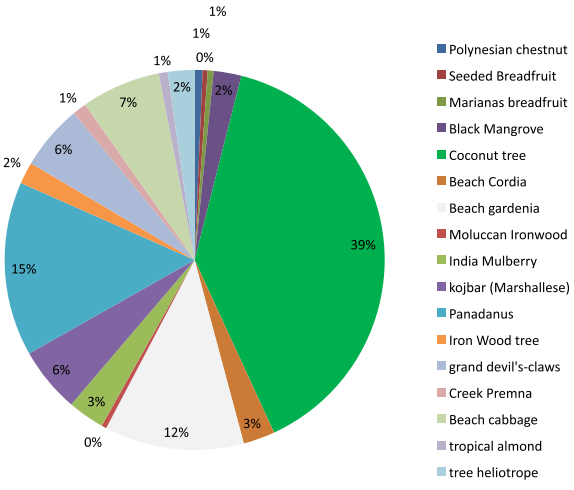


FIGURE 63. Average tree species mix based on sample plots on the ten largest islands (Donnegan et al, 2008).

A comprehensive study of botanicals has yet to be carried out although some atolls were studied decades ago. Three of these atolls have not been permanently occupied and represent an example of native vegetation. To understand the complexity of the forests ecosystems, a national baseline is needed for trend analysis and comparisons (SWARS, 2010–2015).

The information on forest condition indicates that about 37 percent of sampled trees had some form of damage, mostly caused by unspecified insects and other vegetation, including vines (SWARS, 2010–2015). This indicates that the existing forest cover is in moderate to fair condition.

The land cover data is available for 10 atolls out of 29 and five islands, in GIS format. It shows that RMI is mainly covered by forest except in a few select locations where urban areas dominate. These are Majuro (49% urban) and Kwajalein (30% urban). Barren land cover is the second most common land cover type – this is made up of sand and coral bars along and between islets (Figure 64).

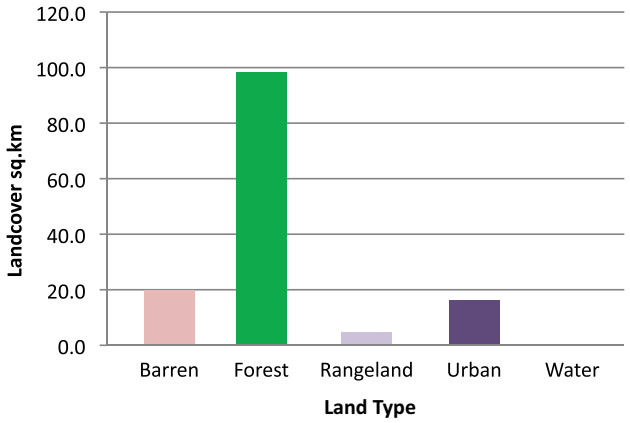


FIGURE 64. Sq Km by land cover type for the 10 largest atolls (Donnegan et al, 2008).

IMPACT

The changes of forest cover on the main urban atolls greatly reduce the habitat and key species of importance. Increased urbanisation has major negative impacts on ground water and forest biodiversity. The loss of forest cover and native tree species has major implications for native fauna. Coastal strand/forest vegetation plays an important role in reducing salt damage to crops and other forest vegetation – the loss of this buffer has adverse consequences.

RESPONSE AND RECOMMENDATIONS

The botanical surveys of the smaller islands – neglected during the 2008 survey – are needed as they contain the most intact examples of native forest. It is recommended that regular and comprehensive monitoring be conducted, particularly in the urban centres, to help spot trends.

Ministry of Resources and Development

SOURCES

Republic of the Marshall Islands State-Wide Assessment and Resource Strategy, 2010–2015. Ministry of Resources and Develop, June 2010.

Donnegan, Joseph A.; Trimble, Steven T.; Kusto, Karness; Kuegler, Olaf; Hiserote, Bruce A. 2011. Republic of the Marshall Islands forest resources, 2008. Resour. Bull. PNW-RB-263. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

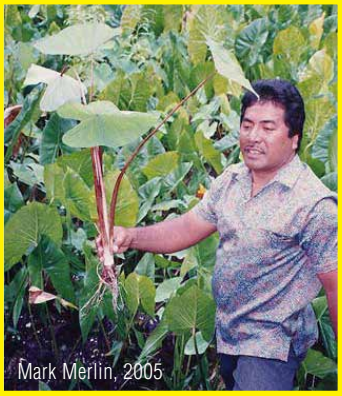
AGRICULTURE: LAND UNDER CULTIVATION

Agriculture is an essential part of the RMI culture and economy, particularly around crops such as taro, coconut, banana, pandanus and papaya, and livestock such as pig, chickens and ducks. Goats were recently introduced. As the total area under cultivation is unknown, an agriculture census needs to be carried out to set a baseline and also to identify all areas under cultivation. Figure 65 shows the giant swamp taro pits on Ebon. Coconut plantations are the most common form of agriculture in RMI (Figure 66).

The main challenge to agriculture and animal husbandry on an atoll is scarcity of water and low soil fertility. RMI is located seven degrees north of the equator, which means there is a little variation in annual temperature. However, the northern part of the RMI is much drier with an annual average of 20 inches, compared to the average annual rainfall of 160 inches in the southern atolls. The negative trend in annual rainfall may contribute to a decrease in agriculture productivity, however the data trend is incomplete.

This indicator tracks the number of households involved in agriculture and livestock production, and the variety of crops being cultivated.

FIGURE 65. Iaraj – giant swamp taro plantation on Ebon (Mark Merlin).



Status
Fair

Trend
Deteriorating

Data confidence
Low

Status: Fair Trend: Deteriorating Data Confidence: Low

Based on anthropological evidence, the Marshallese depended on small scale agriculture prior to Western contact. This has declined based on the 2011 census. However, the RMI has not conducted a nationwide agricultural census to assess the area under cultivation, trends in crop production and economic output (Merlin et al, 1994).

In 2011, census data shows that over half the households were engaged in growing crops, a slightly lower percentage in raising livestock, and a fifth of the households involved in copra production (Census 2011). Fifty two percent of households were engaged in growing crops, mainly for subsistence, 42 percent grew crops for subsistence only, ten percent grew crops for both income and subsistence, and less than one percent grew crops for income alone (Figure 67). Both urban and rural populations were engaged at similar percentages in agricultural production (Figure 68). However, copra production in rural areas is nearly ten times higher than in urban areas due to the large amount of land needed to make it economically feasible.

Nearly all households were involved in agricultural production prior to Western contact. The current rate of 52 percent of households represent an obvious decline in agriculture participation. It is not possible to say when this decline occurred or whether it was fast or slow.

The Laura farmers' association, which provides local produce to the largest market in RMI, is collecting data on produce sold for 17 different crops. This dataset is the best available on quantity and variety of crops grown. While the Laura area is just one of many, it indicates the crop varieties grown and the seasonality of local crop availability.

Data from the Laura farmers' association shows seasonal trends in crop production, with the highest yields in the summer months (Figure 68). The top three products by weight are radishes, cucumbers and pell gourds. Given the

FIGURE 66. Coconut Plantation in the RMI (Photo: Steve T. Trimble).

lack of historical data, the list of 17 crops may provide a good baseline for future monitoring (Figure 70).

The Ministry of Resources and Development started a program in 2013 to provide seed stock and livestock to 22 outer islands.

IMPACT

The impacts which have negative effects on the agriculture sector include less food being produced locally, more imported food, and loss of traditional agricultural practices. These are the effects of rapid development in the main urban centres, as well as climate change (particularly changing rainfall patterns, drying out of soil and water lenses, and saltwater intrusion). All these factors add to poor soil fertility and loss of land for farming. Reduced agricultural output is also affected by globalisation. For example, the relatively low price of imported food, and the challenges of transporting locally produced crops, makes it harder for local farmers to market their produce.

RESPONSE AND RECOMMENDATIONS

A key recommendation is to conduct a nationwide agricultural census. The census can help to answer questions about land cultivation, farming demographics and the variety of crops being grown. It is also an opportunity to develop a better understanding of traditional agriculture practices and crops.

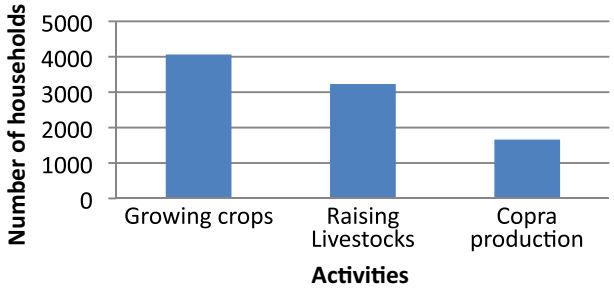


FIGURE 67. Number of households engaged in agricultural activities in 2011 (RMI census 2011).

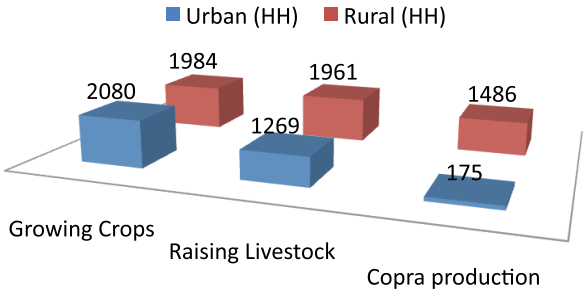


FIGURE 68. Number of households engaged in agriculture activities in 2011 by urban and rural sectors (RMI census, 2011).

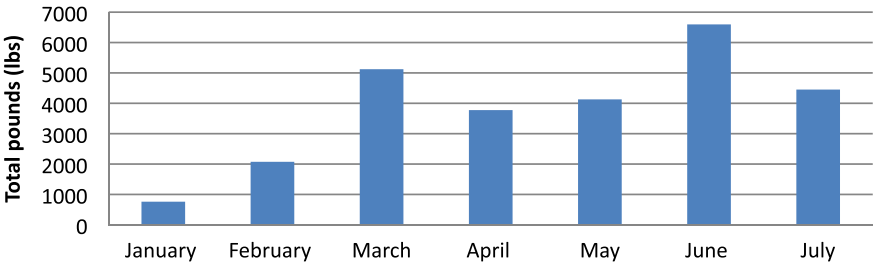


FIGURE 69. Pounds of produce per month from the Laura Farmers association 2014. (Ministry of Resources and Development).

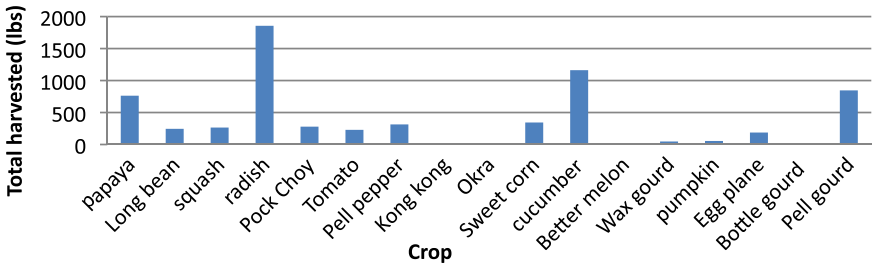


FIGURE 70. Produce variety and weight, Laura farmers association. (Ministry of Resources and Development, 2014).

SOURCES

Laura Farmers' Association 2014 produce harvesting data, unpublished, RND.

Merlin, Mark; Capelle, Alfred; Keene, Thomas; Juvik, James and Maragos, James. Plants and Environments of the Marshall Islands (Keinikkan im Melan Aelon Kein), 1994.

Ministry of Resources and Development.

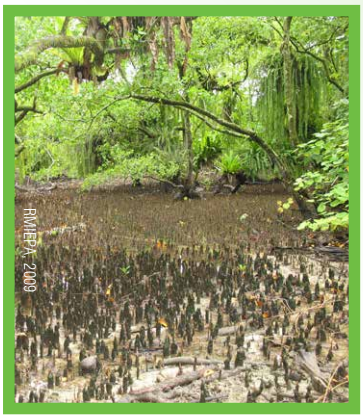
RMI Census Report, 2011.

WETLANDS

Wetland, as defined by Ramsar, are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six metres (Ramsar, 2003). In the RMI, wetlands include diverse marine and terrestrial habitats, including reefs, sandflats, lagoons, seagrass beds, deep water, mangroves and sand cays. Wetlands support a wide range of species that are presently maintaining relatively healthy, reproducing populations.

There are two designated Ramsar sites in RMI – the Jaluit and Namdrik atolls. Namdrik Atoll is one of the smallest with an enclosed lagoon that cannot be accessed by boats. It is one of a few atolls which support mangroves and other native endangered species, as well as the critically endangered hawksbill turtle. Jaluit Atoll also has mangrove systems and supports a range of endangered and critically endangered species.

This indicator describes the importance of wetlands and measures the level of effective wetland management in the RMI.



Status
Fair

Trend
Unknown

Data confidence
Low

Status: Good **Trend: Unknown** **Data Confidence: Low**

RMI has two declared wetlands of international importance with a combined area of 11.38 sq km and some of the most diverse wetland (Table 8). These sites were declared Ramsar sites for a number of reasons, including hosting a breeding population of critically endangered hawksbill turtles, the coconut crab and other rare species. Wetland habitat is more common in the southern atolls, the extent of which is currently unmapped. The two Ramsar designated atolls, Jaluit and Namdrik, have wetland areas that are mapped and being formally managed (Figure 71).

Active management of the Ramsar sites is limited by distance and budget limitations. Both Ramsar sites have local management plans that are managed by the local government with support from the RMI EPA office. An ecological study in Namdrik found that the reefs are healthy and intact (Hulk et. al., 2013).

FIGURE 71. Map of Ramsar Wetlands in the RMI. (Map by SPREP-EMG/GIS).

TABLE 8. Total wetlands in the RMI (Ramsar).

Atoll	Description	Area (km2)
Jaluit	Whole atoll	11.34
Namdrik	Madad islet	0.04

Both Jaluit and Namdrik have unique wetland ecosystems which support various species. The sites have mangrove ecosystems similar to those in the wetter southern atolls. These provide important nurseries for a variety of terrestrial and marine species. The wetland areas also provide habitats for threatened species within and around the sites (Tables 9 and 10).

TABLE 9. Jaluit Atoll species of interest and ecosystem list: (Ramsar).

	SPECIES OR ECOSYSTEM	TYPE	HABITAT	STATUS (IUCN)
Flora	Mangrove ecosystem	forest	terrestrial	Endangered
Fauna	Green	turtle	marine	Endangered
	Hawksbill	turtle	marine	Critically Endangered
	Frigate	bird	terrestrial	vulnerable
	Noddy tern	bird	terrestrial	Least Concern
	White-tailed tropicbirds	bird	terrestrial	Least Concern
	Crested tern	bird	terrestrial	Least Concern
	Brown Boobies	bird	terrestrial	Least Concern
	White tern	bird	terrestrial	Least Concern
	Micronesian pigeon	bird	terrestrial	Near Threatened
	Coconut crab	crab	terrestrial	Data Deficient
	Mangrove crab	crab	marine	Data Deficient
	Trochus	molluscs	marine	Data Deficient
	Sea cucumbers	echinoderm	marine	Data Deficient
	Blacklip pearl oysters	molluscs	marine	Data Deficient
	T. gigas	molluscs	marine	Data Deficient
	T. maxima	molluscs	marine	Data Deficient
	T. squamosa	molluscs	marine	Data Deficient
	H. hippopus	molluscs	marine	Data Deficient
Total species: 19				

TABLE 10: Namdrik Atoll species of interest and ecosystem list (Ramsar).

	SPECIES OR ECOSYSTEM	TYPE	HABITAT	STATUS (IUCN)
Flora	Mangrove ecosystem	forest	terrestrial	Endangered
	Giant Swamp Taro	plant	terrestrial	Vulnerable
	Serrated Ribbon Seagrass	plant	marine	Endangered
	Ponapean peperomia	plant	terrestrial	Vulnerable
Fauna	Green	turtle	marine	Endangered
	Hawksbill	turtle	marine	Critically Endangered
	Humphead Wrasse	fish	marine	Endangered
	Bristle-thighed Curlew	bird	terrestrial	Endangered
	Tree-hole Mosquito	insect	terrestrial	Data Deficient
	Crane Fly	insect	terrestrial	Data Deficient
	Land snail	molluscs	terrestrial	Data Deficient
	White-browed Rail	bird	terrestrial	Lease Concern
	Arno Skink	lizard	terrestrial	Lease Concern
	Sea cucumber	echinoderm	marine	Data Deficient
	Mantis Shrimp	crustacean	marine	Data Deficient
Total species: 15				

IMPACT

The destruction of wetlands can have major negative impacts on the atolls' natural environment and ecosystems, as wetlands provide critical habitats to both marine and terrestrial species, endemic and threatened. Wetland areas also provide coastal protection from storm surges and land erosion.

RESPONSE AND RECOMMENDATIONS

RMI is establishing another Ramsar site on Lib Island which has a freshwater wetland that is yet to be managed. Preserving these national resources will benefit the environmental health of RMI. It is recommended that more wetlands be conserved and managed accordingly.

Photo source: Huffington Post. Photo by Jake Marote, 2015

SOURCES

Houk, P., Benavente D., Mclean, M., Camacho, R., Capelle, J., Silk, M., White, M., Jacobson, D., and Hess, D. " Namdrik Atoll Coral-Reef Resources Monitoring Assessment". University of Guam Marine Laboratory, College of the Marshall Islands, and Marshall Islands Marine Resources Authority, 2013.

Jaluit Atoll Ramsar Information Sheet, 2003.

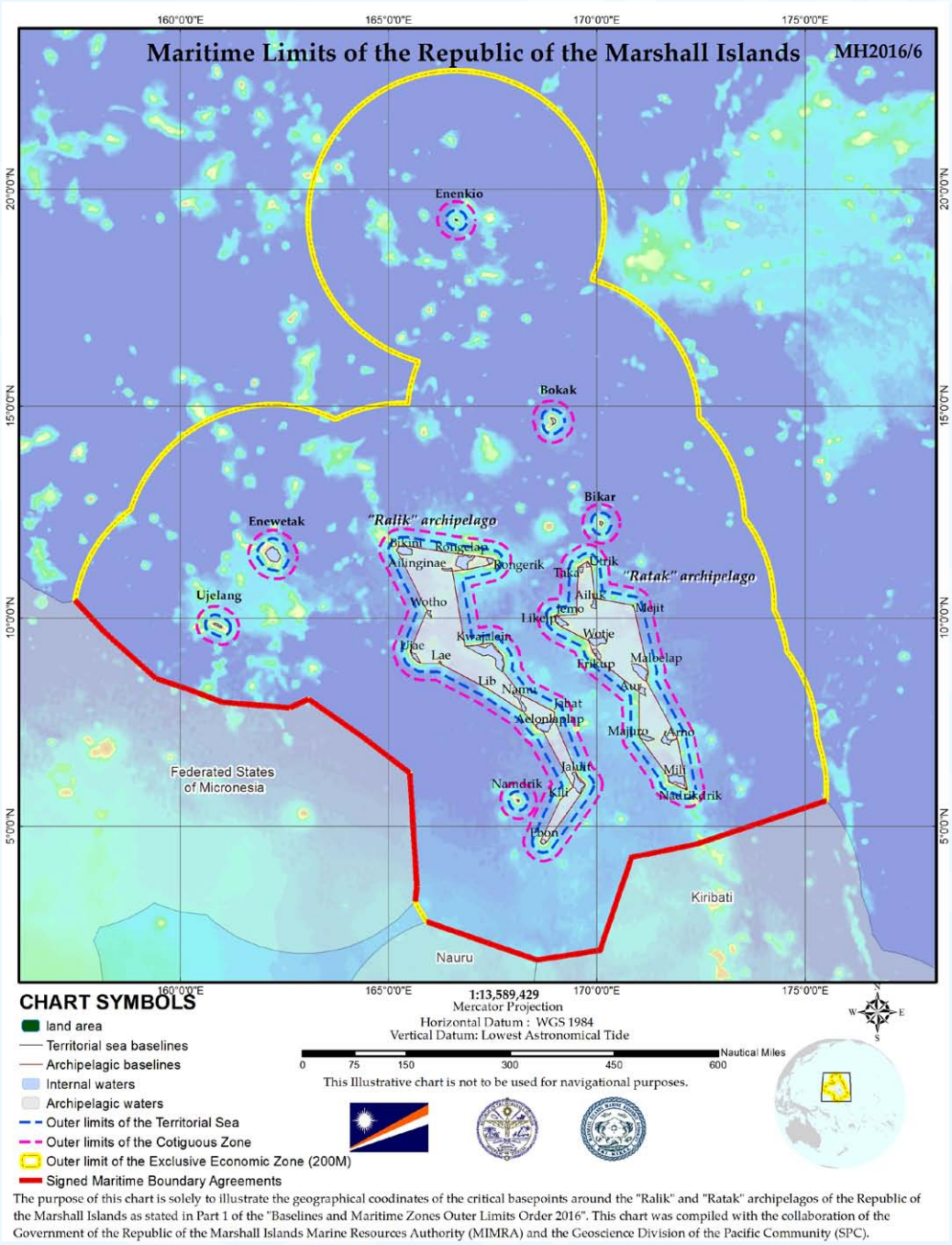
Namdrik Atoll Ramsar Information Sheet, 2009–2012.

Ramsar site map by SPREP-EMG/GIS, 2016.

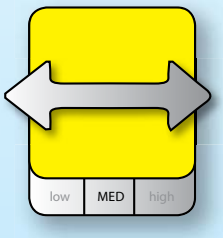
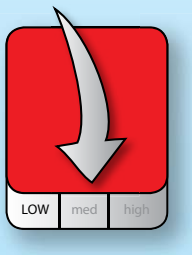
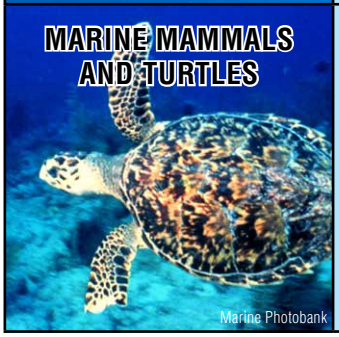
OVERVIEW

The overall state of RMI's marine environment is intact and in good and stable condition. There are over 1000 species of fish, 1600 of mollusc species, and more than 250 species of algae and stony corals. There is a unique management regime where traditional and modern styles are integrated to manage and conserve the nation's marine resources.

In 2011, RMI declared its entire Exclusive Economic Zone a shark sanctuary, banning all activities associated in harvesting sharks and body parts for commercial purposes. The tuna fishery is overfished. Strengthening the monitoring and surveillance is necessary to ensure the tuna stocks are sustainably harvested and managed in the EEZ.



MARINE HIGHLIGHTS

TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
 Paul Anderson, 2015	 **Status** Fair **Trend** Deteriorating **Data confidence** Medium	The state of tuna fishery effort is deteriorating with dramatic increases in total tuna catch. The biomass has declined up to 40 percent. This adds more pressure on the offshore fisheries where catch of all tuna species has exceeded their maximum sustainable yield.	• RMI needs to carefully manage its offshore fisheries to ensure tuna stocks are not overfished. • Strengthen monitoring and enforcement in the RMI-EEZ to ensure foreign fishing vessels comply with RMI's laws.
 Karl Fellenius, 2016	 **Status** Good **Trend** Mixed **Data confidence** Medium	The inshore reef systems and fishery is relatively healthy and stable. Majuro, the most populated and developed area, has reef systems that are still intact. However, pressures on Majuro coral reef ecosystems will increase as its population expands.	• Monitoring needs to continue and be more consistent. • Permanent monitoring sites need to be established to help determine environmental trends of coral reefs over time.
 MIVA	 **Status** Fair **Trend** Stable **Data confidence** Medium	There are 63 marine managed areas covering about 70 percent of reef area in the RMI. Most of the areas are yet to have proper management plans.	Establish management plans for each marine protected area. Work with local governments on improving monitoring and enforcement.
	 **Status** Poor **Trend** Deteriorating **Data confidence** Low	Marine lagoon water quality has deteriorated mainly in the urban centres. The three most contaminated sites in 2014 were Alwal, Jenrok 2 and Small Island. Bacteria counts in the three sites reached over 24,000MPN/100m: the safe standard for lagoon recreation is 104MPN/100ml.	The RMI EPA is improving its capacity to monitor and enforce national regulations on pollution. RMI EPA needs to establish data storage systems to provide sufficient time-steps to determine trends and the relative pro-portion of pollution sources to the marine environment.
 Marine Photobank	 **Status** Poor **Trend** Unknown **Data confidence** Low	There is limited data to indicate the true state of marine mammals and turtles in the RMI.	RMI needs to establish appropriate conservation and management plans for both turtles and marine mammals, particularly for endangered mammals.

OFFSHORE MARINE ENVIRONMENT TUNA, SHARKS AND BY-CATCH HARVESTED

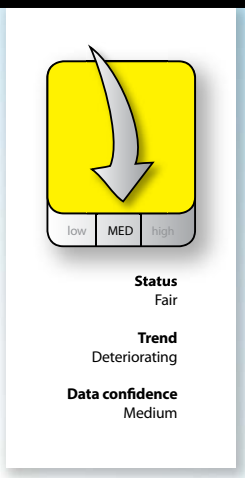
The tuna fishery and the offshore fishery in general are the (Figure 72) top income earners for RMI which is about fourteen percent in 2014 (Graduate School, 2015). This natural resource is the backbone for Pacific islands countries. Offshore fisheries production is an important indicator of pelagic (offshore) fish stock health. This indicator measures the state of offshore fisheries and management, as well as the general state of commercial species and by-catch trends, including sharks and other species.

From 2002 to 2012, the tuna fishery in RMI was dominated by foreign purse seine fleets from Asia, Europe and the United States, mainly targeting skipjack tuna. There are a growing number of domestic long line vessels of mainly Asian-flagged companies. These long-liners target other tuna species such as albacore, yellowfin and bigeye.

Starting in 1966, the FAO recorded a catch of 100 metric tons per year up until the mid-1980s when the catch doubled and trebled, increasing dramatically in 2000. A fish loining plant was established in 1997 which increased the demand for tuna. The RMI pelagic fishery is under-used due to lack of investment, low foreign interest and unclear jurisdiction during the Trust Territory era, leading to low trends of catch.

Skipjack tuna harvested by purse seining is the major component of the fishery in the EEZ. The other two target species are bigeye and yellowfin tuna which make up 20 percent of the total fisheries catch.

The main consumers are canneries in Thailand and Indonesia. The average fish consumption per person per year is about 39 kg. However, the Marshallese people consume most of their fish protein from reef fish. The reefs are able to supply 700 kg of fish per person per year (Bell, 2011).



TUNA AND TUNA-LIKE SPECIES

Status: Fair Trend: deteriorating Data Confidence: Medium

In the last decade the tuna catch has been stable except in 2003, when it declined in RMI and the rest of the region. During the same period the RMI skipjack catch has topped out between 15,000 and 20,000 metric tons. Current trends indicate that the tuna catch for RMI is stable but, potentially, is maxed out due to negative trends in pre-harvest biomass levels. One notable negative trend is the bigeye tuna stock, which is being harvested unsustainably in the Western Central Pacific Region.

The trend in RMI is repeated in the western and central Pacific Ocean, where catches for most tuna species have increased dramatically. Regional stock assessments indicate that key tuna stocks in subregional waters encompassing RMI have declined in biomass up to 40 percent, based on a 2000 baseline study (SPC, 2013). Recent SPC stock assessments for the western Pacific report that albacore, yellowfin and skipjack fisheries all exceed maximum sustained yields and are not currently

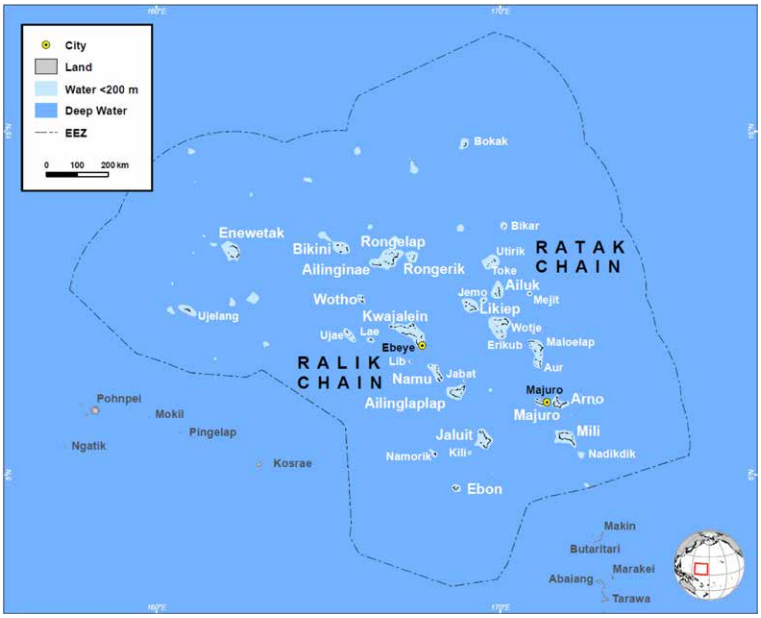


FIGURE 72. RMI EEZ showing the Ralik and Ratak chains.

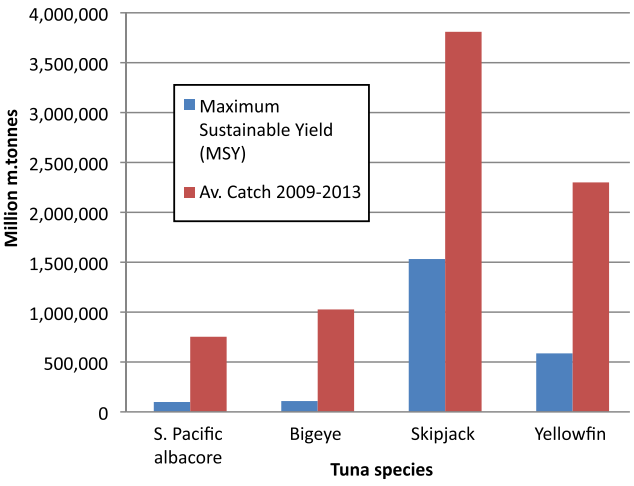


FIGURE 73. Regional data on MSY vs. average catch from 2009 to 2013 (Harley. SPC, 2013).

overfished but are vulnerable (Figure 73). Bigeye tuna is of particular concern because the recent 2015 assessment reports that bigeye catch is well above its maximum sustained yield and is considered overfished, with only 16 percent biomass pre-harvest remaining (FFA 2015). Albacore is not currently overfished, but is vulnerable to being overfished as longline catch continues to increase dramatically. In addition, yellowfin is considered fully exploited with no room for expansion (WCPFC yearbook, 2014).

The RMI pelagic fishery is dominated by skipjack tuna, followed by bigeye and yellowfin. Skipjack tuna harvest data from 2002 shows a maximum catch of 35,000 tons, with an average catch of about 18,000 tons (Figure 74). Regionally, both bigeye and yellowfin are at risk. According to the Western and Central Pacific Fisheries Commission (WCPFC), bigeye is subject to overfishing (Figure 75) and yellowfin stocks are vulnerable to overfishing (WCPFC, 2014).

BY-CATCH

By-catch represents over 1000 metric tons per year, composed primarily of blue marlin, followed by wahoo and mahimahi (Figure 76). The highest by-catch was recorded in 2010 where over 1,150 metric tons was caught. Although the numbers of annual by-catches seems low, over time if the trends increase, it can have major negative impacts on these untargeted fish species. There is a need for better fishing practices to control, better manage and determine the status of these fish species.

Sharks

A third of shark populations worldwide are considered endangered under the IUCN Red list. Figure 77 shows an example. Prior to the shark ban, up to 250 metric tons of shark per year were either caught as by-catch or targeted.

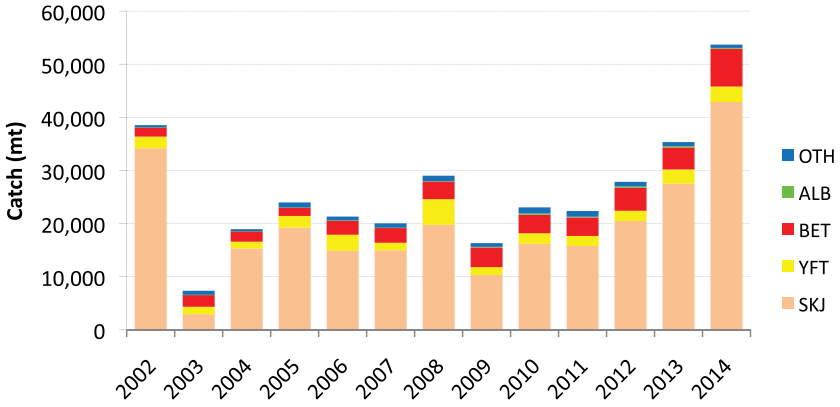


FIGURE 74. RMI tuna catch from 2002–2014 (From MIMRA pole and line, longline, and purse seine catch data).

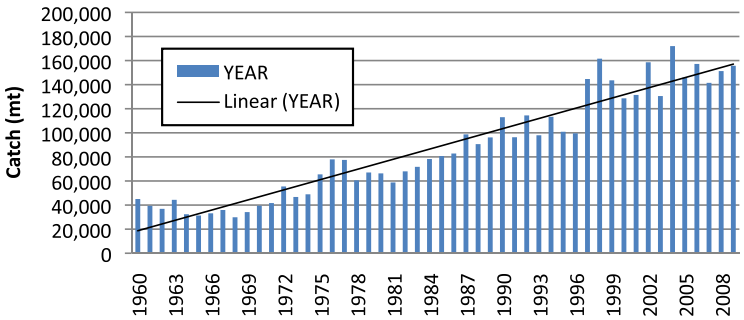


FIGURE 75. Historical bigeye tuna catch across the WCPFC region.

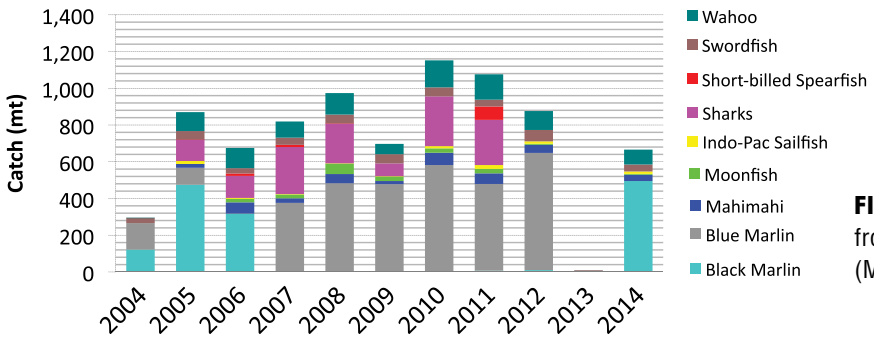


FIGURE 76. Other pelagic species harvested from by-catch and targeted fisheries in RMI (Marshall Islands Marine Resources Authority).

FIGURE 77. Oceanic white tip shark-Carcharhinus longimanus is the most vulnerable shark species (Photo by: Terry Goss).

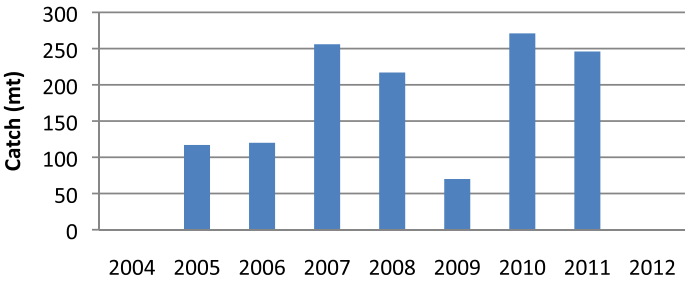


FIGURE 78. Number of shark by-catch reported since 2004 in RMI's EEZ (MIMRA, 2012).

In the MIMRA Act 1997 and the Fisheries Act, Bill 100 came into effect on 17 October 2011, which banned shark finning and possession of shark fins and body parts. This resulted in no shark catch record in the 2012 (Figure 78) and the declaration of RMI's EEZ as a shark sanctuary. Monitoring and enforcement is necessary to ensure no shark harvesting occurs in the RMI EEZ. A critical component of monitoring and enforcement is the observers programme, supported by the Western and Central Pacific Fisheries Commission (WCPFC) and the Secretariat of the Pacific Community (SPC). The ban on shark harvesting indicates a positive trend in by-catch.

IMPACT

The leading cause of overfishing is economic exploitation. Unsustainable fishing leads to a collapse in stocks which balance the marine ecosystem.

The removal of key species like sharks, that maintain the trophic balance, can impact the inshore and offshore ecosystems. Shark harvesting in the Pacific is mainly of silky, hammerhead, white-tip and blue sharks, all of which are classified by the IUCN as near-threatened. Shark populations are extremely vulnerable to overfishing because sharks grow very slowly, and have a much lower capacity to reproduce than other bony fish species. Similar to sharks, the bigeye tuna is harvested well beyond its critical limits and it is listed as a vulnerable species in the IUCN Red list.

RESPONSE AND RECOMMENDATIONS

RMI is a member of the Parties to the Nauru Agreement (PNA) and the Forum Fisheries Agency (FFA) and is signatory to some international maritime conventions and treaties (Table M1). The RMI tuna fishery is managed under PNA's Vessel Day Scheme (VDS), where member countries agreed to limit the number of fishing days. The number of fishing days are then allocated to each country and sold to the highest bidder. The PNA has benefitted RMI's economy and its marine resources.

RMI is also part of the Niue treaty which was ratified in 1995. Under the treaty, the members of the FFA agreed to enhance the ability of surveillance and enforcement of their fisheries laws by working together to address illegal fishing and other unlawful activities.

In 2011, RMI declared its entire EEZ as a shark sanctuary, and banned any activity associated with harvesting sharks. However, it is recommended that a proper shark management plan is established.

SOURCES

Bell, J.D., Johnson, J.E., and Hobday, A.J. (2011). Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change. Noumea, New Caledonia: Secretariat of the Pacific Community.

Harley, S., Davies, N., Hampton, J. and McKechnie, S. SPC Oceanic Fisheries Programme. Stock Assessment of Bigeye Tuna in the Western and Central Pacific Ocean. Report to the Scientific Committee, Tenth Regular Session, Majuro, Marshall Islands, 2013.

Marshall Islands Statistics Office – Overseas Trade Statistics June 2015.

Marshall Islands Marine Resources Authority (Personal Communication Feb. 2015).

Western and Central Pacific Fisheries Commission. Tuna Fishery Yearbook 2013. Secretariat of the Pacific Community, Noumea, New Caledonia.

Photo credit: WWF, Troy Mayne, 2015

INSHORE MARINE ENVIRONMENT PERCENT LIVE CORAL COVER

Live coral reef cover is a significant indicator of the overall state of the inshore ecosystems. For this indicator, live coral cover is defined as the area covered with living coral, both stony and soft corals (Figure 79).

Coral cover provides an indirect measure of land-use impacts and erosion, fishing pressure, relative sea surface temperature (SST), presence of disease and predators like the crown of thorns starfish and mechanical damage from anthropogenic sources or natural phenomena like typhoons. Trends in live coral cover indicate the relative resiliency and health of coral ecosystem at a given site. This indicator is a basic data type for most surveys. The lagoon reef ecosystem is a critical factor in an atoll environment where it provides shelter, protein and income for local communities.

FIGURE 79. Corals in Woja, Ailinglaplap Oceanside (Photo by: Karl Fellenius, 2013).

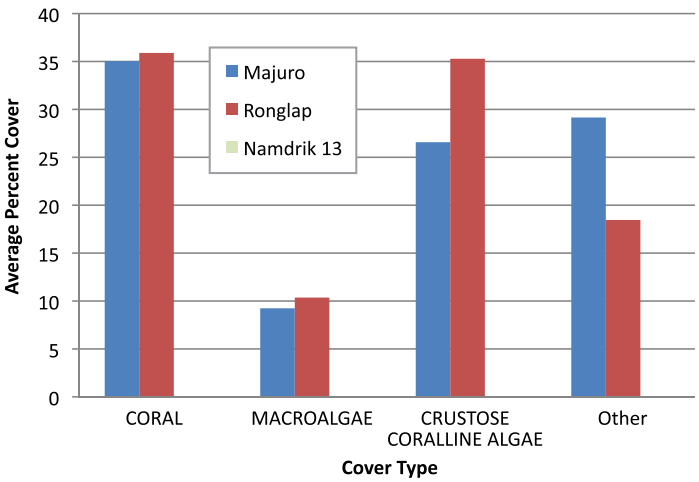
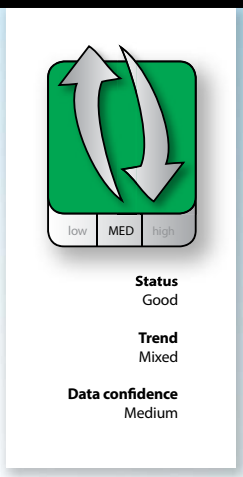


FIGURE 80. Majuro and Rongelap substrate categories from 2003, 2004 (NRAS). Namdrik was recently surveyed in 2013 (Houk et al, 2013).



Status: Good Trend: Mixed Data Confidence: Medium

Coral cover across atolls is relatively healthy, at or above the Indo-pacific average of 22 percent (Figures 80 and 81). Coral reefs in RMI undergo a cycle of decline and recovery from crown of thorns starfish (COTS) or typhoons. One example is the COTS outbreak in southern Majuro between 2004 and 2009 (Waddell, J.E. and A.M. Clarke (eds.), 2008).

Coral cover in RMI is relatively healthy. However, the coral bleaching event in 2014 may have reduced coral cover and recovery. A survey at the end of 2014 suggested that up to half of Majuro's coral cover was affected (Fellenius et al. 2014). With healthy herbivore fish populations, the algae that grows on post-bleaching mortality coral skeletons gets cleaned off, and provides good surfaces for coral recruitment. Because reef fish herbivores are overfished in Majuro, the situation resulted in skeletal collapse, increase in loose rubble and debris, and ensuing loss of both fishery and shoreline protection ecosystem services. Protection of herbivores is paramount before, during, and after coral bleaching events. Documentation of coral bleaching events in Majuro from 2008 to 2014 indicates that this is becoming more common. The dominant coral species found in Majuro lagoon is Porites rus, which is more resistant to changes in temperature and sunlight exposure compared with other species. However, it serves as poor fisheries habitat and has a skeletal foundation which is comparatively weak in the context of shoreline protection. For every bleaching event, Majuro loses coral diversity.

Variations in coral cover trends show higher coral cover in rural atolls, compared to urban atolls. However, the overall healthy reef system has the capacity to provide all the fish protein needed for human consumption now and into the future, provided appropriate management measures are put in place (PROCFish, 2009).

Consistent coral monitoring is needed at key sites to establish trends in live coral cover.

While coral cover data is not available prior to the nuclear tests in the 1950s, the current information for Bikini Atoll indicates that it represents an anomaly for the atolls for

which coral cover data exists. Bikini Atoll has the lowest coral cover of any of the surveyed atolls by a magnitude of two to three (Figure 81).

Majuro's reef system is under significant pressure due to human impacts, over-fishing and developments such as over-population and aggregate mining. Generally, the coral reefs on the northern islands of Majuro are healthy, although there is limited data available from the surveys. Figure 82 shows the atolls where recent surveys were conducted.

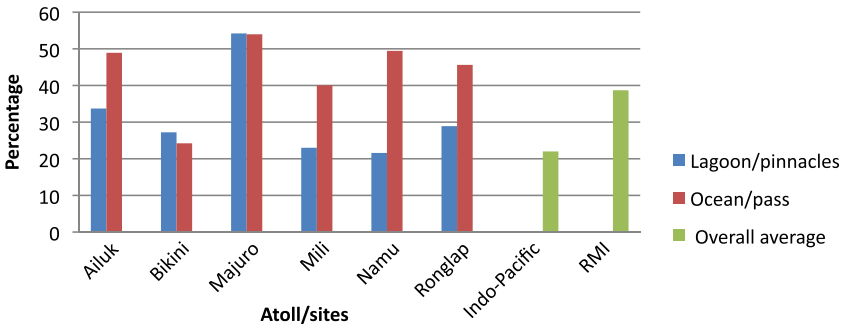


FIGURE 81. Simplified total coral cover broken down by lagoon and ocean in five atolls. (Beger. M., et al, 2008) Indo-Pacific average coral cover is 22 percent (Bruno et al, 2007).

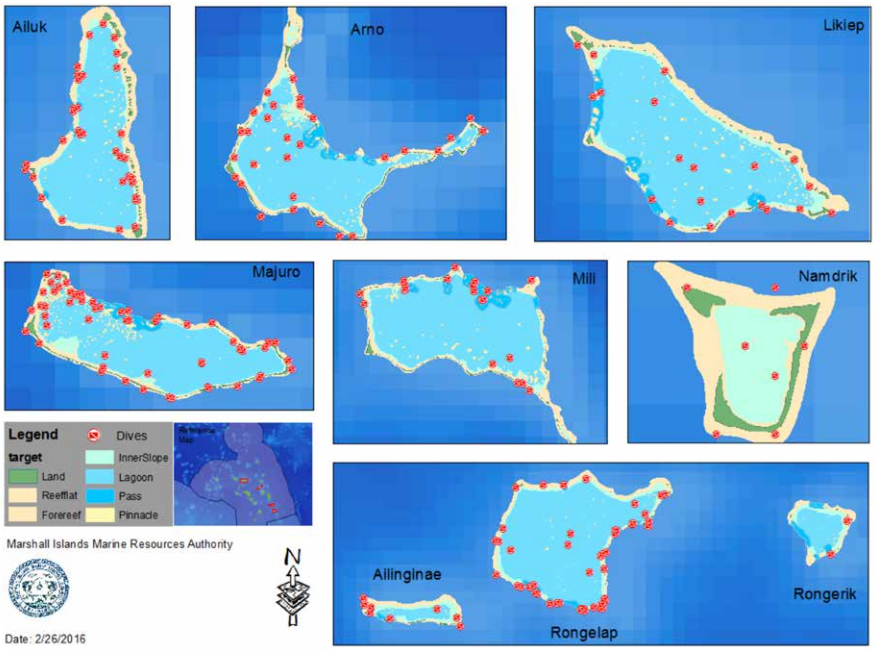


FIGURE 82. Map of all coral reef sampling sites. (MIMRA)

IMPACT

Coral reef ecosystems are relatively intact and provide key ecosystem services, including food. The condition of the reefs, particularly in the less populated islands, has a major positive impact on sustainable livelihoods, including fisheries.

RESPONSE AND RECOMMENDATIONS

- Coral reef management of RMI's reef system will benefit greatly from regular monitoring activities at the same sites over time, and through adding other sites.
- MIMRA and its Coastal Management Advisory Council (CMAC) partners support the integrated management of marine and terrestrial systems through a community-based approach implementing the Reimaanlok (National Framework for Conservation Area Planning), a framework developed in 2008. The Reimaanlok Facilitators Guide helps in the design, establishment and management of conservation areas.
- RMI is planning for replacement of the sewage outfall, which may include primary sewage treatment. Currently, discharge is on the reef flat, which is linked to an increase in Hypnea sp. bloom in eastern and southern Majuro atoll.
- There is strong coordination and collaboration amongst government agencies and NGOs (CMAC) for sharing resources for natural resource management. However, consistent monitoring and data management is lacking and needs improvement.
- It is recommended that plans be set for limited fishing of herbivores around periods of elevated SSTs in order to mitigate the effects of coral bleaching.

SOURCES:

Bruno JF, Selig ER (2007) Regional Decline of Coral Cover in the Indo-Pacific: Timing, Extent, and Subregional Comparisons. PLoS ONE 2(8): e711. doi:10.1371/journal.pone.0000711.

Houk, P., Benavente D., Mclean, M., Camacho, R., Capelle, J., Silk, M., White, M., Jacobson, D., and Hess, D. " Namdrik Atoll Coral-Reef Resources Monitoring Assessment". University of Guam Marine Laboratory, College of the Marshall Islands, and Marshall Islands Marine Resources Authority, 2013.

Houk. P, personal communication 2015.

Maria Beger, Dean Jacobson, Silvia Pinca, Zoe Richards, Don Hess, Frankie Harriss, Cathie Page, Eric Peterson5 and Nicole Baker. The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 208. NOAA Technical Memorandum NOS NCCOS 73. NOAA/NCCOS Center for Coastal Monitoring and Assessment's Biogeography Team. Silver Spring, MD. 569 pp.

Pinca. S., Majuro Underwater Resource Assessment. 2004 NRAS-College of the Marshall Islands.

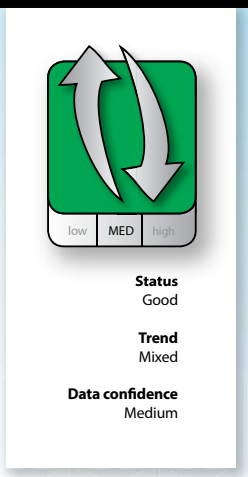
INSHORE MARINE ENVIRONMENT SPECIES DIVERSITY

Coral reefs are one of the most important natural resources in the Pacific region. Species diversity, including mega-fauna, is an important indicator for reef health. High species diversity indicates the coral reef ecosystems are intact and healthy. This indicator demonstrates the difference between urban and rural atolls and the abundance of key species. It measures the state of coastal fisheries which most communities rely on for daily subsistence needs. This indicator includes sharks which have a critical role in regulating the reef ecosystems.

When considering anthropogenic pressures like fishing and development, further analysis shows at least two changing scenarios with regards to the inshore fish populations:

1) Fishing dominated urban sites, with moderate to high fishing pressure and reduced fish biomass (e.g. Majuro and the other three population centres), and

2) Pristine rural sites, with low fishing pressure and high coral cover such as uninhabited atolls like Rongerik, Taka, providing very high levels of key species and coral cover. Pristine reefs are sensitive to natural disaster events such as typhoons, ocean acidification, coral bleaching, El Nino events, high temperature events and crown-of-thorns outbreaks.



Status: Good **Trend: Mixed** **Data Confidence: Medium**

The Houk and Musburger data shows a similar pattern in food fish species diversity in Rongelap, Namdrik and Majuro. Rongelap, with its low fishing pressure and large lagoon size, has higher food fish species diversity compared to Majuro, with an average ten species less by transect (Figure 83).

Majuro, the most populated atoll, has a relatively good number of fish species per site. A survey conducted by Houk and Musburger in 2011 shows that fish species diversity is similar in numbers for Majuro, Namdrik and Rongelap. The PROCfish 2009 report conducted by SPC indicates that Ailuk, Arno and Likiep had similar numbers in terms of fish biomass, size and fishing pressure (refer to Table 11 in the Reef Fish section).

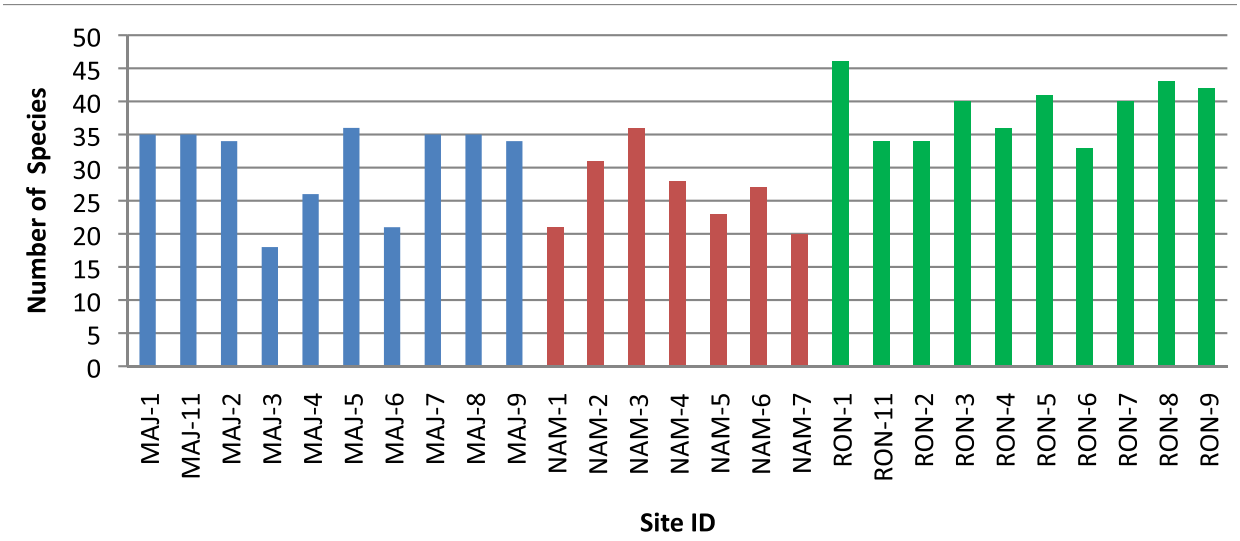


FIGURE 83. Total species per site recorded in a 50m transact (P. Houk and C. Musburger, 2013).

SHARKS

Much like the oceanic sharks, reef sharks are susceptible to fishing pressure and are more likely to decline in number in highly populated areas. They are an important apex predator to the marine ecosystem as they help to maintain the healthy function of the reef ecosystem. As shown in Figure 84, Namdrik and Rongelap have three times more sharks compared to Majuro which has the most development and highest population density in RMI.

IMPACTS

The reduction of fish diversity and shark abundance in urban centres such as Majuro is a negative trend and should serve as a warning signal for the outer islands. Marine biodiversity give RMI its distinctiveness, with certain atoll communities known locally for their unique marine settings. Increasing demand for fish production in the urban centres may lead fishers to shift to alternate fishing grounds in the outer islands, which can threaten biodiversity in these areas if management measures are not in place.

Introduction of non-native invasive species or exotic species is another major impact on the marine biodiversity. Studies have shown that the introduction of invasive species are a greater threat to the biodiversity compared to pollution, over-harvesting and diseases. Case studies in the region have highlighted where an introduced species has altered habitats and disrupted the food chain. Although fish diversity is comparatively high, only a select few marine species have commercial and social importance – if these are affected, the livelihoods of communities will be directly affected.

RESPONSE AND RECOMMENDATIONS

RMI declared the whole of its EEZ as a shark sanctuary in 2011. The Marshall Islands Mayors Association (MIMA) also passed resolutions in support of the shark sanctuary. The monitoring, control and surveillance efforts should be extended to outer islands with training and capacity buildingof local governments. This is challenging due to the vast protection measures also needed for other species.

With resource support from the Micronesia Challenge, CMAC is working with stakeholders to establish guidelines and benchmarks for communities (current and new sites) to distribute resources. The Reimaanlok process to develop Management Plans and Ordinances also supports communities to continue activities identified in their Management Plans. This includes the monitoring, control and surveillance measures

Regulations and guidelines are to be developed in regards to alien and invasive marine species. With a regional Invasive Species Strategic Action Plan for Micronesia and Hawaii in place, gaps in capacity are being addressed. Local community Management Plans should include activities to slow the influx of invasive species and deal with them more effectively.

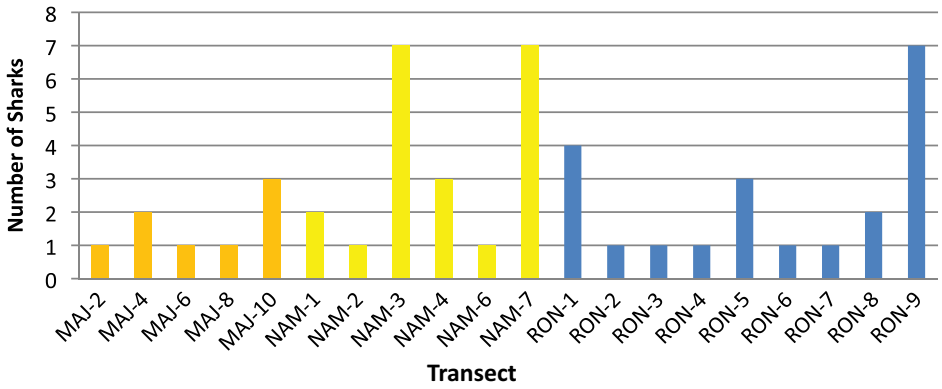


FIGURE 84. Shark count for site (Houk and Musburger, 2013).

FIGURE 85. A school of Parrotfish in Ailuk, Ailuk atoll (Photo: Karl Fellenius, 2014).

SOURCES

Houk, P., and Musburger, C. “Trophic Interactions and Ecological Stability

Across Coral Reefs in the Marshall Islands”, 2013.

INSHORE MARINE ENVIRONMENT REEF FISHERIES BIOMASS

Reef fisheries target both reef fish and invertebrates (e.g. crustaceans, clams, sea cucumbers and trochus). The Marshallese people are reliant on reef fishing for subsistence. There are two small commercial fish markets, and several “mom and pop” shops for reef fish sales. The main indicators used to assess reef fisheries biodiversity are fish consumption trends (kg/person/per day), fishing pressure (either in tonnes per year or tonnes per area) and fish/invertebrate densities and biodiversity.

Reefs and inshore species are mutually supportive, where reefs support fish and invertebrates with food and shelter, and fish and invertebrates help maintain and establish reef systems. The biomass of reef fish provides an insight into the health of the inshore environment in addition to anthropogenic pressures like fishing and development. Reef condition (e.g. coral cover and algal cover) can impact the relative density, species and size of fish. For example, reefs in a state of heavy algae cover are indicative of the absence of algae-eating herbivores, like parrotfish (Figure 84) and surgeonfish that could otherwise facilitate coral recovery. High coral cover supports a diverse array of fish, who use corals for shelter and feeding.

Inshore fishing typically targets larger reef fish (e.g. goatfish, parrotfish and surgeonfish), and therefore can impact the health of reefs by removing important grazers from the ecosystem. Fishing pressure is mainly led by human population and access to fish markets.

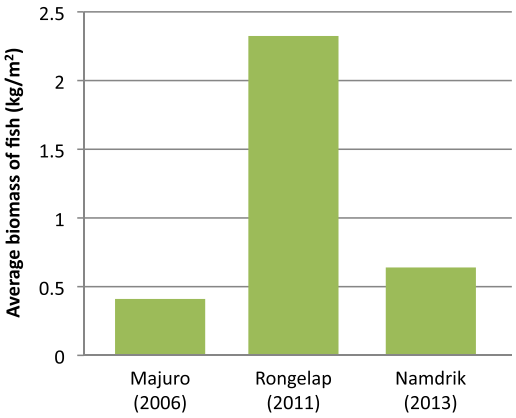
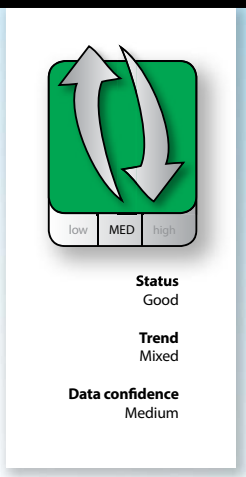


FIGURE 86. Average fish biomass by atoll. (Houk and Musburger, 2013 and houk et al, 2014).

TABLE 11. Human population numbers from the RMI national census reports (Census report, 2011).

	Lagoon size (km²)	Year of National Census		
		1988	1999	2011
Majuro	295.1	19695	23676	27797
Namdrik	8.4	814	722	508
Rongelap	1,004.30	0	19	79



Status: Good Trend: Mixed Data Confidence: Medium

The status of inshore fish biomass in the RMI is healthy. The trends are mixed based on the unique characteristics of the islands – some pristine, some with low fishing pressure due to low population density, and some with high fishing pressure.

In 2013 and 2014, two surveys were undertaken in three atolls with different population density and lagoon sizes. Rongelap has a particularly large lagoon (>1,000 km²) with a very low human population; Majuro has a moderate sized lagoon with the highest population in RMI (Houk and Musburger, 2013), and Namdrik has a very small lagoon (about 8 km²) and a moderate human population of ~500 people (Houk et al, 2014).

Rongelap has a high biomass while Majuro and Namdrik have low biomass based on the 2013 and the 2014 studies. While the biomass range in Majuro is broad (~0–200 (kg/m²]), biomass for Rongelap is higher than Majuro and Namdrik (Figure 86). Namdrik has a low human population, however the lagoon is small and isolated, which may explain its low biomass (Houk and Musburger 2013 and Houk et al, 2014).

Data collected from thirty different sites on three atolls show three very different trends, due to the unique characteristics mentioned above (Figure 87). Rongelap has six times the biomass of Majuro. Rongelap is larger with very low population density, while Majuro is a large atoll with a very high population density. However, Namdrik has a lagoon size of 8.4km² with a population of ~500 (Table 11).

The report indicates that Majuro fish stocks are in good condition. For most of RMI, fish consumption averages about 110 kg per person per year. The data is based mainly on subsistence reef fishing, which is expected to increase (Table 12). Even with nearly all households fishing, the biomass, fish size and biodiversity remains high in Majuro, Arno, Ailuk and Likiep.

The market data collected by MIMRA in 2012 shows that over 63,000 lbs (28,576.32 kg) of fish and shellfish were imported to Majuro from seven outer islands, with the closest island, Arno, regularly shipping the greatest volume of fish (Table 13). In the PROCfish report in 2009, Arno's fishing pressure was predicted to increase and the 2012 survey showing over 12,000lbs of fish being shipped to Majuro.

Grouper, squirrelfish and parrotfish were the most common fish from the outer islands in 2012 (Figure 88). While there is no trend data to suggest the outer island catch is increasing, the sheer volume indicates that the catch is an important income source as well as an increasing impact on outer island food webs.

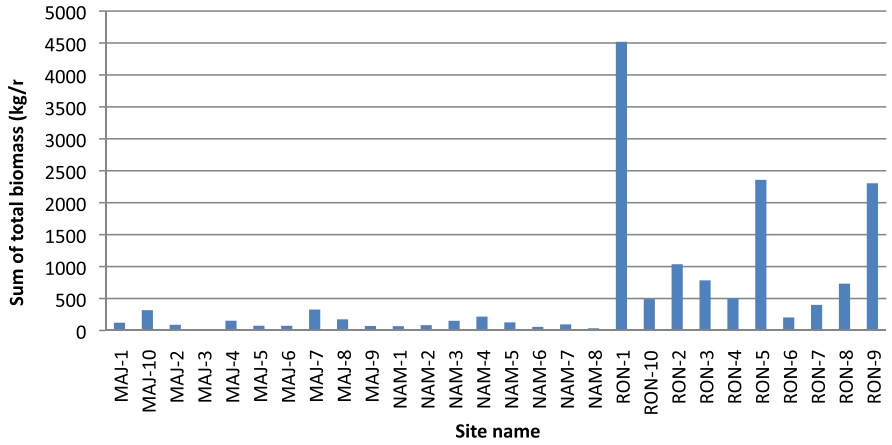


FIGURE 87. Total biomass per site, three atolls (Houk and Musburger, 2013 and 2014).

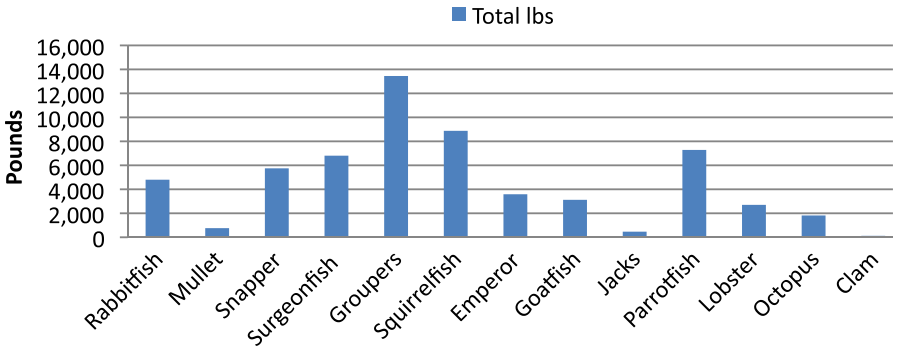


FIGURE 88. Majuro fish market data from outer islands 2012 (MIMRA, 2012).

TABLE 12. Key findings of the PROCfish resource and reef environment survey for Ailuk, Arno, Laura (Majuro) and Likiep (2009) (* Results from Preston et al, 1995)

	Ailuk	Arno	Likiep	Laura (Majuro)
Fishing Pressure	Low	Low but increasing	Low	High
Status of reef fish resources (PROCfish)				
Consumption of fish and invertebrates (kg/person/year)	120	83	128	90
Biodiversity (species per transect)	43±3	37±2	38±3	46 ±3
Biomass (g/m^2)	69.6	73	70.1	73.2
Av Size (cm Fork Length)	17	16	17	17
Size Ratio (fish size/max reported)	52	49	53	53
% HH involved in fishing	100	100	100	96

TABLE 13. MIMRA fish market data per atoll (lbs). (MIMRA, 2012)

Atoll	Rabbitfish	Snapper	Squirrelfish	Groupers	Squirrelfish	Emperor	Goatfish	Parrotfish	Lobster	Octopus	Shipment
Ailuk	11	104	2	1,162	2	126	80	8	0	87	2
Arno	1,050	588	312	1,553	312	587	935	1,975	126	108	36
Aur	1,774	2,078	4,249	4,093	4,249	676	412	1,075	695	94	8
Jaluit	860	173	3,629	229	3,629	33	1,224	3,037	267	1,472	4
Maloelap	859	2,000	643	5,500	643	1,906	374	397	1,332	55	9
Mili	24	0	31	131	31	0	62	637	11	2	1
Wotje	221	805	11	782	11	260	35	157	272	0	2
Total lbs	4,800	5,749	8,877	13,449	8,877	3,587	3,123	7,284	2,703	1,817	62

IMPACTS

The reef fish stock in RMI is still in good condition but if the trend of importing fish from the outer islands to the centres continues, the integrity of outer island fish stocks will suffer. A recent report from the US army indicates a high toxicity of all reef fish in Kwajalein and that an immediate ban on fish consumption should be considered. Given the overall good condition of RMI near shore fish stocks this is a major concern. It should be addressed by fully understanding the source of the contamination, taking steps to prevent additional contamination, remediating the Kwajalein lagoon and ensuring that no additional areas in RMI are contaminated.

RESPONSE AND RECOMMENDATIONS

It is highly recommended that two large atolls, like Kwajalein and Maloelap, along with two small ones, be included in future surveys to show how the impact of high and low human population pressures affect fish biomass. To understand the trend of the fish market imports, more data from different years should be included and monitored.

Due to concerns over the overfishing of certain grouper species listed as “Near Threatened” on the IUCN Red list, spawning aggregations need to be identified. Management measures, such as seasonal closures, should be imposed. Other species of commercial interest, such as sea cucumbers and trochus, are in need of monitoring and protection to achieve minimum harvest densities. Improved data and data management needs to be set up for future reference and information sharing.

Photo credit: WWF/SFI

SOURCES

Houk, P., Benavente D., Mclean, M., Camacho, R., Capelle, J., Silk, M., White, M., Jacobson, D., and Hess, D. “Namdrik Atoll Coral-Reef Resources Monitoring Assessment”. University of Guam Marine Laboratory, College of the Marshall Islands, and Marshall Islands Marine Resources Authority, 2013.

Houk, P., and Musburger, C. “Trophic Interactions and Ecological Stability

Across Coral Reefs in the Marshall Islands”, 2013.

Majuro Fish Market, Marshall Islands Marine Resources Authority, 2012.

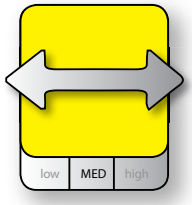
Pinca, S., Tardy, E., Awira, R., Kronen, M., Pakoa, K., Boblin, P., Friedman, K., Vunisea, A., Chapman, L., Lasi, F., Magron, F. Marshall Islands Country Report: Profiles and Results from Survey Work at Likiep, Ailuk, Arno and Laura. (Pacific Regional Oceanic and Coastal Fisheries Development Programme (PROCFish/C/CoFish) / Reef Fisheries Observatory; Secretariat of the Pacific Community, August and September 2007.

Serena Hackerott, 2016

INSHORE MARINE ENVIRONMENT MARINE MANAGED AREAS

The RMI Second National Report to the Secretariat of the Convention on Biological Diversity highlighted marine and coastal ecosystems as biodiversity areas of high priority, due to the country's geography. Since the development of Reimaanlok (Looking into the Future) – National Conservation Area Plan for the Marshall Islands in 2008, management measures have incorporated Mo management systems. Mo is a customary form of conservation and prohibition imposed by chiefs or landowners to manage the use of resources on land and at sea, is supported in the Marshall Islands under Reimaanlok.

This indicator looks at the effectiveness of marine managed areas (Figure 89) to protect and improve marine resources. It measures the area under management, the number of plans and their effectiveness.



Status
Fair

Trend
Stable

Data confidence
Medium

Status: Fair Trend: Stable Data Confidence: Medium

Across the 29 atolls and five islands of the RMI, there are 64 marine managed areas (Table 14). Of these, 57 are specified areas within the atolls, and six are whole atoll marine managed areas: Bikini, Ailinginae, Rongelap, Rongerik, Wotje, and Erikub atolls. In total, 2654.45 km^2 of reef (18.87% of total reef area in RMI) is within a managed area.

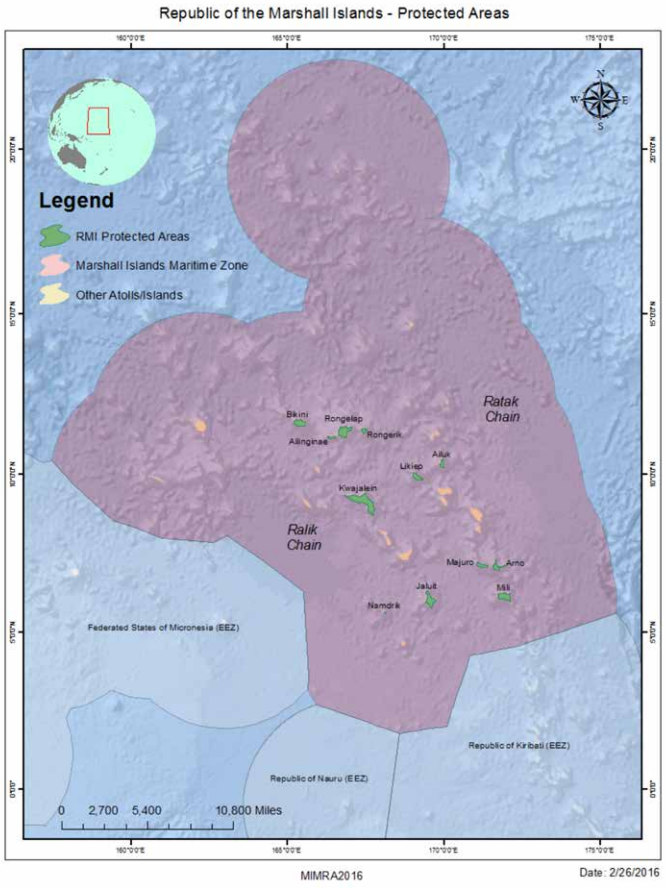


FIGURE 89. RMI map of Protected Areas, highlighted in green (MIMRA).

TABLE 14. Marine Managed Areas (MMA) across the RMI as of 2015 (MIMRA, 2016).

Atoll	Total MMA Sites	Management Type	Km^2
Ailuk	6	subsistance	24.08
Rongelap	Whole Atoll	subsistance	1133.70
Ailinginae	Whole Atoll	special reserve not take	164.33
Aelonlaplap	1	special reserve not take	0.48
Bikini	Whole Atoll	special reserve not take	743.09
Arno	16	4 Not take, 12 Subsistance	62.25
Jaluit	21	14 No Take, 7 Subsistance (Ramsar Site)	197.42
Rongerik	Whole Atoll	special reserve not take	205.90
Kwajalein	2	special reserve not take	7.77
Mili	3	not specified, (traditional Mo)	96.10
Namdrik	1	not specified, (Ramsar Site)	16.19
Likiep	2	subsistance	0.31
Majuro	5	special reserve not take with different management plans	2.83
Wotho	not specified	not specified	not specified
Wotje	Not specifie: Erikub is under Wotje's jurisdiction. These two Atolls have traditional conservation sites (mo). Erikub is also one of known turtles nesting sites in the RMI		
Erikub			

There are plans and guidelines that cover 89 percent of marine managed areas. They range from fisheries and resources management plans, atoll conservation plans, and coastal zone management plans (the exception is Bikini Atoll which is a World Heritage site). Two plans are being developed for Ene Kalamur and Bokanbotin on Majuro, while Woja Conservation Area is developing an Alternative Livelihoods programme. The management of the marine managed areas is overseen by local governments and/or Local Resources Committees, with technical support provided by CMAC.

MPA management effectiveness studies have been undertaken in several sites – Ailuk, Jaluit, Namdrik, Anenuaan on Likiep, and Woja Conservation Area and Bikirin on Majuro. Similar studies are being developed for Enekalamur and Bokanbotin, also on Majuro.

With support from the Micronesia Challenge, CMAC is working with stakeholders to establish guidelines and benchmarks for communities (current and new sites) to distribute resources. The passing of the PAN legislation will allow CMAC to deliver a complete management planning process under Reimaanlok.

IMPACT

Conservation areas protect sensitive resources and create a sanctuary for species. Communities benefit from these areas through increased resources for subsistence and commercial activities, ecosystem services, enhanced tourism values and recreational activities.

RESPONSE AND RECOMMENDATIONS

Information on enforcement efforts need to be documented and monitored for management effectiveness. Marine biological monitoring, conducted as part of the Reimaanlok process, must be standardized with the rest of the Micronesia Region to properly report standing with the Micronesia Challenge. Local Government Enforcement Divisions should be included in the training.

With the passing of the PAN legislation in the Nitijela (Parliament), PAN regulations and other instruments are needed to allocate resources in a timely manner, and acknowledge the Reimaanlok process as the standard.

Karl Fellenius, 2016

SOURCES:

RMI EPA (2001). Second National Report. (https://www.cbd.int/doc/world/mh/mh-nr-02-en.pdf – accessed 27 July, 2015).

Reimaanlok National Planning Team. 2008. *Reimaanlok: National Conservation Area Plan for the Marshall Islands 2007–2012*. Published by: N. Baker: Melbourne (http://icem.com.au/documents/biodiversity/marshallisland/reimaanlok_national_conservation_area_plan_for_the_marshall_islands_final_may30.pdf – accessed 27 July, 2015).

Anon (2010). *Moving Toward Measuring Our Effectiveness: the 2nd Meeting of the Micronesia Challenge Measures Working Group and PICRC-JICA Coral Reef Monitoring Project Meeting: Palasia Hotel, Koror, Republic of Palau*, p 104. (http://www.reefresilience.org/pdf/Final_MC_Measures_PICRC-JICA_Project_Meeting_Report.pdf – accessed 27 July, 2015).

INSHORE MARINE ENVIRONMENT LAGOON WATER QUALITY

The lagoon ecosystems in RMI are some of the most significant natural assets. They provide food, storm protection and habitats, and tourist attractions. These lagoon ecosystems are particularly sensitive to water quality impacts from land based activities and waste disposal, associated with recreational use and aquaculture. The impact of lagoon water quality plays an important role for local community incomes and daily subsistence. Therefore, it is an important indicator of anthropogenic impacts on the marine environment, particularly the coastal water quality.

Water quality monitoring started in 1984 when the Environmental Protection Act came into effect, which the Environmental Protection Authority was mandated to carry out. The monitoring sites are mainly in the urban areas of Majuro and Ebeye where coastal water quality checks are conducted quarterly. There are over 40 coastal monitoring sites in the two populated centres.

Status
Fair

Trend
Deteriorating

Data confidence
Low

State: Poor Trend: Deteriorating Data Confidence: Low

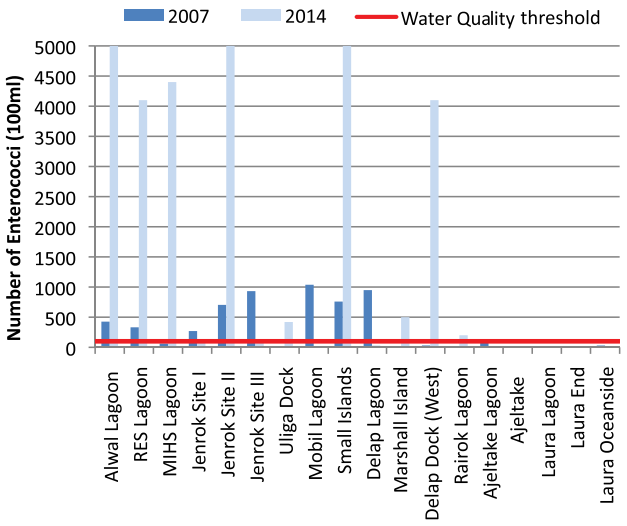


FIGURE 91. 2007 and 2014 Majuro Lagoon Sampling sites. Safe standard for marine water recreation is 104MPN/100ml (EPA Coastal water quality monitoring reports of 2007 and 2014).

Limited data is available since the program started in the 1980's. Data shows that the quality of lagoon water has deteriorated over the last seven years (Figure 90). Enterococci – a bacteria found in the intestines of humans and animals – is used as an indicator for faecal pollution in marine waters. The safe use standard for lagoon recreational water is 104MPN (most probable number)/100ml: the three most contaminated sites, Awal, Jenrok lagoon[2] and Small Island had bacterial counts reaching 24,000MPN/100ml. Twelve out of the eighteen sites exceeded the safe standard level for recreational activities on Majuro, which represent 66 percent of the sampling sites. Figure 92 shows the contaminated urban areas from Rita (Alwal) to Rairok.

A clear trend is visible in the decline of Majuro's coastal water quality (Figure 93) over a seven year period. In 2009, 67 percent of the sites met the safe use standards for enterococci. In 2015, only 32 percent of the lagoon areas were safe.

Ebeye coastal water has not been tested as the Ebeye laboratory is not certified and there is a lack of qualified personnel to carry out such tests (RMI EPA annual report 2011): all samples are sent to Majuro. In 2011, ten samples were collected and sent to Majuro for analysis, and half showed unsafe levels (Figure 94). Ebeye has 22 coastal water quality monitoring sites (Figure 95). However, due to the lack coastal water quality data, the state of Ebeye's lagoon is in question. The data suggests that Ebeye may be experiencing the same trends as Majuro.

FIGURE 92. Majuro Lagoon sampling sites from Alwal to Rairok. Red dots are contaminated sites (RMIEPA, 2014).

IMPACTS

Impacts from impaired lagoon water quality include environmental, social and economic factors. Poor water quality is a result of excessive nutrients, harmful bacteria and sedimentation which can accelerate algal bloom, leading to environmental and health issues. Reef habitats in lagoons are susceptible to smothering from algal growth, stimulated by excess organic and nutrient matter. Other factors contributing to lagoon pollution are runoffs from residential grounds, road drainage that links directly to the lagoon and continual use of lagoon or shoreline areas for defecation and dumping of domestic wastes. The degradation of lagoon habitats impacts on people who rely on the inshore environment for subsistence, income and health.

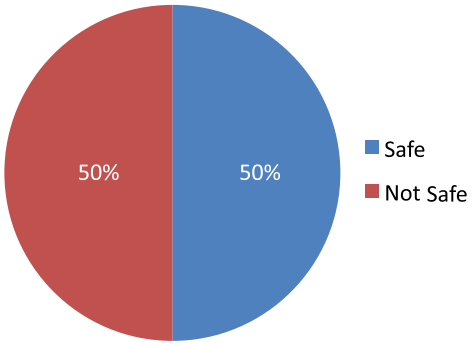


FIGURE 93. Coastal water quality monitoring sites timeline from 2009 (RMI EPA, 2015).

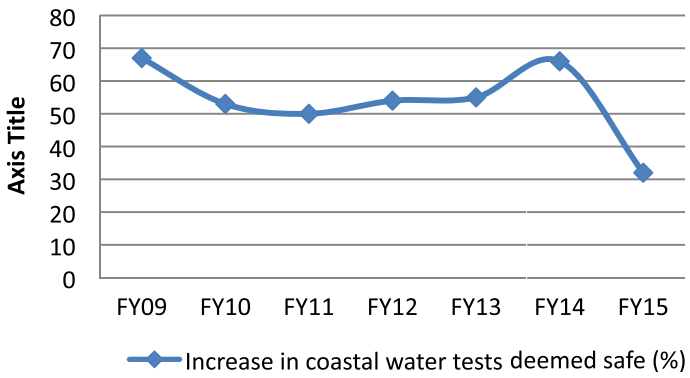


FIGURE 94. Ebeye marine water quality data (RMI EPA, 2011).

RESPONSES

Existing Critical Ecosystems and Species

Poor water quality and high sedimentation are the most serious pollution issues affecting the urban centres of Majuro and Ebeye. These problems affect ecological processes, public health, and social and commercial use of marine resources. The coastal marine environment hosts a range of fauna ecosystems:

- Seagrass community and meadows
- Supratidal and intertidal
- Sandy areas of the intertidal and subtidal zones
- Coral reefs
- Reef holes, artificially quarried and bombed
- Sea surface, lagoon water column, open water
- Deep water

The coastal marine environment has a diverse range of fauna species (molluscs, arthropods, and fish) and is home to endangered species including blue whales, sperm whales, leatherback turtles and the hawksbill turtle.

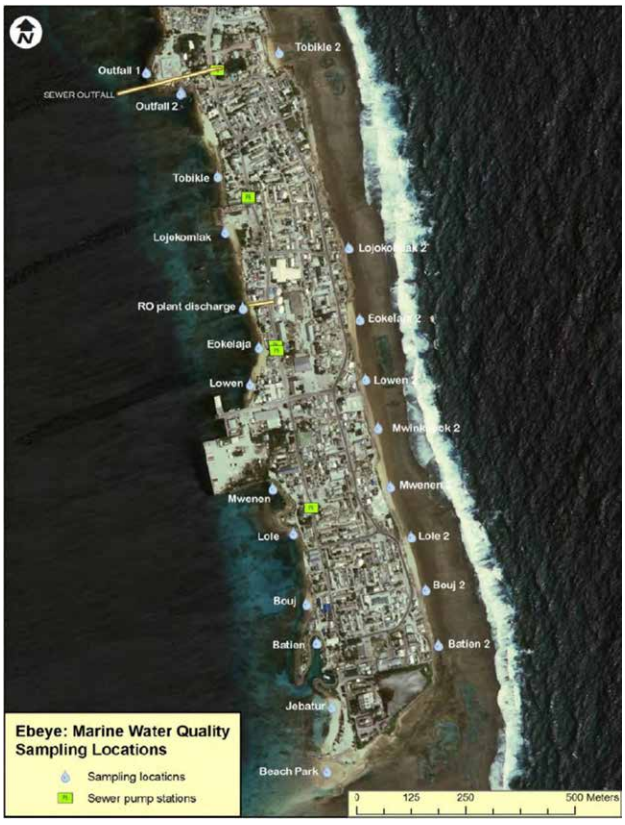


FIGURE 95. Ebeye Marine Water Quality Sampling sites (Ebeye Water Supply and Sanitation Project: Initial Environmental Examination, 2015).

EPA responses on Marine Water Quality

EPA regulations

- Earthmoving regulations 1989 – all earthmoving activities shall be planned in such a manner so as to prevent accelerated erosion, sedimentation and disturbance of cultural resources.
- Earthmoving regulations 1989, Part III, Section 11b – Sedimentation resulting from earthmoving activities in the waters of the RMI shall be contained and confined in a manner that water turbidity is kept at a minimum;
- Earthmoving regulations 1989, Part III, Section 11f – Acceptable coastal protection structure shall be constructed to safely contain fill to prevent accelerated sedimentation within a body of water or tidal zone.
- Earthmoving regulations 1989, Part III, Section 11h – Runoff from a project area shall not be discharged into the waters of the RMI without effective means to prevent sedimentation.

Solid Waste Regulations 1989 – Establishment of minimum standards governing the design, construction, installation, operation and maintenance of solid waste storage, collection and disposal systems to:

- Prevent pollution of the drinking and recreational waters of the RMI,
- Prevent air and land pollution,
- Prevent the spread of disease and the creation of nuisances,
- Protect the public health and safety,
- Conserve natural resources and
- Preserve and enhance the beauty and quality of the environment.

Solid Waste Regulation 1989, Part IV, Section 16 – Prohibition of waste disposal into the waters of the RMI.

- Toilet Facilities and Sewage Disposal Regulation 1990 – The purpose of this regulation is to establish minimum standards for toilet facilities and sewage disposal to minimise environmental pollution, health hazards, and public nuisance.
  - Toilet Facilities and Sewage Disposal Regulation 1990, Part II, Section five – It is required that all public buildings or any buildings which may be used for dwellings shall have toilet and sewage facilities.
  - Toilet Facilities and Sewage Disposal Regulation 1990, Part IX, Section 37 – Prohibition of disposal of treated, semitreated or untreated sewage or excreta into any pond, well, reservoir, body of water, or onto the ground, whether public or private, unless such activity is of economic or social value or research purposes that poses no public health hazard.

Marine Water Quality Regulation 1992 – Identify the uses for which the marine waters of the RMI shall be maintained and protected, specify the water quality standards required to maintain the designated uses and to prescribe regulations necessary for implementing, achieving and maintaining the specified marine water quality.

- Marine Water Quality Regulation 1992, Part V, Section 18 – Prohibition of point source discharges into the waters of the RMI without a Pollution Discharge Elimination System permit from the EPA;
- Marine Water Quality Regulation 1992, Part VII, Section 28(a) – Prohibition of sewage discharges from marine vessels; (b) All marine vessels with toilet facilities must have marine sanitation devices with discharge standards.
- Marine Water Quality Regulation 1992, Part VII, Section 30 – Prohibition
- of hazardous substances disposal or leakage into the waters of the RMI.

Marine Water Quality Regulation 1992, Part VIII, Section 40 – Prohibition on Discharge of Oil.

- Marine Water Quality Regulation 1992, Part I, Section 3f – All sewage and waste must receive a degree of treatment before discharge to protect the ideal uses of the waters of the RMI.

Environmental Impact Assessment Regulation 1994 – Implementation of the NEPA 1984 and Coast Conservation Act 1988 for proposed development activities that may affect the quality of the environment of the RMI.

- Environmental Impact Assessment Regulation 1994, Part III, Section 9a – Proposed development activities that have the potential for significant effect to the environment shall conduct an Environmental Impact Assessment and submit to the EPA.
- Environmental Impact Assessment Regulation 1994, Part III, Section 11 – A scoping process identifying the significant issues related to the proposal shall be initiated by the EPA.
- Environmental Impact Assessment Regulation 1994, Part III, Section 13 – Formulation of an EIA must take into considerations any guidelines, directions, policies or plans issued by the EPA regarding the protection, conservation and management of the environment.

EPA's Education and Awareness Division:

- Main responsibility is to increase public awareness and understanding at national and local levels
- Information is relayed to the public through outreach to the schools and communities regarding environmental issues, and to promote educational support for sustainable management efforts. The division notifies the public of all EPA activities, regulations enforced by EPA, water quality results, and other

- issues through a radio program every Thursday. The division visits schools to provide awareness regarding EPA's mandate, policies, regulations and environmental issues such as 3Rs (Reduce, Reuse, Recycle), drought and climate change. The division collaborates with the Ministry of Education for workshops to promote environmental education to teachers. The division holds events for raising awareness to the community with other organisations and NGOs. More information is available from https://www.facebook.com/rmiepa.outreach/

RECOMMENDATIONS

Although monitoring has been useful, the data storage and availability needs to be improved. The monitoring does not provide enough measures to determine trends and the relative proportion of pollution sources to the ambient marine environment (e.g. proportion of human vs animal sewage vs solid and other liquid waste). Detailed source monitoring (for example, using isotopes or trace chemicals) to rank relative sources of pollution is required. This will ensure that suitable mitigation activities are developed.

Once the sources are determined, a range of mitigation options should be considered under a cost-benefit analysis plan. Reticulation of sewage waste may need to be considered for sensitive coastal foreshore areas.

Critical areas such as shorelines, coral reefs, coastal beaches and coastal mangrove areas that prevent erosion, are subject to increasing pressure from urban development, sea walls, pollution and other threats. Activities should include the development of effective waste management and guidelines to help control the impact on coastal ecosystems.

Brian Skerry

SOURCES:

Environmental Protection Authority. Coastal Water Quality Report, 2014.

Ebeye Water Supply and Sanitation Project: Initial Environmental Examination, 2015.

ENDANGERED MARINE SPECIES TURTLES AND CETACEIANS

Marine mammals and turtles are important components of the RMI biodiversity, culture and natural heritage. The tooth of a whale was valuable in Marshallese traditions where it was used as a tool for canoe carving and building. Interaction between people and whales has changed from consumption and commercial whaling to one of scientific research and conservation. This indicator looks at the stability of marine mammal and turtle populations – it uses data collected over the past decade on turtle nesting and whale migrations.

Status
Poor

Trend
Unknown

Data confidence
Low

Status: Poor Trend: Unknown Data Confidence: low

Turtles

The marine turtle populations are declining regionally and globally. Five turtle species are known to occur in the Pacific region (Table 15).

TABLE 15. List of marine turtles (IUCN)

Common Name	Scientific Name	Status
Green	*Chelonia mydas*	Endangered
Hawksbill	*Eretmochelys imbicata*	Critically Endangered
Olive ridley	*Lepidochelys olivacea*	Vulnerable
Leatherback	*Dermochelys coriacea*	Vulnerable
Loggerhead	*Caretta caretta*	Critically Endangered

There is limited information to fully understand the state of stock structure, abundance and trend in turtle populations in RMI and the region. Based on the SPREP Turtle Research and Monitoring Database System (TREDS), 83 tagged turtles were recorded in RMI during monitoring efforts in the early 1990s and mid 2000s: 79 were Green turtles, and four were Hawksbill turtles (Figure 96). Olive Ridley and Leatherback turtles have been recorded within the RMI EEZ. However, little is known about these two turtle species within RMI (Kabua, 2010). Green turtles are the only common species of turtle which nests in RMI, while Hawksbill turtles are considered rare (Maison et al, 2010) (Figure 97). Nesting season normally takes place from May to November. The main nesting sites are Bikar, Erikub and Jemo, with minor nesting sites in the atolls of Bokak, Ailinginae, Rongerik, Bikini, Wotje, and Taka.

Flipper tag returns and satellite tags indicate that Green turtles nesting in RMI are linked to nearby countries Nauru, Kiribati and FSM, and as far as Japan and the Philippines (Figure 98). Based on the data from the NOAA technical memorandum on green turtles for the RMI, consumption of nesting turtles and their eggs is the most significant source of turtle mortality (NMFS and USFWS, 1998; McCoy, 2004). Table 15 shows 621 nesting sites that were recorded in the RMI from surveys in 1992 and 2003 (McCoy, 2004).

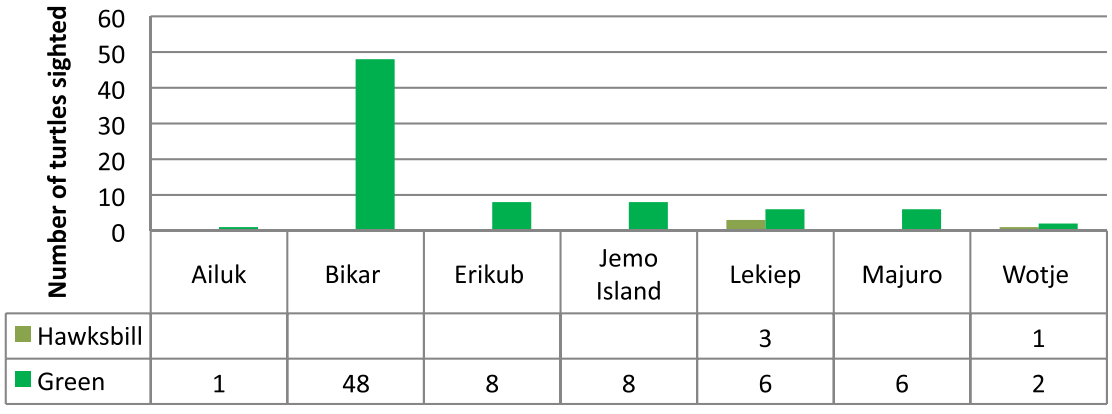


FIGURE 96. Turtle sighting in the RMI. SPREP TREDS combined data from 1992, 2006 and 2007 (SPREP).

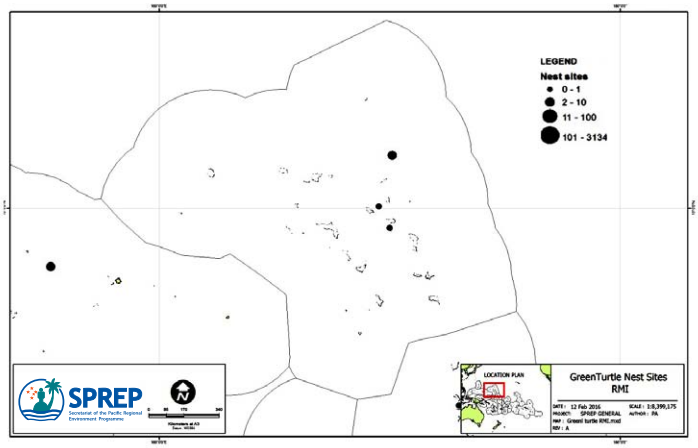


FIGURE 97. Main nesting site for turtles in the Marshall Islands (SPREP).

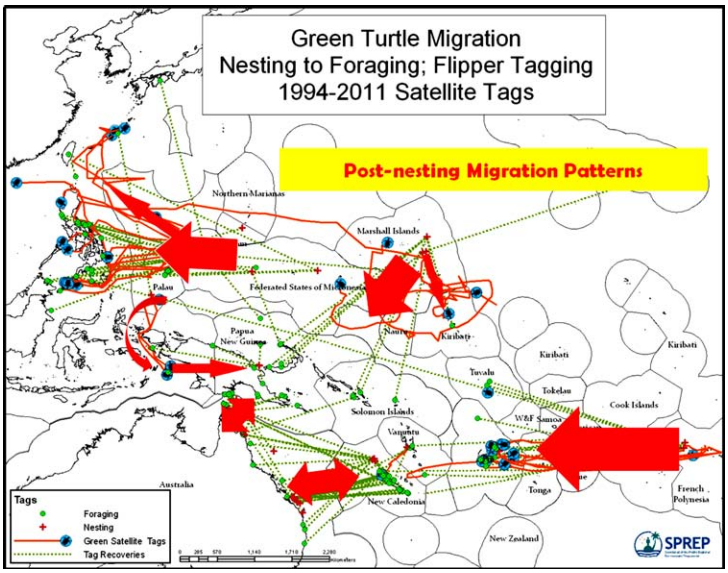


FIGURE 98. Migrations of green turtles found in the SPREP region, based on flipper tag recoveries and satellite tags (SPREP).

TABLE 16. Number of green turtle nests recorded in the RMI.

Atoll/Islands	Observation Year	Recorded Nest
Wotho	1988	0
Wotje	2003	0
Rongerik	2003	21
Bikini	1992	75
Enewetak	1992	75
Erikub	1992	75
Jemo	1992	75
Bikar	1992	300

Cetaceans

Cetaceans (whales and dolphins) have a very slow reproductive rate, making them (much like most shark species) particularly at risk from any harvesting activity. Fifteen species have been reported from RMI (Miller, 2007). However, this is most likely an under-representation of the numbers (Table 17) as there is no formal monitoring programme for cetaceans.

Historical records refer to humpback whales (Kellogg 1928) and this species is presently listed in UNEP-WCMC (2003) as having RMI as part of its range. A group of sperm whales was sighted near Bikini Atoll in 1947 (unpublished account in Reeves et al. 1999), but more recent reports have not been documented. Other sightings in the area include a group of five melon-headed whales, striped dolphins and spinner dolphins, although not much detail is provided (Reeves et al. 1999). Lastly, a skull of a Steno bredanensis is at the US National Museum, being collected from Rongerik Atoll in 1946 (Reeves et al. 1999): (Miller, 2007 pg. 45).

TABLE 17. List of Cetaceans in RMI. (Miller, 2007)

Common Name	Scientific name
Minke whale	*Balaenoptera sp.*
Blue whale	*Balaenoptera musculus*
Fin whale	*Balaenoptera physalus*
Humpback whale	*Megaptera novaeangliae*
Sperm whale	*Physeter macrocephalus*
Bryde's whale	*Balaenoptera sp.*
Killer whale	*Orcinus orca*
Short-finned pilot whale	*Globicephala macrorhynchus*
Melon-headed whale	*Peponocephala electra*
Common dolphin	*Delphinus sp.*
Pantropical spotted dolphin	*Stenella attenuata*
Striped dolphin	*Stenella coeruleoalba*
Spinner dolphin	*Stenella longirostris*
Bottlenose dolphin	*Tursiops sp.*
Rough-toothed dolphin	*Steno bredanensis*

IMPACT

Turtles have played an important role in the lives of the Marshallese people for centuries. They are a prestigious ceremonial food, with cultural restrictions on take and consumption. They are also iconized in Marshall Island symbolism, visual art, legends/myths, and rituals. However, globalisation, changes in social practices, and loss of respect for the culture, has resulted in negative impacts on turtle populations. Reduction of this resource is recognised as a loss to the Marshallese way of life.

The term 'subsistence take' is not well defined, and it seems to be open season on turtles in RMI, the only restriction being a minimum size limit. There are still cases of the traditional practice of seeking permission from a high chief, prior to harvesting turtles. In any case, if a subsistence take is allowed there should be a maximum, not a minimum, size limit. It is exclusively the larger animals that are the breeders.

Lack of awareness on existing laws, lack of a monitoring program and very limited enforcement has led to uncontrolled turtle harvesting, resulting in a 'poor' status of RMI turtle populations. Moreover, turtles have moved into the monetary economy, despite laws prohibiting such practices. With these factors, turtle numbers will continue to decline. There is a lack of

knowledge, awareness and understanding of whales and dolphins and their cultural values for the Marshallese people. There is also a limited national capacity to research and manage cetaceans.

SOURCES

Kabua, Emma., Edwards, Florence. 2010 Republic of the Marshall Islands Marine Turtle Legislation Review.

Kinan, Irene., Dalzell, Paul. 2005 Sea Turtles As a Flagship Species: Different Perspectives Create Conflicts in the Pacific Islands.

Maison, K.A., Kinan Kelly, I. and K.P. Frutchey. 2010. Green Turtle Nesting Sites and Sea Turtle Legislation throughout Oceania. U.S. Dept. Commerce, NOAA Technical Memorandum. NMFS-F/SPO-110, 52 pp.

Marshall Islands Marine Resources Authority Inshore Division personal communications, 2015.

McCoy, Mike.A. (2004) Defining parameters for sea turtle research in the Marshall Islands. Administrative Report AR-PIR-08–04, Pacific Islands Regional Office, NOAA Fisheries, Honolulu.

Miller, C. 2007. Current State of Knowledge of Cetacean Threats, Diversity and Habitats in the Pacific Islands Region. WDCS Australasia Inc. pp. 98.

Seminoff, J.A., C.D. Allen, G.H. Balazs, P.H. Dutton, T. Eguchi, H.L. Haas, S.A. Hargrove,

M.P. Jensen, D.L. Klemm, A.M. Lauritsen, S.L. MacPherson, P. Opay, E.E. Possardt, S.L. Pultz, E.E. Seney, K.S. Van Houtan, R.S. Waples. 2015. Status Review of the Green Turtle (Chelonia mydas) Under the U.S. Endangered Species Act. NOAA Technical Memorandum, NOAANMFS-SWFSC-539. 571 pp.

RESPONSE AND RECOMMENDATIONS

MIMRA recognizes the importance of protecting sea turtles and cetaceans and recommends the following actions to address declining populations:

1. Boosting education and awareness efforts – Education and awareness are needed to support the conservation and management of all marine resources. MIMRA's most recent turtle education project included the development of a turtle themed curriculum, a reusable bags campaign, and public outreach via mass media.
2. Promotion of community-based resource management planning – The Reimaanlok: National Conservation Area Plan is a key instrument used by MIMRA and its CMAC members to designate protected areas and develop community-based management plans for natural resources, including turtles and turtle nesting sites. With the growth of protected areas through Reimaanlok, the potential for local communities to increase protection and management of these species should be considered, given the limited capacity to monitor and enforce legislation and policy.
3. Improving existing legislation – The RMI Marine Turtle Legislation (Review by Kabua. E and Edwards. F. 2010) aimed to address gaps and improve the legislative framework to protect turtles. The key recommendations provided by the authors have yet to be adopted including a maximum size limit, catch limits, seasonality, and others.
4. Conduct research and monitoring on population and harvesting – With very little data on the population size and structure of turtles and cetaceans in the RMI, the most recent turtle research in 2007 deployed satellite transmitters on five post-nesting Green turtles in Erikub Atoll. MIMRA also has a turtle tagging program which can be expanded to include local communities. A monitoring program on nesting females/eggs and rate of harvesting is also needed. In regards to cetaceans, national priorities for research, including local capacity building in cetacean research and management, have yet to be identified. With occasional cetaceans strandings, however, communities should at least know how to respond to stranded whales and dolphins.
5. Monitoring and enforcement – Due to limited human and financial resources, there is poor monitoring, compliance, enforcement and surveillance. Capacity building is needed at the institutional and community level, especially in isolated areas of the outer islands.

Recommendation – Turtle conservation regulations, protection of mature females and best management practices should be considered in turtle conservation management planning. Regional and global trends include loss of feeding habitat (seagrass beds for Green turtles, coral reefs for Hawksbill) and breeding habitat (breeding beaches lost through storm damage, sea level rise and increasing sand temperature causing egg mortality). There is a need to consider stricter regulations on turtle harvest, including zero take of all mature adults, unless specifically permitted for culturally important occasions.

With only 182 km^2 (70 sq. miles) of land and a small proportion suitable for settlement, land is the most prized possession and the basis of Marshallese culture. When the first Marshallese landed on these tiny strips of land, they established food crops and medicinal plant species because the land had limited resources to support human settlement. Those colonists had a great influence in shaping the land environment over the last 3000 years of human habitation with early atoll agriculture (Fosberg, 1990).

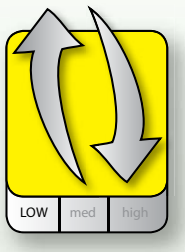
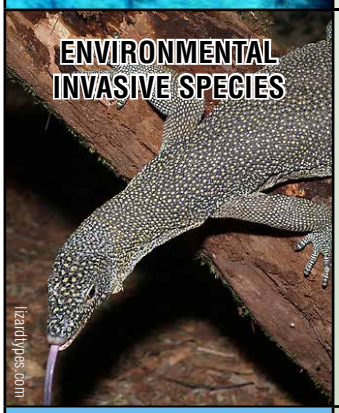
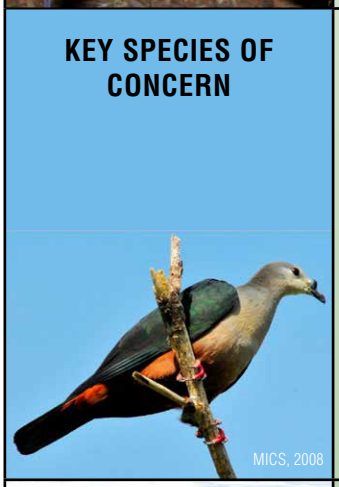
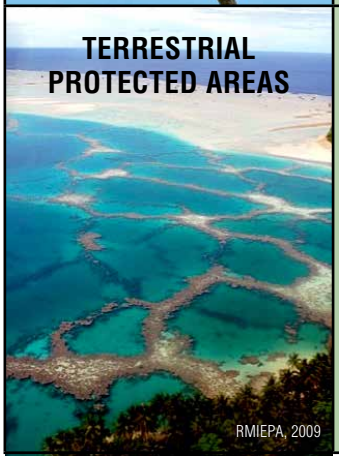
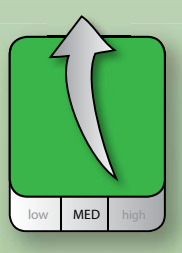
The Marshallese are an integral part of their land ecosystem. The people have developed and maintained a remarkable knowledge of native forests and plants, and strong skills in agro-forestry.

Traditional conservation practices, known as Mo, were governed by Iroij (chiefs). Mo was designed to protect and manage the natural resources in order to secure sustainable and reliable food harvesting. The attrition of traditional resource management has negative implications for biodiversity in the RMI.

This chapter covers the theme of Biodiversity, reviewing the state of threatened and endemic species, invasive species, key species and terrestrial protected areas (marine protected areas are addressed in the Marine Section). This section describes what the RMI's government is doing, and needs to do, to protect its unique species and ecosystems from further degradation.

Majuro, Marshall Islands. Photo credit: Huffington Post, Jake Marote, 2015

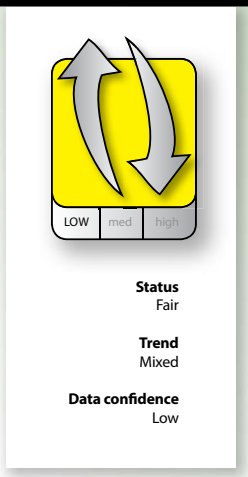
BIODIVERSITY HIGHLIGHTS

TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
	 **Status** Fair **Trend** Mixed **Data confidence** Low	The RMI threatened species list, includes the endangered, vulnerable and critically endangered, is dominated by marine species or about 8% of the IUCN assessed species list. Terrestrial species make up about 0.5%.	The RMI government is preparing legislation to protect 19 endangered species: 18 marine and 1 terrestrial. Most endangered species are protected.
	 **Status** Poor **Trend** Improving **Data confidence** Low	RMI has 523 invasive species known to impact the environment in their introduced range. Most are plant species.	RMI has endorsed their participation in the Regional GEF6 Invasive Species Project with a contribution of $US1m.
	 **Status** Fair **Trend** Mixed **Data confidence** Low	There is limited data on the status of Hawksbill turtles and endangered shark species. However, the Mule pigeon has been a success on Majuro, where only eight breeding pairs were found in 2007. In 2009, their numbers were up over 70 birds. There is a little information available to know the true state of marine mammals in the RMI	There is a lack of proper conservation and management plans. It is strongly recommended that all pending legislation and management plans are established to ensure threatened species are protected.
	 **Status** Good **Trend** Improving **Data confidence** Medium	Over 20% of all land area is protected. The RMI has met one of its national commitments in the Micronesian Challenge, which is to conserve at least 20% of terrestrial resources by 2020.	Under the Micronesia Challenge, the RMI agreed to have 30% of Near-shore Marine Resources, and 20% of Terrestrial Resources, “Effectively Conserved” by 2020. The amount of terrestrial resources has not been measured.

BIODIVERSITY ENDEMIC, NATIVE AND THREATENED SPECIES

The RMI has an EEZ of 2,131,000 km^2, of which .009% is land. Marine species make up most of the biodiversity classification. It has a limited number of terrestrial species which are endemic and a low number of terrestrial species. According to Fosberg "little or none of the true original vegetation remains of the Marshall Islands". The original ecological system was altered by the first Marshallese settlers and also during the colonial era (Fosberg, 1990). There are more than 5,800 flora and fauna species of which 57 are endemic (Table 18).

This indicator assesses the number and percentage of endemic and native species which are threatened in the RMI, based on the IUCN Red List.



Status: Fair **Trend: Mixed** **Data Confidence: Low**

TABLE 18. Total recorded species in the RMI. (Source: OEPPC, biodiversity CHM)

Scientific classification: Flora and Fauna	TOTAL
Total number of flora and fauna species	5821
Number of native species	1524
Percent of native species	26.18%
Number of species endemic to RMI	57

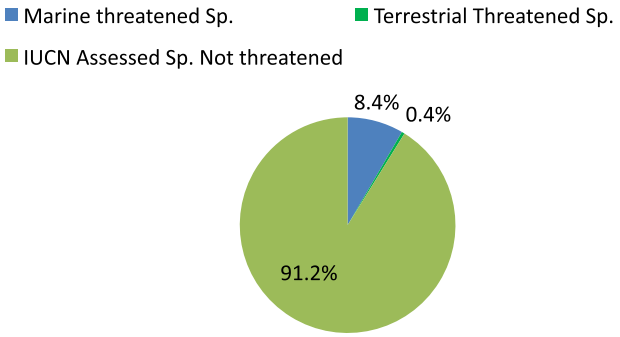


FIGURE 99. Threatened species Biomes – RMI (IUCN Red List, 16 March 2016).

Threatened species are all species (including animals, plants, fungi, etc.) which are at risk and facing extinction. They are sometimes measured by their biomass in relation to the population growth rate (IUCN). The RMI threatened species list – which includes the endangered, vulnerable and critically endangered – is mainly marine species which make up about eight percent of the IUCN assessed species list. Terrestrial species make up about 0.5 percent (Figure 99). The most comprehensive survey of biodiversity in 2000 found that RMI has more than 5,821 species (Vander–Velde, 2000). The IUCN has assessed only 1130 species, a subset of the 5821 species identified by Vander-Velde, finding 101 were threatened by extinction. Of the 101 species, none are classified as critically endangered.

This is due to an error in the Red List as the critically endangered Hawksbill turtle does occur in RMI. Eight species are listed as endangered and 88 as vulnerable, while the remaining species are listed as near threatened (NT), lower risk (conservation dependent), data deficient (DD) or least concern (LC) (Figure 100).

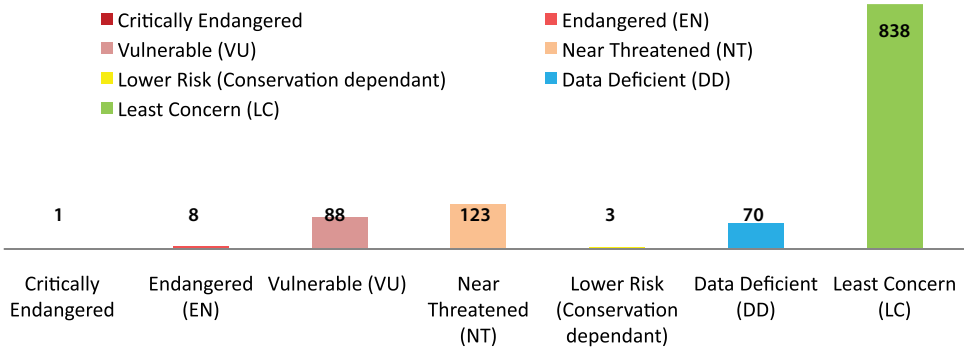


FIGURE 100. Total number of species in different IUCN categories (IUCN Red List).

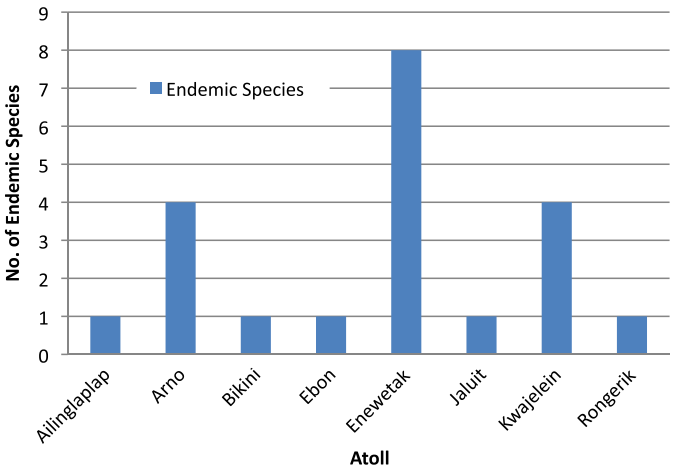


FIGURE 101. Distribution and range of endemic species found only in one atoll (IUCN Red List).

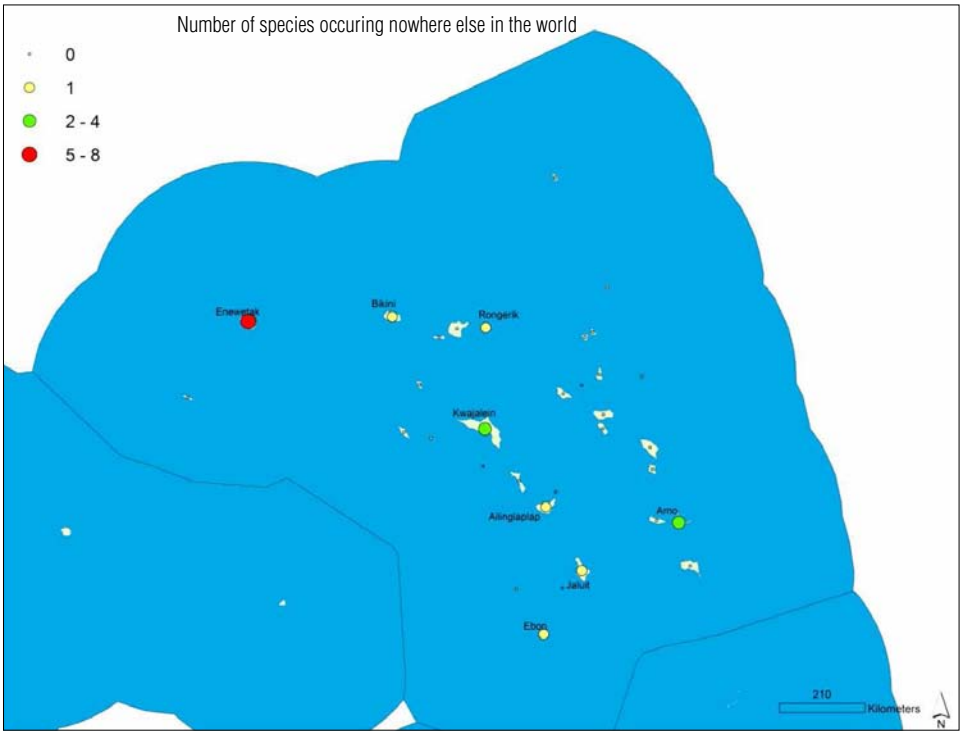


FIGURE 102. Map of islands where a range of endemic species only occur (SPREP, 2016).

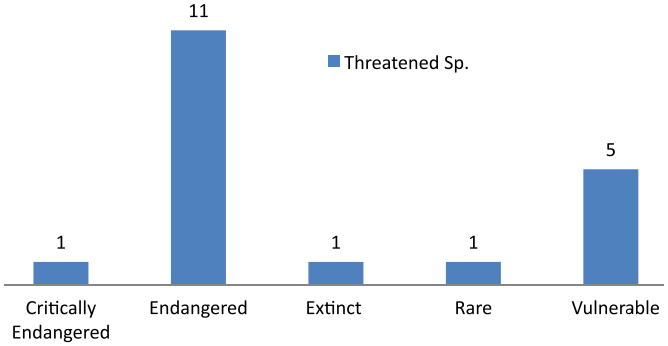


FIGURE 103. Number of threatened species for conservation (RMI-OEPPC CHM).

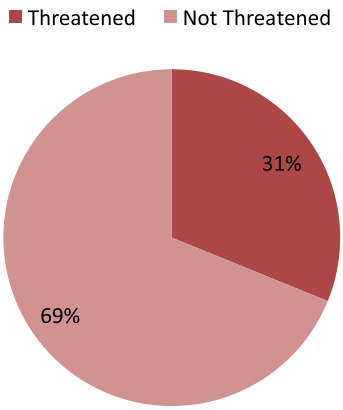


FIGURE 104. Percentage of threatened species for conservation (RMI-OEPPC CHM).

Endemic

Endemic species, only found in RMI, are a particular concern because of their limited geographic range. Of the 57 endemic species, only four have been assessed by the IUCN: three are endangered and one is extinct. The very nature of endemic species is that they are sensitive to extinction. A few of these endemic species only occur in one atoll, making them extremely rare. Enewetak has the highest number of eight endemic species, followed by Arno and Kwajalein with four endemic species (Figure 101). Ailinglaplap, Bikini, Ebon, Jaluit and Rongerik all have only one endemic species which makes them a priority to protect. Figure 102 shows the eight islands where these endemic species occur.

Species of local Concern

There are 61 species and subspecies considered for conservation by the RMI government and its partners, namely IUCN, CITES and US Fish and Wildlife. Based on the nationally compiled list of animals and plants, there are thirteen nationally endangered or critically endangered species (five marine mammals, three birds, and five marine reptiles: one being critically endangered). Five are vulnerable species – one bird, one shark, three arthropods, (the T. gigas and T. derasa giant clam species, and the Triton's shell Charonia tritonis) – and one extinct species, the Wake Rail (Figure 103). The eighteen threatened species are about 31 percent of total species considered for conservation (Figure 104). The other 42 species are listed as Near Threatened, Low Risk or (with conservation measures), Data Deficient or Least Concern.

IMPACT

The population of RMI is mainly urban so much of its biodiversity in the outer islands is intact. Due to the global pressures on species and habitats, the RMI serves as a refuge to these many species. Marine turtles are a particular concern, as unregulated harvesting and dwindling of nesting sites has led to their decline.

RESPONSE AND RECOMMENDATIONS

RMI government takes the threatened species issue seriously and has made initiatives to establish legislation to protect nineteen endangered species – eighteen marine and one terrestrial. Other threatened species are protected by individual atoll local government jurisdictions. Local governments set the restrictions on land and near-shore marine resources which include the conservation of biodiversity, so the Marshall Island Marine Resources Authority (MIMRA) provides advice and technical assistance for local governments.

Management plans are yet to be put in place for a number of species e.g. Mule (Ducula oceanica ratakensis: Ratak Micronesian Pigeon) which is extinct in other atolls. One other endemic land bird was the Wake rail (Gallirallus wakensis) which is extinct from Wake Atoll. It is highly recommended that conservation and management plans are prioritized for these threatened species.

It is highly recommended that traditional knowledge on biodiversity is taught in the schools. By doing so, the traditional knowledge and practice of conserving the natural surroundings can be revived to help preserve the Marshallese traditions and heritage.

SOURCES

Fosberg, Raymond. F. 1990: "A Review of the Natural History of the Marshall Islands". National Museum of Natural History Smithsonian Institution, Washington, D.C., USA.

IUCN Red List, www.iucnredlist.org: date accessed: 16 of March 2016.

Marshall Islands Marine Resources Authority (MIMRA).

Office of the Environmental Planning and Policy Coordination, Biodiversity Clearing House Mechanism: http://biormi.org/index.shtml?en/home.html; Date accessed" 2nd of March 2016.

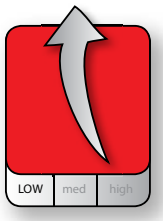
Shyama Pagad: IUCN SSC Invasive Species Specialist Group, University of Auckland, New Zealand. Personal communications on updated list of conservation assessed species for RMI from the IUCN Red List.

Vander-Veld, N., Marshall Islands- Living Atoll Amidst the Living Sea. The National Biodiversity Report of the Republic of the Marshall Islands, 2000.

Namdrik Atoll mangrove forest. Photo credit: RMIEPA. 2009.

BIODIVERSITY ENVIRONMENTAL INVASIVE SPECIES

This indicator looks at the number and extent of environmental invasive species and also the rate of new introductions and the infrastructure in place to control invasive species. Environmental invasive species are introduced species that are not associated with agriculture.



Status
Poir

Trend
Improving

Data confidence
Low

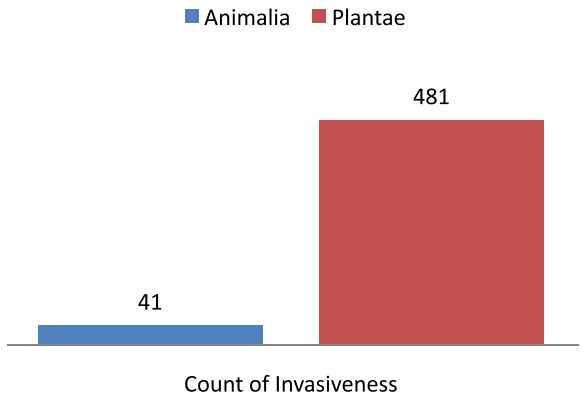


FIGURE 105. Total number of animal and plants invasive species in the RMI (OEPPC – RMI Clearing House Mechanism).

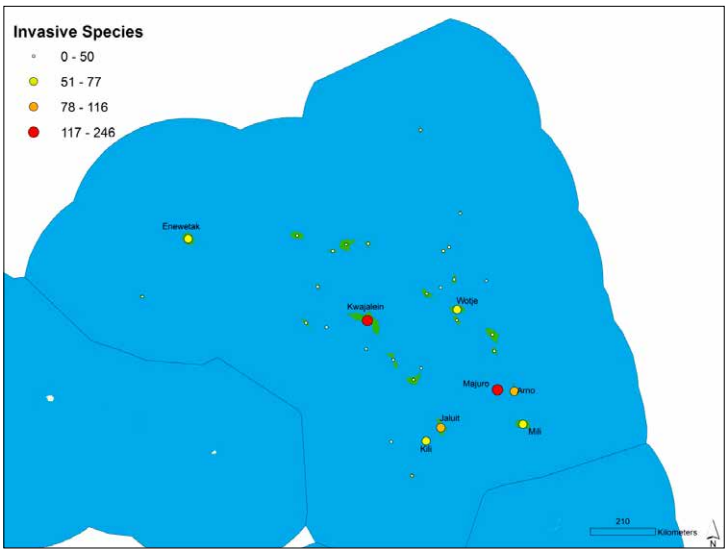


FIGURE 106. Map of Atolls with high invasive species presence (SPREP, 2016).

Status: Poor Trend: Improving Data Confidence: Low

A study conducted in RMI in 2015 recorded 523 alien species that impact the environment, as invasive and potentially invasive species. Most are plants. Over 130 species in the inventory are classified as 'invasive' based on 1) evidence of impact or 2) evidence of aggressive spread in the natural environment. The remaining species are classified as 'invasiveness not specified' (Pagad, 2015).

The Office of Environmental Planning and Policy Coordination (OEPPCE) has a biodiversity Clearing House Mechanism webpage which includes an inventory of pestiferous and potentially pestiferous species. This list is a subset of the 523 species which includes agricultural pests and environmental invasives. (http://biormi.org/)

Of the 523 alien species, 41 are animals, the remainder are plants (Figure 105). The most harmful ones to native flora and fauna are cats and rats. Many land and marine invasive species, plants or animals are threatening the biodiversity. Once an invasive species establishes itself, eradication and control can be extremely difficult and costly. The well established merremia vine, the crazy ant and red-vented bulbul bird are already having negative impacts by taking over ecosystem niches.

The 523 invasive species are unevenly distributed across the nation. Eight atolls have more than fifty identified invasives; these include Arno, Enewetak, Jaluit, Kili, Kwajalein, Majuro, Mili and Wotje. Majuro and Kwajalein have the highest number of invasives, 244 and 187 respectively, as the two atolls are the main ports of entry to the country (Figure 106).

RMI strengthened its management of Invasive Alien Species (IAS) and has its own cross-sectoral IAS Committee. RMI is a member of the Micronesia Regional Invasive Species Committee, and joined with FSM and Hawaii to develop the Micronesia and Hawaii Regional Biosecurity plan. In 2015, RMI approved its National Invasive Species Strategy and Action Plan (NISSAP) and has completed a desktop survey of IAS in priority sites.

Biosecurity procedures exist at international ports of entry and there is capacity in Early Detection Rapid Response (EDRR). There are also weed management actions on Majuro, Bikini and Kili atolls (Moverley, 2016).

IMPACT

Invasive species are one of the biggest threats to biodiversity in RMI. Impacts include those on economic revenue, e.g. lower crop productivity, reduced export potential, and habitat change. Social impacts include increased human labour costs, reduced aesthetic value, loss of culturally important species including traditional medicines, and increased erosion affecting water cycles and supply.

RESPONSE AND RECOMMENDATIONS

Border responses are driven by economic pests e.g. African snail and oriental fruit fly, but there is a need to increase support for invasives that do not have a perceived economic impact.

A National Biodiversity Steering Committee has been established, and with the new NISSAP, RMI has a plan in place to address the threats on invasive species.

RMI has endorsed their participation in the Regional GEF6 Invasive Species Project with a contribution of $US1m – this will improve the current situation and also shows the political will to improve.

Mangrove forest in Namdrik AtolI.Photo credit: RMIEPA, 2009.

SOURCES:

Moverley, David: Invasive Species Adviser at the Secretariat of the Pacific Environment Programme, Personal Communication, 18th of March 2016.

Office of the Environmental Planning and Policy Coordination, Biodiversity Clearing House Mechanism: http://biormi.org/index.shtml?en/home.html. Date accessed" 2nd of March 2016.

Pagad, Shyama. Compile and Review Invasive Alien Species Information for the Republic of the Marshall Islands. Report for the Secretariat of the Pacific Regional Environment Programme (SPREP), 2015

Secretariat of the Pacific Regional Environment Programme, Map of Atolls with High Invasive Species Presence: Map by Paul Anderson, March 2016

BIODIVERSITY KEY SPECIES OF CONCERN

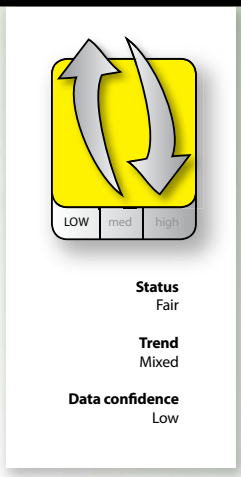
RMI has few indigenous or endemic species, and one of the most endangered land birds in the region. The Ducula oceanic radakensis (Ratak Micronesian Pigeon) is known locally as Mule. Their habitat and feeding grounds on Majuro is less than ten square miles where they feed on mature breadfruit (Autocarpus altilis and A. mariannensis) or mejwaan, papaya (carica papaya) and other native fruit trees. This pigeon is only found in the eastern islands in the RMI (Ratak Chain), with a land mass of about 30 square miles. These birds once inhabited Arno, Ailuk, Aur, Lekiep, Maloelap and Wotje.

Bikar, Erikub and Jemo are the three main nesting sites for the Green turtle (Chelonia mydas). The Hawksbill turtle (Eretmochelys imbricatel) is rare with only one nesting site identified in Bikar in the early 1970's (Hendrickson, 1972). These turtles have been part of Marshallese culture since the first human settlement. Both are considered threatened in the IUCN Red List.

Much like turtles, most shark species are threatened. However, sharks are protected by law. The challenge for RMI, along with other countries such as Palau and the Cook Islands, is enforcement and monitoring. These countries are taking measures to protect sharks within their EEZs.

This indicator measures the trend and how these key species of concern are addressed in RMI.

FIGURE 107. The Mule in its habitat (Photo by: MICS, 2009).



IMPERIAL MICRONESIAN PIGEON (MULE)

Status: Fair Trend: Mixed Data Confidence: Low

In 2006, the Marshall Islands Conservation Society (MICS) initiated a project to restore the Ratak Micronesian Pigeon (Ducula oceanica radakensis) or Mule on Majuro. The population of Mule (Figure 107) declined to just eight breeding pairs due to the loss of habitat (removal of native trees), human activity and predators (mainly rats and cats).

The Mili Atoll bird expedition led by MICS in 2009, confirmed that Majuro and Mili were the only atolls left where the Mule occurs. However their population on Mili was not known.

The Mule campaign made significant progress in population recovery where 80 birds were recorded. The restoration of their natural habit and community awareness campaigns made a big difference with the numbers of Mule increasing. The Mule plays a vital role in distributing the seeds of the Mejwan (seeded breadfruit tree).

Key activities in the Majuro Mule restoration project (Table 19)

- Aluminium flashing, or banding of the nesting trees, was very effective in protecting the mule and its habitat from predators.
- The local community and the landowner in the northern islets, planted Mejwan (seeded breadfruit) and papaya to ensure a food source for the birds and people.

TABLE 19. Mule Restoration Project on Majuro (MICS).

Activity	Number of output	Result
Banding	215	365 trees banded on populated islands
Transplant papayas	300	700 have been distributed
Transplant Mejwan (seeded breadfruit)	64 have been planted	75 planted on seven islets
Billboard Signs	2	2 signs erected to raise public awareness about the Mule and its habitat

The Green turtle is the most common of the four turtle species which occur in the Marshalls Islands. There were over 620 nesting sites and over 70 individuals recorded during the surveys of 1998, 2006 and 2007 (Figure 108). The number of nesting turtles in Bikar alone is estimated at 100–500 (NMFS and FWS 1998). In the early 1970's, Bikar was considered the largest turtle nesting site in the Micronesian region (Hendrickson, 1972). However the trend of turtles in the RMI is unknown. Human exploitation of sea turtles has become easier with the use of motor boats, compared to outrigger canoes. Hawksbill turtles (Figure 109) are listed as critically endangered in the IUCN Red List and are considered rare. However there is limited knowledge on this turtle.

By law, it is an offence to harvest sharks or shark parts for commercial purposes (RMI Revised Code, 2011). The RMI government declared their EEZ a Shark Sanctuary in 2011. About 183 metric tons of sharks were caught annually from 2005 to 2011 before the sanctuary was established (MIMRA by-catch data). Whale sharks Rhincodon typus (Figure 110) are listed as vulnerable under the IUCN Red List and occasionally get caught up in fishing nets from purse seiners.

IMPACT

Removing these key species from their natural habitat would have negative impacts on the natural ecosystem. Each has different roles in maintaining their natural habitats. For example, the Mule spreads the seeds of the mejwan (seeded breadfruit tree).

Turtles and sharks play a critical role in the marine ecosystem, and removing them could have negative impacts on the marine ecosystem. Maintaining healthy ecosystems and their biodiversity has many benefits and adds value to the socio-economic well-being of RMI.

SOURCES

Hendrickson, John. R., South Pacific Islands – Marine Turtle Resources. A report prepared for the South Pacific Islands Fisheries Development Agency by the Food and Agriculture Organization of the United Nations in Rome, 1972.

Marshall Islands Conservation Society (MICS); Mule Restoration Project conducted in Majuro, Marshall Islands, 2007–2011.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1998. Recovery Plan for U.S. Pacific Populations of the Green Turtle (Chelonia mydas). National Marine Fisheries Service, Silver Spring, MD.

RMI Revised Code, 2011. Volume 2: Title 51-Management of Marine Resources: Chapter 2: part 5; sections 229 and 230.

Trevor, Michael and Taylor, Robert. Status and conservation management of the Micronesian Imperial Pigeon in the Marshall Islands, 2014.

Turtle Research and Monitoring Database System (TREDS): Secretariat of the Pacific Regional Environment Programme (SPREP).

Trevor, Anne. Republic of the Marshall Islands TREDS Report, SPREP 2010.

Photo Credits: Marine Photobank.org. www.marinephotobank.org: Data accessed: 22 March 2016; Marshall Islands Conservation Society: Mule restoration project: 2007–2011.

RESPONSE AND RECOMMENDATIONS

Currently, a Mule conservation plan is lacking and more needs to be done with the ongoing turtle research and review of legislation. Whales are protected under RMI law, however, only a few species are listed and there are no management or conservation plans. It is vital to have the management plans and legislation in place to ensure these species are protected.

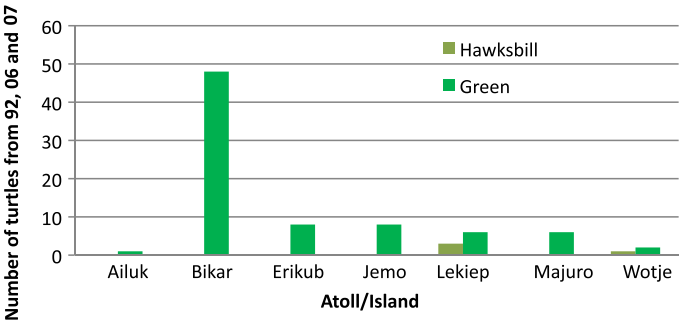


FIGURE 108. Number of turtles recorded during surveys conducted in 1992, 2006 and 2007 (SPREP-TREDS Dataset).

FIGURE 109. The Hawksbill turtle is listed as critically endangered in the IUCN Red List. (Photo by: Marine Photobank).

FIGURE 110. The Whale Shark is listed as Vulnerable in the IUCN Red List (Photo by: Florida Keys National Marine Sanctuary/Marine Photobank)

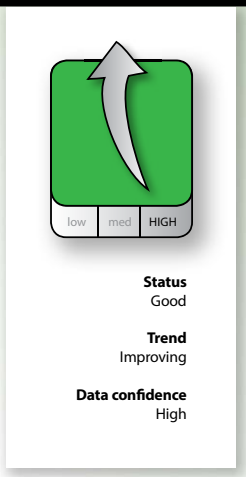
BIODIVERSITY PROTECTED AREAS

In the past, the Marshallese used many methods to sustainably harvest natural resources. One of the methods remaining in use in some areas is Mo – the traditional system to designate all or part of an island, or a reef area, as a restricted site. Special permission from the Iroij (chief) was required to visit a Mo. Harvesting from the Mo was done for special occasions, or in times of famine. The rules and regulations for Mo varied across the archipelago and often involved rituals and chants. There was a belief that failure to comply with the rules, rituals and chants could result in a bad storm for the homeward journey, or a tragic accident for a member of the visiting party.

Other methods for conserving natural resources included seasonal harvesting of different species, and other restrictions, such as those practiced on Wotje Atoll, where the size of coconut crabs was restricted and no females with eggs were to be taken. On some atolls Mo are still known by the community and are respected. In other places (e.g. urban centres) the community has no living memory of Mo and how this important method of conservation and sustainable use is being lost, along with the deep ecological understanding that accompanied it.

The need to document and revive the knowledge and practice of Mo, and of traditional environmental management in general, has been emphasised in work done since 1999 on planning for biodiversity conservation. The Marshallese heritage, like other indigenous peoples around the world, includes a deep understanding of how to live in harmony with the environment. This plan acknowledges the importance of reviving traditional knowledge and practice, while adding national and local government support for conservation.

Conservation efforts in the RMI are guided by the 2008 Reimaanlok National Conservation Area Plan. This indicator measures how RMI has progressed in addressing the natural resources concerns through protected areas.



Status: Good Trend: Improving Data Confidence: Medium

RMI has 36 terrestrial protected sites or areas on 14 atolls covering 27.12 square kilometres (MIMRA, 2016). Of the 14 atolls, six are listed as whole atoll-protected areas, while the other seven have specified protected sites for their protected areas (Table 20). These protected areas are managed by each atolls' local government. The conditions of management vary. Most sites have no specified management plans in place but are covered under general atoll-wide management plans. Jaluit and Namdrik atolls are listed as Ramsar sites while Lip Island is being processed.

TABLE 20. Total Protected Areas in the RMI (RMI data-MIMRA, 2016)

Atoll	Total sites	Total Protected Area (km^2)	Total RMI Land Area (km^2)	Percentage
Ailuk	1	0.02		0.01
Rongelap	whole atoll	7.43		4.10
Ailinginae	whole atoll	3.06		1.69
Bikini	whole atoll	6.36		3.51
Arno	13	5.60		3.09
Jaluit	2	1.03		0.57
Rongerik	whole atoll	1.59		0.88
Kwajalein	1	0.05		0.03
Mili	7	0.89		0.49
Namdrik	1	0.98		0.54
Likiep	1	0.01		0.01
Majuro	4	0.11		0.06
Wotje	whole atoll	Not Specified		
Erikub	whole atoll	Not Specified		
Total	**36**	**27.12**	**181**	**14.99**

About 15 percent of all land area is protected in the RMI. Five percent more to reach its commitment under the Micronesian Challenge, which aims to conserve at least 20 percent of terrestrial resources by 2020.

The RMI is close to reach its Aichi biodiversity targets which state that by 2020 at least 17 percent of terrestrial areas are conserved (Figure 111). The next phase is to track if the protected areas are effectively conserved and managed.

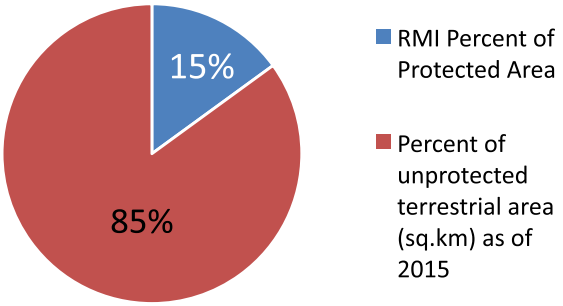


FIGURE 111. Percentage of protected areas in the RMI as of 2015 (MIMRA, 2016).

IMPACT

The RMI is heading in the right direction by establishing Protected Areas. However, only four have management plans, while others are being drafted (Table 21). Most of these protected areas are managed through island-wide systems which are often insufficient. Table 22 explains the process.

TABLE 21. Status of Reimaanlok Community-based resource management plans as of February 2016.

Pending	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
Aur Jabat Utrik	Maloelap	Jemo	Rongelap	Wotho	Wotje	Majuro-Bikirin	Bikini	
Kwajalein	Mili	Arno	Lib	Ebon	Majuro-Woja	Namdrik	Ailuk	
Ailinglaplap	Enewetak		Ujae		Majuro-Bokan Botin		Jaluit	
Edikub Ujelang	Namu		Lae		Majuro-Ene Kalamur		Likiep	
Jemo Taka Rongedrik	Kili		Mejit		Majuro-Denmeo			
Bokaak Bikar Ailininae	Jaluit				Ailinginae			

Coastal Management Advisory Council (inclusive of updates from CMAC Monthly Meeting October 29 2015 and updates from MIMRA/MICS review on Feb 15 2016)

TABLE 22. Reimaanlok management planning process

1	Initiation	A need to develop a community-based resource management plan is identified either at the local government level or at the national level.
2	Project Scoping and Setup	Establishment of a project workplan, a team of facilitators, and identification of budget and resources.
3	Building Commitment	An initial visit is made by the national team to carry out education awareness about the benefits of conservation and resource management, and to build trust with the community
4	Collecting and Managing Information	Further visits focus on collection and documentation of local knowledge and use of resources, socio-economic information and baseline scientific information.
5	Developing the Management Plan	Several visits are made to the community to develop, draft, and revise a detailed management plan.
6	Sign-Off	Achieve commitment to the to the plan through sign-off of management plan.
7	Monitoring, Evaluation, and Adaptive Management	Monitor achievement of the objectives - both biological and socio-economic. Adapt the management plan accordingly.
8	Maintaining Commitment	Ensure community has adequate support for ongoing management.

RESPONSE AND RECOMMENDATIONS

Work continues with communities to increase their ownership of the monitoring and management process beyond the funding and project cycles. The national government is developing national plans and policies to help coordinate the implementing of management plans and local ordinances, to address biodiversity issues.

Under the Micronesia Challenge, the RMI has agreed to have 30% of Near-shore Marine Resources, and 20% of Terrestrial Resources, Effectively Conserved by 2020. The definitions that follow are the result of consultations with government and local communities in 2006 and 2007. These definitions provide an interpretation of the Micronesia Challenge commitment.

Near-shore Marine Resources are defined as all those resources from the high water mark to a depth of about 100m (the ocean-side reef drop-off), and including the entire lagoon. Given this definition, the total area of Near-shore Marine Resource in the RMI is about 14,067 km^2. Terrestrial Resources are defined as resources within the land area outside of population centres.

The total land area in the RMI covers 182 km^2, however the amount of terrestrial resources has not been fully measured. Within forests, animals such as land crabs and birds need varying levels of protection, depending on their vulnerability and abundance. The greatest threats to terrestrial animals and birds are habitat loss and invasive species including snakes, rats, crazy-legged ants and other invasive plant species. Some terrestrial environments should be placed under high levels of protection to serve as habitats for important or threatened species, and to protect their life-cycle (Reimaanlok, 2008).

It is highly recommended for RMI to establish consistent monitoring programs; carry out more research and secure funding to help protect the natural biodiversity. Currently, there is limited information on RMI's biodiversity. In the last decade, national and local governments have acted to conserve and sustainably manage biodiversity resources in RMI (Table 23).

TABLE 23. Key activities in addressing biodiversity issues in RMI.

National Efforts on Policy, Planning and Coordination
1999–2000: Development of the National Biodiversity Report and the Biodiversity Strategy and Action Plan (NBSAP).
2002: Establishment of MEIC known as the Coastal Management Advisory Council (CMAC) as a collaborative multi-agency group focused on sustainable use of coastal resources, fisheries management and biodiversity conservation.
2005: Drafting of RMI National Coastal Management Framework and Atoll Coastal Management Plans initiated by RMI EPA for Majuro, Jaluit, Wotje and Majuro.
2006: Evolution of MEIC to the Coastal Management Advisory Council (CMAC) and development of a strategic plan.
Community/ atoll-level driven efforts
1997: Bikini Atoll declared a protected area under local government ordinance.
1999–2003: Development of the Jaluit Atoll Plan of Management for conservation and sustainable livelihoods and, in 2004, declaration of Jaluit Atoll Conservation Area as a Ramsar site.
2003: Ailinginae, Rongelap and Rongerik declared as protected areas under local government ordinances.
2003: Fisheries management plans for Likiep and Arno Atolls drafted.
2003: Draft management plan for Mili Conservation Area prepared.
2005: Fisheries management planning for Majuro initiated.
2007: Fisheries and conservation management plan for Ailuk Atoll prepared.
Biological Resource Assessment Surveys
In addition, biological surveys have been carried out on Jaluit (2000), Likiep (2001), Ailinginae and Bikini (2002), Mili, Likiep, Ailinginae and Rongelap (2003), Namu and Majuro (2004), and Ailuk (2006) with the specific purpose of helping to identify areas of biodiversity significance for the establishment of conservation areas and fisheries management plans (RMI EPA and NRAS).
Effective Conservation of Terrestrial Resources
Generally, Effective Conservation in terrestrial areas means actively maintaining the current land use. For agroforestry, it means ongoing maintenance and management of the forests. Many forests in the Marshall Islands are fast-growing and form successive states of dynamic equilibrium – meaning they are subject to periodic disturbances and changes in the assemblage of species. The natural history of the Marshall Islands makes it clear that people have been part of the terrestrial ecosystem for most of the time land has existed here. Most of the forests are able to tolerate a high level of use although this is not the case with the old stands of Pemphis acidula, which should be subject to high levels of protection.

SOURCES

Local Governments from: Ailuk; Arno; Bikini; Likiep; Majuro and Mili Atolls.

Coastal Management Advisory Council (CMAC).

College of the Marshall Islands (CMI).

Environmental Protection Authority (RMI EPA).

Marshall Islands Conservation Society (MICS).

Marshall Islands Marine Resources Authority (MIMRA).

Marshall Islands Marine Resources Authority: Updated Protected Area list, 2015.

Natural Resources Assessment Survey (NRAS).

Office of Environmental Planning and Policy Coordination (OEPPC).

Reimaan National Planning Team, 2008. Reimaanlok: National Conservation Area Plan for the Marshall Islands 2007–2012. Published by N. Baker, Melbourne.

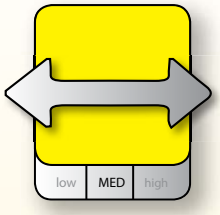
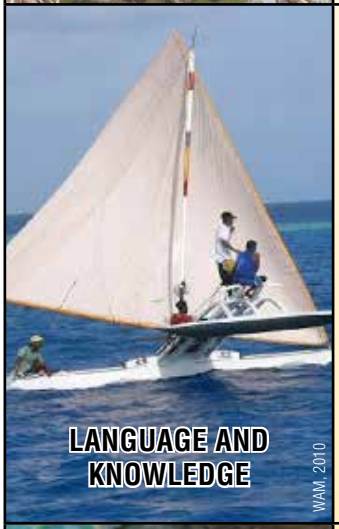
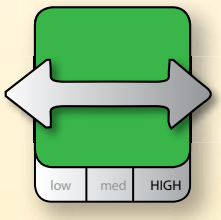
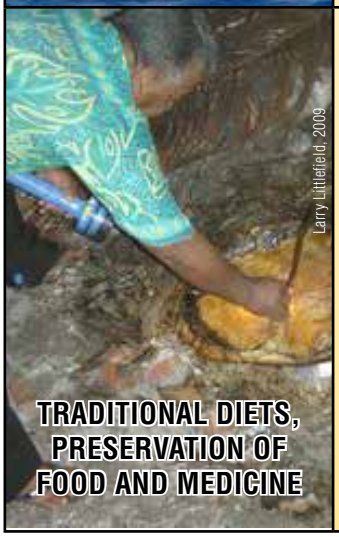
This chapter is about the cultural and heritage elements in Marshallese society as they relate to the environment, and the impact of a changing environment. An important aspect of any SOE report is the link between people, traditions and the environment. For this theme, three main indicators were chosen to highlight the current relationship between culture and the environment:

1. The State of Historical and Traditional sites, which tie directly to the environment as either a preserved site, such as WWII battle sites, or natural sites on which the myths and legends of the Marshallese are based.
2. The State of Language linking to Environmental Knowledge, showcasing the use of language in maintaining a sense of place, marine managed areas, key traditional practices and products.
3. The State of Traditional Diets, highlighting the ties between diet and culture, and diet and the environment, through agricultural practices, food security, and reliance on imports.

All indicators show that traditional culture forms the basis for both new and old environmental practices. The changing diet of 'easy to prepare' foods is having significant negative impacts on the ability to cope with the changing social and economic aspects, particularly food security. In addition, there are historic and traditional sites that require better management and care. These sites are essential as they maintain and sustain ties between Marshallese culture and the environment. Modernisation is rapidly changing the traditional social structure. However, much of RMI's success can be found in embracing both the past and future.

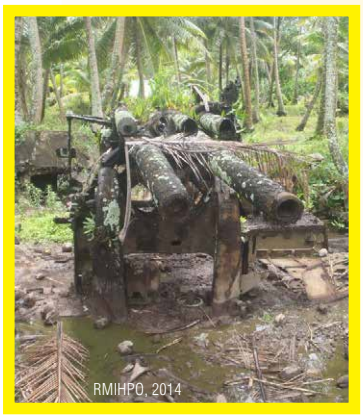
Ailuk Atoll. Photo credit: David Kane, 2014.

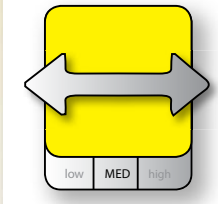
CULTURE AND HERITAGE HIGHLIGHTS

TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
 RMIHPO, 2014	 **Status** Fair **Trend** Stable **Data confidence** Medium	There are 118 prehistoric sites and 212 historic sites in RMI. Most have general management plans except for Jaluit Atoll.	The Historic Preservation Legislation of 1992 has codified Cultural Resource Management (CRM) into law - however there are changes needed to coincide with traditional values and processes. Highly significant sites should be prioritised for management planning and action.
 WAM, 2010	 **Status** Good **Trend** Stable **Data confidence** High	Nearly all speak Marshallese. This is a good indicator that the local language is intact and will be used into the future.	The language is stable. The only recommendation is to sustain the use of the Marshallese language. The traditional knowledge and languages are the foundation of the Marshallese people. RMI recognises that this national asset is the backbone of Marshallese identity and culture.
 Larry Littlefield, 2009	 **Status** Fair **Trend** Deteriorating **Data confidence** Low	A recent study shows a shift towards imported foods. This dependence on imported foods results in a decrease in traditional food production and preservation.	Public health campaign on healthy eating and Be Active making NCD a priority. There is a need to improve breeds of small livestock and crops that can cope with atoll environments and extreme climate events.

INTRODUCTION

The culture, history and natural environment of the Marshallese cannot be separated because specific places, rocks, trees and animals have powerful cultural meaning. Land is 97 percent privately owned and controlled by three titles: Iroij (chief), Alap (landowner or clan elder) and Ri-jerbal (land steward). The Iroij has the highest authority and he or she controls all affairs concerning land rights. Land is prized above all else and the conservation and use of the environment is linked to Marshallese culture and traditions. The Mo sites (tradition conservation sites) continue to influence the land management today. There are conditions that apply to Mo which include seasonal harvesting in the marine, coastal and terrestrial environments, taboo sites for Iroij and Alap, as well as burial sites. Over 300 sites have been mapped of which the most significant are traditional or pre-historic sites. This indicator measures the state of historical and culturally significant sites which link the Marshallese and their land.





Status
Fair

Trend
Stable

Data confidence
Medium

Status: Fair Trend: Stable Data Confidence: Medium

With over 3000 years of human habitation there are some very significant prehistoric sites. These include battle sites, burial sites and others that are central to local myths and legends. The management of natural cultural sites is coordinated at the national level by the Historic Preservation Office. However, many sites are infrequently monitored or managed.

There are 118 traditional/prehistoric sites and 212 historic sites (Figure 112). Most have general management plans, but no specific ones. Only Jaluit has a detailed site level management plan, while five islands have none (Figure 113). The wide geographic spread, transportation costs and varying conditions of important sites makes ongoing management a challenge.

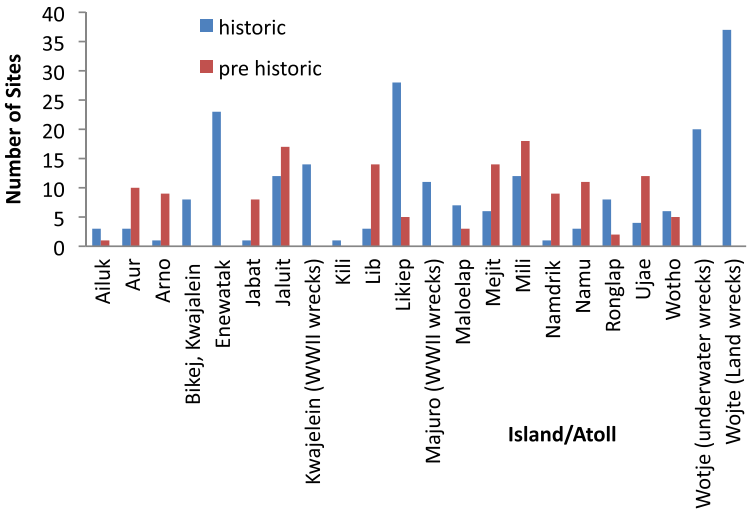


FIGURE 112. List and number of prehistoric and historic sites (RMI-HPO Archaeological Surveys).

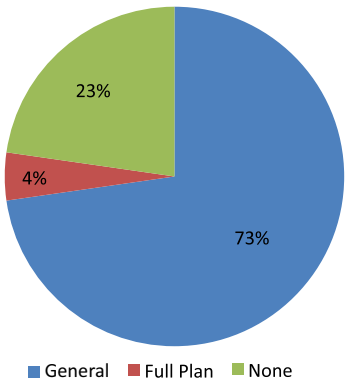


FIGURE 113. Percentage of sites with management plans (RMI-HPO Archaeological Surveys).

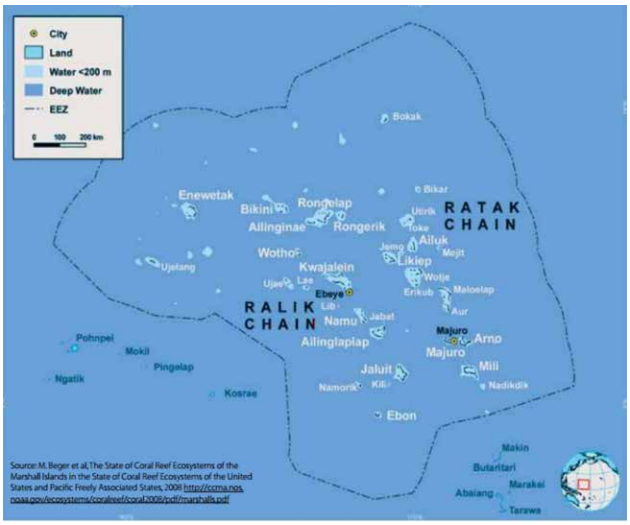


FIGURE 114. Map of the Marshall Islands (Maria Beger et al, 2008)

IMPACT

Prehistoric and historic sites have intrinsic value for the Marshallese but are at risk from development, raising sea levels, and neglect. Loss of these sites means loss of culture, history and national unity.

RESPONSE AND RECOMMENDATIONS

These sites are non-renewable cultural resources which require prudent management and preservation. The Historic Preservation Legislation of 1992 has codified Cultural Resource Management (CRM) into law, however there are changes needed to coincide with traditional values and processes. Highly significant sites should be prioritised for immediate management planning and action.

SOURCES

Marshall Islands Historical Preservation Office Archaeological Surveys

Deurnert, Boris, Langinbo Frank, Lucy Harris, Matt Harris, Kevin Lynch, Lucile M. Roberts, Donna K. Stone, Richard Williamson, and Jeffrey Zebedy, 1999, Anthropological Survey of Jaluit Atoll: Terrestrial and Underwater Reconnaissance Surveys and Oral History Recordings. HPO Report 1999/02 Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Holly, Matthew B. 2000. Archaeological Survey and Inventory of Submerged Cultural Resources

in the Lagoon of Kwajalein Atoll. HPO Report 2000/02, Series Editor Richard V. Williamson,

Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Holly, Matthew B. 2000. Archaeological Survey and Inventory of Submerged Cultural Resources

in the Lagoon of Majuro Atoll. HPO Report 2000/01, Series Editor Richard V. Williamson,

Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Holly, Matthew B. 2000. Archaeological Survey and Inventory of Submerged Cultural Resources in the

Lagoon of Wotje Atoll. HPO Report 2000/03, Series Editor Richard V. Williamson, Majuro Atoll,

Republic of the Marshall Islands: Historic Preservation Office.

Mead, Leslie A., Langinbo Frank, and Fredrik Langmoir, 2003, Cultural Resources Survey of Namdik Atoll, Republic of the Marshall Islands. HPO Report 2003/01 Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Petrosian-Huse, Carmen C.H., 2004, Anthropological Survey of Arno Atoll. Preliminary Report 2004/3 Historic Preservation Office, Majuro Atoll, Republic of the Marshall Islands.

Petrosian-Husa, Carmen C.H., 2005, Preliminary Anthropological Survey of Mili Atoll. HPO Report

2005/02 Majuro Atoll, Republic of the Marshall Islands Historic Preservation Office.

Petrosian-Husa, Carmen C.H., 2004, Anthropological Survey of Wotho Atoll (Preliminary Report). HPO Report 2004/02 Majuro Atoll, Republic of the Marshall Islands Historic Preservation Office.

Suzanne S. Finney, 2007, Phase Two Survey and Inventory of Submerged Cultural Resources in Portions of Maloelap Lagoon. Historic Preservation Office, Republic of the Marshall Islands.

Thomas, Frank R., 2004, Archaeological Survey of Ellep (Lib) Island. HPO Report 2004/04. Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Williamson, Richard and Donna K. Stone, 2001, Archaeological and Anthropological Survey of Ailuk Atoll. HPO Report 2001/08. Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Williamson, Richard and Donna K. Stone, 2001, Archaeological and Anthropological Survey of Aur Atoll. HPO Report 2001/08. Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Williamson, Richard V. and Hemley Benjamin 1999, Archaeological Reconnaissance Survey of Bikej Island, Kwajalein Atoll: A Preliminary Survey Conducted by the Historic Preservation Office for the Environmental Protection Authority. HPO Report 1999/01 Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Williamson, Richard and Donna K. Stone, 2001, Archaeological Survey of Enewetak Atoll. HPO Report 2001/05. Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Williamson, Richard and Donna K. Stone, 2001, Archaeological and Anthropological Survey of Jabat Island. HPO Report 2001/06. Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Williamson, Richard and Donna K. Stone, 2001, Archaeological Survey of Kili Island. HPO Report 2001/03. Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Williamson, Richard and Donna K. Stone, 2001, Anthropological Survey of Likiep Atoll. HPO Report 2001/07 Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Williamson, Richard and Donna K. Stone, 2001, Anthropological Survey of Mejit Island. HPO Report 2000/04 Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Williamson, Richard and Donna K. Stone, 2001, Anthropological Survey of Namu Atoll.HPO Report 2001/11 Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Williamson, Richard and Donna K. Stone, 2001, Archaeological Survey of Rongelap Atoll. HPO Report 2001/02 Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Williamson, Richard and Donna K. Stone, 2001, Anthropological Survey of Wotje Atoll. HPO Report 2001/09 Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

Wright, Mary Jane, 2011 An Inventory of Archaeological Resources on Ujae Atoll, Republic of the Marshall Islands. HPO Report 2011/02. Majuro Atoll, Republic of the Marshall Islands: Historic Preservation Office.

CULTURE AND HERITAGE LANGUAGE AND KNOWLEDGE

Language and action is used to establish one's heritage and connection to other people. Traditionally, oratory has allowed the Marshallese to express themselves such as when addressing high chiefs or during important events. This is usually accompanied with a chant that further describes a person's place of belonging: as a result, the speaker and listener have a stronger vested interest in the sense of place and belonging to that environment. Inon and bwebwenato are traditional Marshallese folklore or oral history which was passed down orally from generation to generation.

The RMI has two native dialects (Ralik and Ratak), which everyone can understand. The Marshallese language is the most common language used at home, work and in schools (Figure 115). However, traditional formal speaking styles have declined and only a few of the older generation still use them. There is also a mixture of other languages incorporated into Marshallese, as a result of the colonial influence. Figure 116 shows that the local language is intact and stable with no difference in the numbers of Marshallese speakers in 1999 and 2011 (RMI National Census Reports 1999 and 2011).

The Marshallese language has particular depth in describing environmental characteristics which have specific cultural and practical uses. In particular, fishing methods and the limited terrestrial flora are described in detail. For example, pandanus has over 50 documented uses and over 100 named varieties.

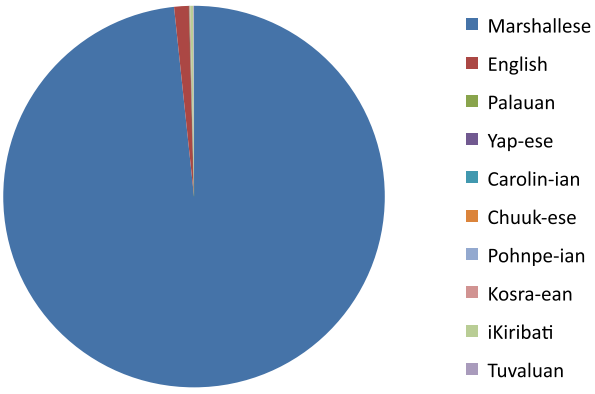


FIGURE 115. Population by language spoken at home.

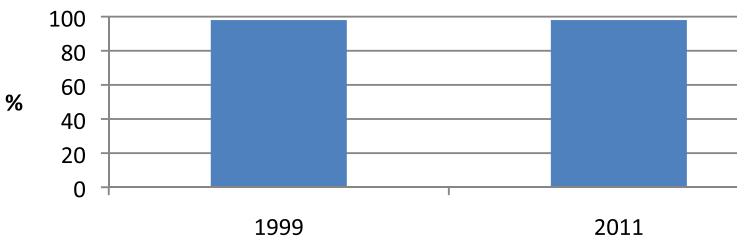
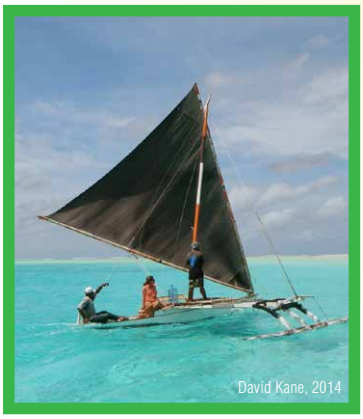
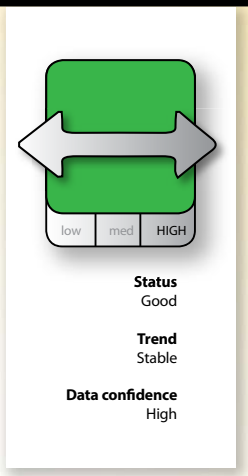


FIGURE 116. Spoken Marshallese language in 1999 and 2011.





Status: Good **Trend: Stable** **Data Confidence: High**

Almost all speak Marshallese, a sign that the native language is intact and stable. Marshallese courses are integrated into the school system and this ensures that the number of Marshallese speakers will continue well into the future.

There is also a Marshallese font and spell checker for computers. All national documents are now being processed and translated into the local language.

The backbone of the Marshallese Culture and Language is the traditional outrigger canoes known locally as Walap, Tipnol, or Korkor (Figure 117). The outrigger canoe is the most important metaphor and foundation of the Marshallese culture.

FIGURE 117. Outrigger canoe sailing across Majuro lagoon (Photo: Karen Earnshaw).

The outrigger links to the navigation and weather skills. The stick charts Rebbelip (showing sailing direction) and Wapepe (showing wave patterns) are used for traditional navigational training (Figure 118).

The lines in the Rebbelip, Meto and Wapepe – representing the currents – are made of coconut fronds or sometimes Lo or hibiscus in English, while the points of Ane or islands are made of Likajir shells. These stick charts contributed to the history of cartography as they represent a system of mapping ocean swells and currents. The charts were memorised before a voyage took place. The Rebbelip and Wapepe are perfect examples of the link between language, culture and environment.

The Walap, up to 100 feet long, is the biggest canoe and was used for long voyages. Tipnol is a mid-size canoe of 20 to 40 feet, used for fishing in the lagoon and ocean side. The Korkor is the smallest, a paddling outrigger that can be fitted with a sail for the lagoon. Every part of the canoe has a special name which can be used in other ways. For example, the outrigger or Kubak is a metaphor for the way a man and woman complement one another. The canoe is significant to every aspect of the Marshallese way of life. (Miller, 2010).

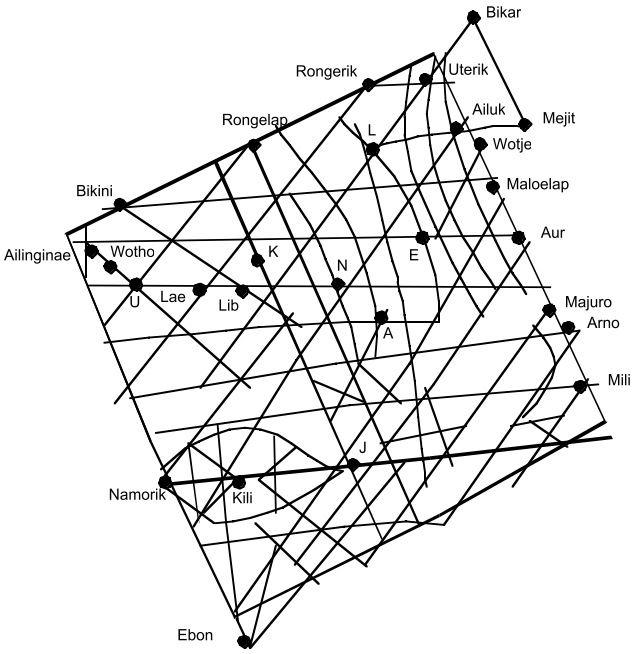


FIGURE 118. Traditional Marshallese Navigation Chart known as Wapepe, Meto or Rebbelip.

IMPACT

The dominance of the Marshallese language is slowly changing due to the influence of outside cultures. The traditional Marshallese language and the way of doing things has declined to the extent that few elders use it.

RESPONSE AND RECOMMENDATIONS

The language is stable. The main recommendation is to sustain the use of the Marshallese language which is the foundation of the Marshallese people, their identity and culture. As a result, national initiatives have been established by government and the education department to support the Marshallese language, culture and heritage of the people. These include:

The establishment of the Marshallese Studies Department at the College.

- Public School System (formerly MOE) has a language policy for Marshallese language instruction and evaluation.
- Translation of all national documents into Marshallese.
- Documentation of traditional songs and chants.
- Revised Marshallese dictionary, Marshallese fonts and spell checker for computers.

It is also recommended that the national archives at the Alele museum be properly maintained and made more open to the public. More activities and programmes are needed to stimulate the interest of the younger generation to learn more about Marshallese traditions and culture.

Stick chart. Photo credit: WAM, 2015

SOURCES

Economic Policy, Planning and Statistics Office (EPPSO), Republic of the Marshall Islands Census Reports, 1999, 2011.

Miller, Rachel. Wa Kuk Wa Jimor: Outrigger Canoes, Social Change, and Modern Life in the Marshall Islands. 2010.

Photo source: Waan Aelon in Majel (WAM): http://www.canoesmarshallislands.com/: Photo Karen Earnshaw

CULTURE AND HERITAGE TRADITIONAL DIETS

Food production in an atoll environment is not easy. The early Marshallese developed a unique system of cultivation adapted to the poor soil quality of the islands. They also preserved food in case of famine or for long voyages. The status of food security is vulnerable, due to the increased dependence on imported food products and the decline in traditional food preparation and preservation.

Major crops adapted to atolls include coconut, pandanus, breadfruit, and swamp taro grown in marsh areas. Sea level rise poses threats to taro farms and food security. Most introduced crops require modification for their growing to survive in the harsh atoll environment. Some breadfruit varieties are more resilient. However, breadfruit does not tolerate salt water spray or prolonged dry periods which affect most introduced crops. The main livestock on atolls are pigs and chickens. The influence of climate change, pests and diseases are an increasing concern for both livestock and introduced crops.

Status
Fair

Trend
Deteriorating

Data confidence
Low

Status: Fair Trend: Deteriorating Data Confidence: Low

For thousands of years, the Marshallese people were food secure and self-sufficient, preserving food for times of scarcity. A recent study shows a shift towards imported foods and a decrease in traditional food production and preservation.

In 2004, a project was initiated to preserve the traditional knowledge of producing and preserving the Mokwon, or dried pandanus paste. Mokwon can reach over two meters and weigh a few hundred pounds (Figure 119). This project showed that the raw materials, skills and demand can still be part of the modern Marshallese diet. Another traditional craft in decline is the production of traditional tools such as the pandanus scraper or Wekan (Figure 120) for making the paste for Mokwon. This tool was used to collect pandanus juice. The dried paste is then bound with pandanus leaves to make a Mokwon (Figure 121). (Loeak, Anono Lieom., et al. Life in the Republic of the Marshall Islands, 2004).

FIGURE 119. Marshallese children sitting on a ten foot long Mokwon, a traditional food preservation method consist of dried pandanus paste rapped in pandanus leafs (Petrosian-Husa, 2004).

FIGURE 120. Pandanus paste scraper or Wekan (Petrosian-Husa, 2004).

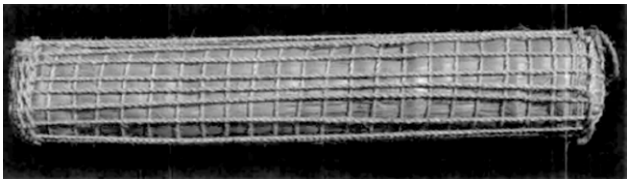


FIGURE 121. Dried pandanus paste roll, preserved in pandanus leaves, maan, and tied with sennit, ekkwal (Petrosian-Husa, 2004).

The survey results from Arno atoll show that 82 percent of protein is from imported food (Figures 122, 123 and Tables 23, 24) (RMI Atoll Resilient Agriculture Centre, 2014-SPC unpulished data). The imported foods are mostly inferior in nutrition and quality, and are linked to higher levels of diabetes, heart diseases, stroke, obesity, dental disease and a number of cancers. A survey conducted by RMI and World Health Organisation (WHO) showed that the risk factors of poor diet, lack of physical activity, and lifestyle behaviours lead to obesity and Non-Communicable Diseases (NCDs) (Marshall Islands STEPS Survey, 2002). Traditional food production and food preservation has declined, most dramatically on Majuro and Ebeye.

IMPACT

The traditional methods of land cultivation in RMI have declined due to easier access to imported food. About 90 percent of food is imported.

RESPONSE AND RECOMMENDATIONS

More public health campaigns on healthy eating are needed. Non-communicable diseases should be prioritised in public health awareness campaigns. There is a need to strengthen, diversify and improve breeds of small livestock and crops that can cope with atoll environments and extreme climate events.

TABLE 23. Energy Sources

	Total Local	Total Import	Total/day/person	% Import
grams	241	793	1034	91%
Kilo-calorie	292	2867	3158	

TABLE 24. Protein Sources

	Total Local	Total import	Total/person/day	% Import
grams	50	89	140	81%
kilo-calorie	41	178	218	

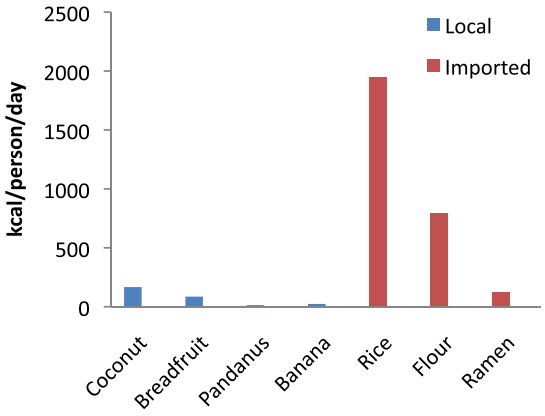


FIGURE 122. Local vs. Imported Starch Food Consumption (SPC, 2009).

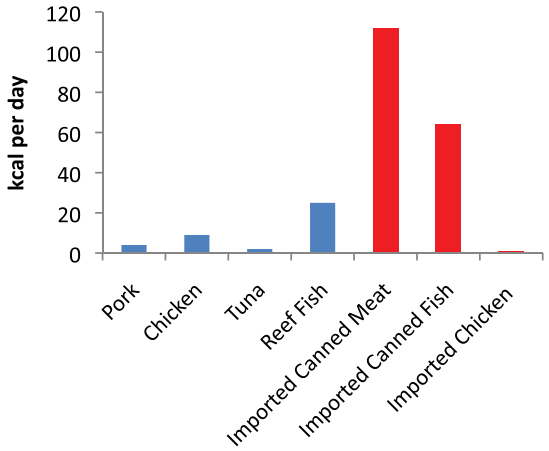


FIGURE 123. Local vs. Imported protein consumption (SPC, 2009).

SOURCES

Loeak, Anono Lieom., Kiluwe, Veronica C., and Crowlde, Linda., 2004. Life in the Republic of the Marshall Islands, University of South Pacific.

RMI Atoll Resilient Agriculture Centre – Arno Island, 2014, RMI-SPC. (unpublished data).

Petrosian-Husa, Carmen C.H., 2004, Traditional Marshallese Tools. Alele Report 2004/2 Majuro Atoll, Republic of the Marshall Islands.

SPC

WHO STEPS, 2002, chronic disease risk factor surveillance, fact sheet. www.who.int/chp/steps.

Picture sources:
www.cuisinivity.com/globalfeast/pacific/Marshall_Island;
www.hawaii.edu/cpis/MI/plants/ma.htmls/2013

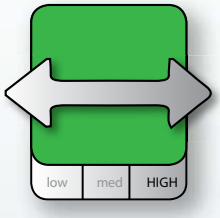
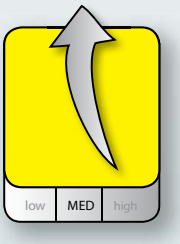
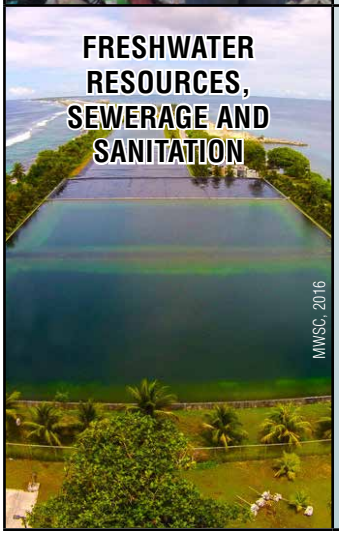
Cultural Culinary Connections	
Seafood – Fish including snapper and tuna, clams, lobster, turtle, cone-shell. Photo Source: www.cuisinivity.com	
Coconut (ni), pandanus (Bob), breadfruit (ma), taro (iaraj, kotak), pumpkin, banana, arrow root and sweet potato. Photo Source: www.cuisinivity.com	
Traditional food preservation; e.g. bwiro, jaankun, jabkwunujo (coconut cooking oil) dry taro, pandanus fruit and breadfruit, preserved coconut sap, smoked or salted fish. Photo Source: www.cuisinivity.com	 
Food preparation e.g. Um and jinre (komaat lal) Photo Source: www.hawaii.edu	

Based on the census report 2011, 73.8 percent of the population lives in an urban area. People have more access to imported goods, including white goods such as washing machines and fridges and other items like vehicles. The main environmental impact of urbanisation is that the urban population is outpacing the ability of urban services to meet demand. Overall, drinking water and access to electricity have improved over the past 30 years. Although per capita consumption of energy is increasing, renewable sources such as solar, and better water and energy infrastructure, are improving energy efficiency.

Solid (household) and liquid (sewage) waste are having a huge negative impact on the environment. Only one of the waste management facilities in RMI has available data and even this facility is full (many waste sites burn as a regular practice). Recycling rates are inadequate. Poorly functioning septic systems are a major issue in urban centres. The urban foreshore areas are polluted by excessive nutrients, and fecal coliforms from broken sewage outfalls.

Majuro reservoirs. Photo credit: Sunergise International Limited, 2014.

BUILT ENVIRONMENT HIGHLIGHTS

TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
	 **Status** Good **Trend** Stable **Data confidence** High	75% of the population has access to grid electricity: 92% in the urban areas of Majuro and Ebeye and 32% in the rural outer islands. Marshall Islands are extremely vulnerable to fluctuating global fossil fuel prices.	• General electric retrofit – MEC • Increase renewables • Review of the Energy Policy and other legislation and regulations • Revive the price monitoring board. • Government subsidy (land owners, outer islands), increase accessibility.
	 **Status** Fair **Trend** Improving **Data confidence** Medium	The Census 2011 showed 58.1% of waste is taken to landfill while 41.9% is dumped into pits, burnt, composted or dumped at sea. No proper management of solid waste disposal existed before 2007.	The RMI is developing a plan to increase compositing at the household level. Composting of organic waste is carried out at a small scale at the landfill site. There is a plan to do more composting if there is space.
	 **Status** Poor **Trend** Improving **Data confidence** Low	Due to RMI's limited storage capacity and aging reticulated water system, water is rationed. Under non-drought, normal operating conditions, the public water operates 3 times a week for 4 hours per day. Some use a flush toilet connected to a central sewerage system (37.8%) or to their own septic tank (36.3%).	Due to RMI's limited storage capacity and aging reticulated water system, water is rationed. Under non-drought, normal operating conditions, the public water operates 3 times a week for 4 hours per day. Some use a flush toilet connected to a central sewerage system (37.8%) or to their own septic tank (36.3%).

BUILT ENVIRONMMENT ENERGY

In the RMI and across much of the Pacific, energy is a problem due to 1) the small size of the country and relative isolation, which poses a challenge to providing access to affordable energy for all citizens, and 2) most islands are highly dependent on fossil fuels for their energy needs.

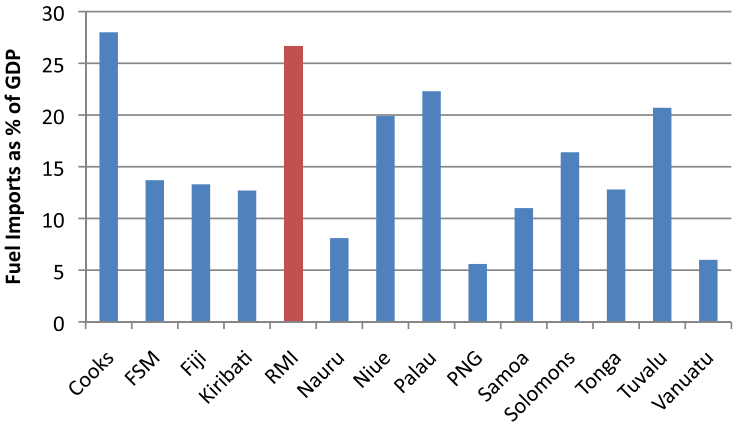


FIGURE 124: Percent fuel imports of GDP in 2009 across Pacific Islands (NMDI, SPC).

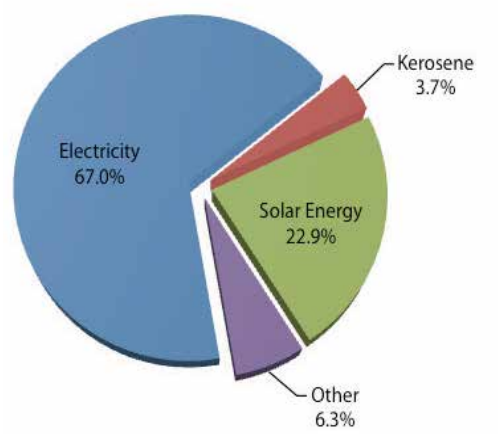
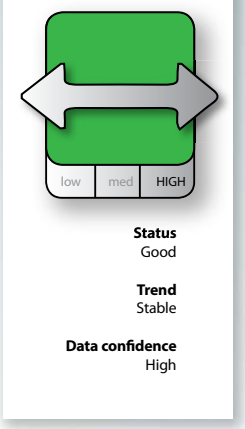


FIGURE 125. Electricity sources for RMI (RMI Census 2011).



Status: Good **Trend: Stable** **Data Confidence: High**

About 75 percent of the RMI population has access to grid electricity: 92 percent in the urban areas of Majuro and Ebeye and 32 percent in the rural outer islands. The five other islands in RMI, namely Majuro, Kwajalein, Kili, Jaluit and Wotje have central power plants, some of which run during limited hours of the day. Other remote populations receive electricity services from photovoltaic-battery systems provided by international donors and maintained by the central utility (RMI's Second National Communication to UNFCCC, p. 35)

RMI is extremely vulnerable to fluctuating global fossil fuel prices. In 2009, RMI spent about 26 percent of their GDP on importing fossil fuels, the second highest after the Cook Islands in proportion of GDP amongst Pacific Island Countries (Figure 124). The RMI Census 2011 revealed that electricity is the main source of lighting, followed by solar energy. Most households (67.0%) use electricity for lighting, and some (22.9%) use solar energy (Figure 125). A few (3.7%) use kerosene or other sources (6.3%), such as batteries, candles, or their own generator.

Electricity is the major source for lighting in Majuro (91.6%), Kwajalein (88.7%) and in selected atolls, namely Kili (100%), and Wotje (73.5%). Solar energy prevails in over half of the outer islands – Ailinglaplap, Ailuk, Arno, Aur, Ebon, Enewetak, Jabat, Lib, Likiep, Maloelap, Mejit, Mili, Namdrik, Namu, Ujae, Utirik and Wotho. In Kwajalein Atoll, solar energy is used by 5.3 percent of households, while 2.9 percent of households in Majuro use kerosene for lighting (RMI Census 2011).

Solar installation. Photo credit: Sunergise International Limited, 2014.

Energy consumption is decreasing due to the prepaid system introduced in 2011 and the Import Duty incentive on energy efficient goods. From 2005 to 2014, the consumption of electricity fell even though the population grew from 25,000 in 2005 to about 28,000 in 2014 (Figure 126). In 2014 residential usage of electricity dropped a quarter compared to the total MWh used during 2005. The decrease in energy consumption shows that the community and government initiatives to promote energy efficiency are effective.

Energy from diesel generation fell from 2005 to 2014 (Table 26) while solar energy grew from zero MWh in 2005 to 160 MWh in 2014. The trend for fuel used for electricity generation fell from 21 million litres in 2006 to 14 million litres in 2014, saving the government over USD$7,000,000 in 2014 alone (Global Petrol Prices, September 2014). As at December 1st, 2014, the price per kilo-watts-hour (kWh) in the RMI is $0.346 for residential vs $0.12 kW/h in the mainland U.S in 2014 (Table 27). The urban centres of Majuro and Ebeye consume more than 90 percent of the country's electricity (Figure 127).

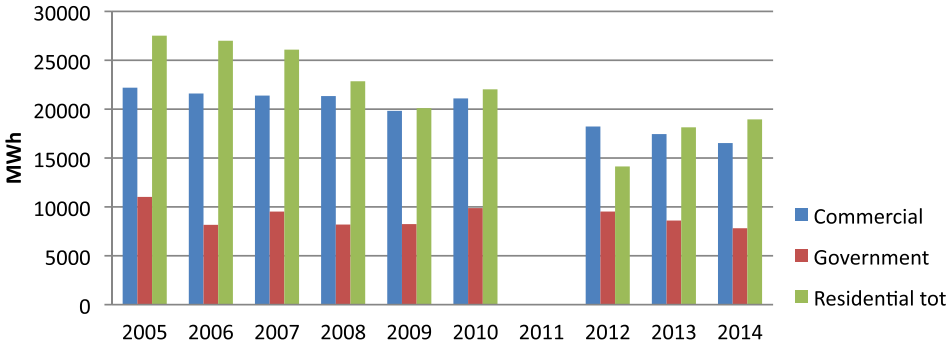


FIGURE 126. Energy consumption by commercial, government and residents, Majuro (MEC).

TABLE 26. Generation and distribution of energy in the Marshall Islands (MEC).

Year	Generation by Diesel Engine (MWh)	Generation by solar PV (MWh)	Total Generation (MWh)	Fuel used (litres)	Station losses (MWh)
2005	82366	0	82366	N/A	5684
2006	79077	0	79077	21337034	5300
2007	77469	0	77469	20602327	6173
2008	70696	0	70696	19303004	7726
2009	63312	0	63312	17623641	*Not measured*
2010	62912	0	62912	17116754	*Not measured*
2011	62639	0	62639	15512001	*Not measured*
2012	61494	120	61494	15200499	*Not measured*
2013	62457	217	62437	14547000	*Not measured*
2014	58594	160	58594	14591780	*Not measured*

TABLE 27. Current price for tariff/kWh (Eligibility Assessment for Energy Sector report, 2014).

Type of User	Tariff/kWh (USD$)
Lifeline users (below 500kWh/month)	$0.326
Residential sector (over 500kWh/month)	$0.346
Commercial sector	$0.406
Government sector	$0.416

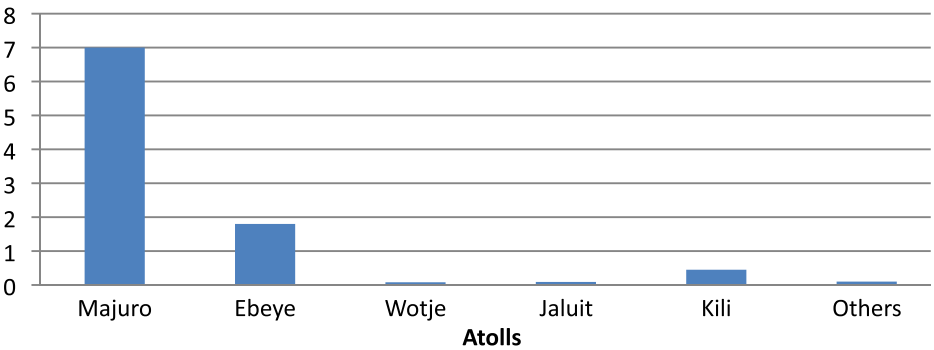


FIGURE 127. Average load (MW) per atoll, 2014 (MEC and KAJUR).

IMPACT

There are several economic, social and environmental implications for RMI in energy consumption and efficiency. Expanding into more renewable resources for energy production decreases the vulnerability to world market volatility of fuel prices. Diversifying energy sources helps to reduce vulnerability during disasters. In addition, the transition to more renewable and/or efficient energy sources reduces the emission of greenhouse gases.

- RMI is vulnerable to changes in world fuel prices.
- High energy losses from the current distribution system.
- Limited energy sources increase vulnerability during disasters.
- GHG emissions per capita relatively high, related to current energy sources.

RESPONSE AND RECOMMENDATIONS

The RMI government has taken steps to improve access to affordable energy. These include:

- General electric retrofit – MEC.
- Increase the renewable energy use and proportion sold back into the grid.
- Review of the Energy Policy as well as relevant legislation and regulations.
- Revive the price monitoring board.
- Government subsidy (land owners, outer islands), increase access.

The 2014 Energy Policy states that the RMI government is aiming at 100 percent electrification of all urban households, and 95 percent of outer island households to have access to off-grid solar power by 2015. The policy aims for households and business to be 50 percent more energy efficient (75 percent energy efficient for all government buildings) by 2020. Also, to reduce by 20 percent the supply side energy losses at MEC, and to add 20 percent of energy to the main grid through renewable resources, by 2020.

Photo credit: MSNBC

SOURCES

Marshalls Energy Company (MEC).

Secretariat of the Pacific Community, National Minimum Development Indicators, 2009 (www.spc.int/nmdi/).

Economic Policy, Planning and Statistics Office, Republic of the Marshall Islands Census, 2011.

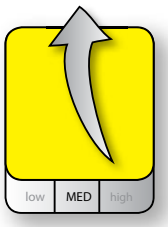
Eligibility Assessment for Energy Sector Reform Contracts in the Republic of the Marshall Islands, Final Report 2014.

Majuro Jable landfill. Photo credit: Tim Hartley, 2016.

MUNICIPAL SOLID WASTE COLLECTION, RECYCLING AND WASTE SEPARATION

Management of solid waste is an ongoing problem in RMI and across the Pacific, due to physical, resource and human capacity limits. Smaller Pacific Island nations such as RMI experience the impacts of waste accumulation faster and more intensely than larger metropolitan countries.

For this indicator, solid waste includes household and commercial waste products such as paper, plastics, metals and garden/kitchen organic wastes. Hazardous wastes (e.g. asbestos, PCBs, paint and other special wastes) are discussed in the Hazardous Waste indicator.



Status
Fair

Trend
Improving

Data confidence
Medium

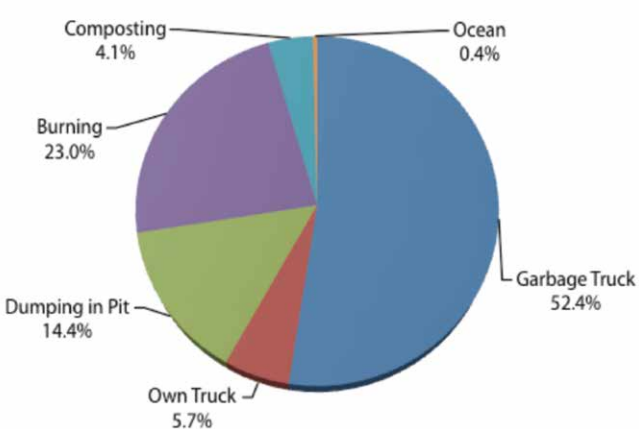


FIGURE 128. Households by manner of garbage disposal (RMI Census: 2011).

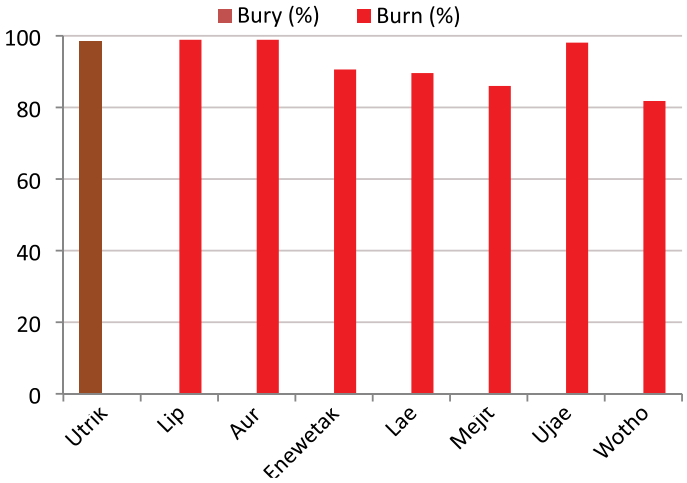


FIGURE 129. Matter of garbage disposal (burn or bury) in the outer islands. (RMI Census 2016)

Status: Fair Trend: Improving Data Confidence: Medium

The state of solid waste management in RMI has improved. The RMI Census 2011 indicated that 58.1 percent of waste is taken to landfill while 41.9 percent is dumped into pits, burnt, composted or dumped at sea (Figure 128). No proper management of solid waste disposal existed before 2007.

Collection of waste takes place only on the two main centres of Majuro and Ebeye. In Majuro, a collection service runs from Rita to the airport. Residents on the Laura side of the island transport their own waste to the landfill or dispose of it by burying and burning. A total of 668 illegal or unauthorized dumpsites were recorded in 2011 (Majuro Infrastructure Survey Report, 2011). Unregulated dumpsites are putting more pressure on the surrounding areas which leads to other social and health issues.

The Majuro Atoll Waste Company (MAWC) reports that operating and managing the Majuro landfill is expensive, exceeding USD$800,000 annually (Pattle Delamoe Partners Ltd, 2015). “A garbage truck provided by the government is the main means of garbage disposal for 76.7 percent of households in Kwajalein and 70.6 percent of households in Majuro. In Kili, 96.6 percent of households dispose of their garbage using a garbage truck provided by the government, while almost all households (98.6%) in Utirik use their own pit to bury garbage (no burning). Note that burning of waste is a common manner of garbage disposal in several atolls/islands. All the households in Lib dispose of their garbage by burning, and a large percentage of households in Aur (98.9%), Enewetak (90.6%), Lae (89.6%), Mejit (86%), Ujae (98.1%) and Wotho (81.8%) use this method for garbage disposal” (RMI Census 2011) (Figure 129).

As of 2013, fourteen percent of landfill funding is provided by operational revenue (commercial waste collection and recycling activates) while the remaining 86 percent is covered by Compact funds, bilateral and other outside

donors. In 2014 and 2015 the annual operational costs were projected to increase by up to 40 percent due to the costs of a new landfill. Waste collection for commercial establishments accounts for about fifteen percent of revenue, which generates about $70,000 annually (PDP Ltd, 2015). Figures 130 to 133 show the Majuro Landfill.

The increase in waste generation is influenced by increased population in Majuro and changes in the consumption of goods (Figure 134). More inorganic goods are entering the country, without an increase in recycling options. An ongoing challenge for the MAWC is locating buyers for recycled materials.

The report by Pattle Delamoe Partners Ltd (PDP) in 2015 on status options for solid waste management on Majuro Atoll revealed that individual waste production in 2010 was 0.9 kg per person per day. In 2013, it was one kg per person per day. This rate is very high compared to other urban areas in the Pacific. The report also revealed an urgent need to address the landfill in Majuro at Jable because it reached full capacity in 2011. Waste is piling up, and is now the highest elevation in RMI. There is a risk of failure of the sea wall holding the rubbish. The most common waste is paper, about 26.3 percent in volume, compared to leather or rubber at 0.36 percent. The landfill has more compostable green waste than solid waste like metal, glass, plastic and rubber (Table 28). Over half of waste collected is cardboard/paper, green waste and kitchen waste (Figure 135). This could be diverted from the landfill and used for composting.

TABLE 28. The composition of waste at the Majuro Landfill in 2013 (Pattle Delamoe Partners Ltd, 2015).

Type of Waste	Volume of Waste (%)
Paper	26.32
Green Waste	20.79
Synthetic Resin/Plastic	20.22
Metals	11.95
Disposable Diaper	5.60
Kitchen Garbage	4.70
Textile/Clothes	4.19
Glass/Ceramic/Coral/Shell	4.14
Leather/Rubber	0.36
Miscellaneous	1.72

FIGURES 130 and **131**. Waste segregation at Majuro landfill (Photos: Paul Anderson, 2015).

FIGURE 132 and **133.** Majuro landfill (Photos: Paul Anderson, 2015).

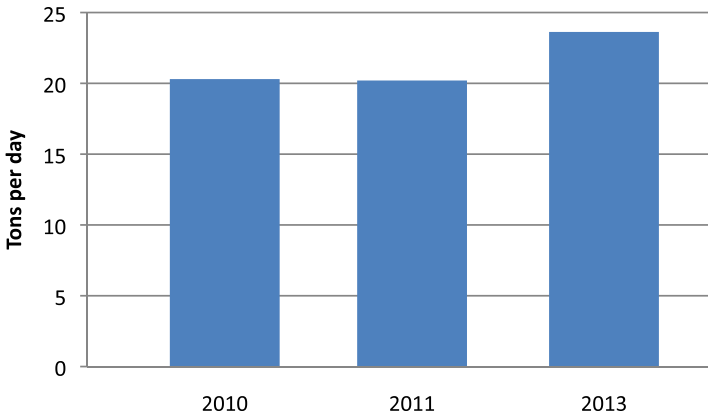


FIGURE 134. Waste Generation for Majuro in 2010, 2011 and 2013, Majuro Atoll Waste Company and ADB RMI snap-shot report June 2014.

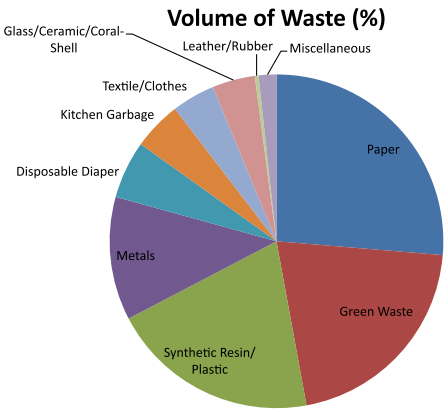


FIGURE 135. The composition of waste at the Majuro Landfill 2013 (Pattle Delamoe Partners Ltd, 2015).

IMPACT

As the RMI population increases, so will its waste stream, causing more pressure and negative impacts to the environment, society and economy. Solid and hazardous waste must be handled properly to protect the environment and especially the health of RMI citizens. The impacts of solid waste on the environment, society and economy include:

- The leaching of pollutants into the surrounding land, sea and ground-water environments.
- The increase in greenhouse gas emissions from waste decomposition.
- The spread of diseases through unsanitary waste management methods.
- Degraded amenity through increased litter and odours.

RESPONSES

RMI is planning to increase composting at household level. Composting of organic waste is carried out on a small scale at the landfill site due to lack of space. Other responses include:

- Construct a new landfill site for Majuro.
- Introduce a Container Deposit Legislation (CDL) for beverage containers (glass, plastic and aluminium), proposed to commence in 2017.
- Establish a Recycling Fund (as part of the CDL) to assist in recycling and exporting waste materials to international markets.
- Develop and launch a new five year National Solid Waste Management Strategy in 2017.
- Environment Protection Agency working with respective Atoll Local Governments Donor Agencies, Majuro Waste Company, Government Ministries, USP, and communities in waste awareness and education programs.
- Training on waste management.
- Composting and recycling programs organized for communities.
- Introduce a pre-paid garbage bag collection system across the entire Majuro atoll.
- Extend the current waste collection service to the entire Majuro atoll.
- Construction of a materials recovery facility with a metal compactor and PET plastic baler.
- Launch a used lead acid battery buy-back system to encourage public collection of batteries for international export and recycling.

It is recommended that diversion of green waste from the landfill is pursued, with MAWC trialling diversion of green waste to Laura Farm for composting. The current landfill needs a sound compaction and rehabilitation plan to ensure the provision of safe waste disposal can be maintained until the new landfill is constructed.

SOURCES:

Economic Policy, Planning and Statistics Office, Republic of the Marshall Islands Census, 2011.

Majuro Atoll Waste Company 2010, 2011 and 2013 data set.

Majuro Landfill Photos, Paul Anderson, Secretariat of the Pacific Regional Environment Programme, 2015.

Majuro Infrastructure Survey Report, 2011.

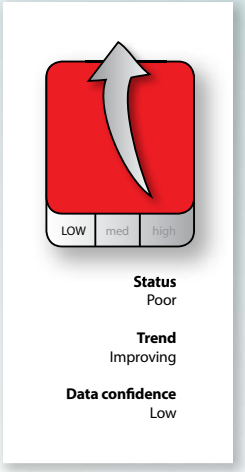
Pattle Delamoe Partners Ltd., Assessment of Status and Options for Solid Waste Management on Majuro Atoll, 2015.

Majuro new proposed landfill site. Photo credit: Tim Hartley, 2016.

HAZARDOUS WASTE HOSPITAL, HOUSEHOLD AND WHITE GOODS WASTE

Hazardous waste consists of solid, gas or liquids that contain elements that pose a significant risk to public health or the environment. Effective transport, storage and end-of-life management of hazardous waste is extremely critical to preventing disease bearing materials and toxic chemicals from entering the environment. For the purpose of this indicator, hazardous waste includes:

- E-waste (electronic waste): from disposed computers, phones and other electronics containing heavy metals or other toxins.
- Bulky items and white goods: such as cars, tires and refrigerators that are difficult to dispose of and/or contain hazardous chemicals.
- Health Care Waste: including needles (sharps), bottles, blood and body tissues and materials that have come into contact with them. These items carry a significant health risk to anyone exposed.
- Asbestos: a fibrous, fire-proof building material used in the mid to late 1900's in roofs, paint, walls, stucco and other materials. Fibres released during handling and destruction of materials cause asbestosis, a serious lung disease. (RMI has no or a very small amount of asbestos).
- Batteries: Including car, boat and other engine batteries, as well as batteries from electronic devices.
- Other household toxins: including solvents, paints, pesticides and other household chemicals.



Status: Poor Trend: Improving Data Confidence: Low

E-waste, white goods, batteries, household chemicals and bulky waste such as cars are collected as general waste and taken to Majuro landfill. While there is no separation of the waste at the source, some hazardous wastes are separated at the landfill, including batteries, white goods and computers. There has been an increase in TVs, stoves, phones, air conditioning units and computers over the past decade (Figure 136).

According to Pattle Delamoe Partners Ltd (PDP, 2015), there is limited data on toxic waste, but it is believed that chemical and hazardous wastes are being illegally dumped in RMI. It is an EPA arrangement that all waste oil generated in Majuro is received by the Majuro Energy Company. This is used in power generating by burning to produce electricity.

Health care waste is handled by Island Supplies International (ISI) who runs the incineration plant for hospital waste. The ash is buried in multiple cement lined pits at the incineration site; however financial support is required to continue outsourcing treatment to ISI (PacWaste Baseline report). No health care waste is dumped at the landfill. However sharps medical tools are disposed of in a SteriMed 70 healthcare waste processor, while other health care waste in Ebeye, including pharmaceuticals, pathological and anatomical waste, is disposed of in an unlined landfill open to scavengers. There is little asbestos in RMI, the only notable amount is in water pipes and poses a small threat while buried in place (PACWASTE 2015).

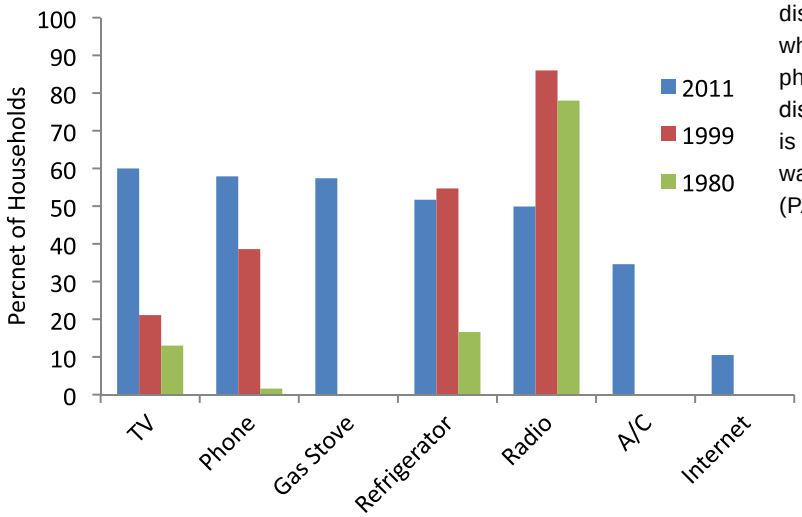


FIGURE 136. Percentage of households with appliances (Marshall Islands Census 1987, 1999, 2011).

While there is little data on hazardous waste figures, the imports of goods which end their life cycle as hazardous, is increasing (Figure 137). Used lead acid batteries are a growing problem for RMI, due to increased household solar systems. It is estimated that there are 7000 solar system batteries and 3000 car and boat batteries in RMI. The current recovery rate is around 10 percent (Improvements to the Management of Used Lead Acid Batteries, 2015)

There is little data on household appliances and vehicles that are classified as waste. The percentage of households owning registered vehicles declined from about 21 percent in 1999 to just over 16 percent in 2001, due to an increase in the number of unregistered vehicles – this reflects a governance issue and not an actual decrease in vehicle numbers (EPPSO). E-waste is currently collected at the landfill and separated for export. However, there is evidence of waste dumped at the landfill and in open dumps and private properties. In some areas, cars are used as seawalls – this is not a safe practice due to threats of hazardous oil and other metals, such as lead, which may leak into the environment during big swells and storms.

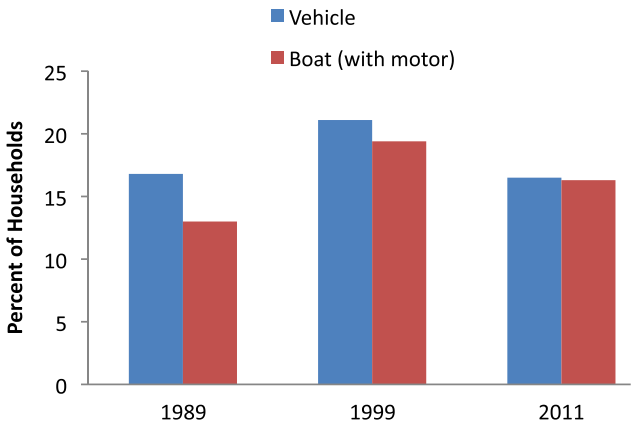


FIGURE 137. Percent of households with vehicles (Marshall Islands Census 1987, 1999, 2011).

IMPACT

The impacts of hazardous waste include:

- Filling up of dump sites with bulky waste, e-waste and white goods, which discharge toxins into the environment.
- Untreated hospital waste poses high health risks to waste handlers and the public.
- Government has minimal authority over privately owned land and the accumulation of hazardous waste on land is unsightly and adds more health and environment problems.

RESPONSE AND RECOMMENDATIONS

- Stronger enforcement of littering and tracking of hazardous waste streams.
- Training on enforcement.
- Training on hazardous waste handling and management.
- Strengthened enforcement on waste management.
- Identification of recycling markets abroad.
- National chemical and waste oil management plan developed.
- Hospital waste management plan.
- Capitalise a revolving fund to increase the value of used batteries that people bring from outer islands to Majuro.

SOURCES

Economic Policy, Planning and Statistics Office, Republic of the Marshall Islands Census Report, 1987, 1999, 2011.

Environmental Protection Authority.

Improvements to the Management of Used Lead Acid Batteries in Four Pacific Island Countries. Secretariat of the Pacific Environmental Programme, 2015/4.

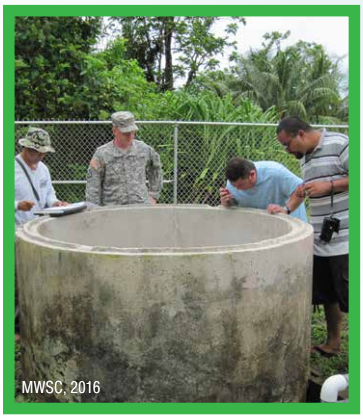
Office of Environmental Planning and Policy Coordination (OEPPC).

Pattle Delamoe Partners, Ltd., Assessment of Status and Options for Solid Waste Management on Majuro Atoll, 2015.

Stella, Natalie. Latimer, Geoff. *Baseline Study for the Pacific Hazardous Waste Management Project – Healthcare Waste, RMI.* ENVIRON Australia Pty Ltd and Secretariat of the Pacific Environmental Programme, 2014/7.

FRESHWATER RESOURCES

Water resources are finite and fragile, particularly in atoll environments, and it is increasingly under pressure due to the effects of climate change, population growth, urbanisation, economic development, the waste steam and other forces. In RMI, water is a scarce and vital resource. For this indicator, potable water is assessed using two primary indicators 1) the proportion of the population with access to improved drinking water (i.e. water that has gone through at least one stage of treatment or is from relatively clean sources), and 2) drinking water quality (i.e. the levels of bacterial contamination in the drinking water).



Status
Good

Trend
Improving

Data confidence
High

State: Good **Trend: Improving** **Data Confidence: High**

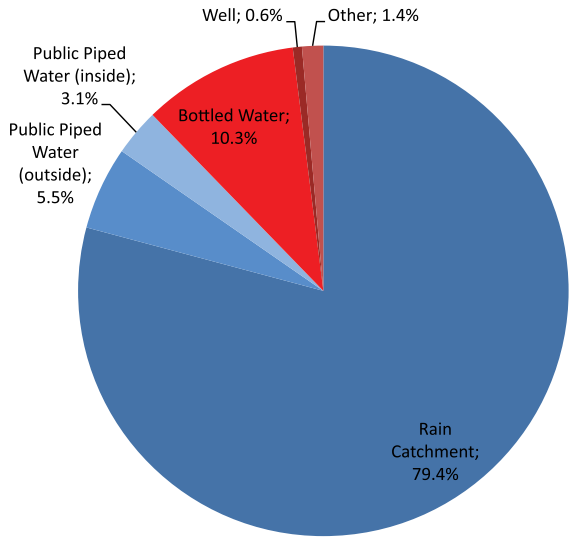


FIGURE 138. Households by source of drinking water, RMI Census 2011. Blue colours indicate improved drinking water sources whereas red colours indicate unimproved drinking water sources.

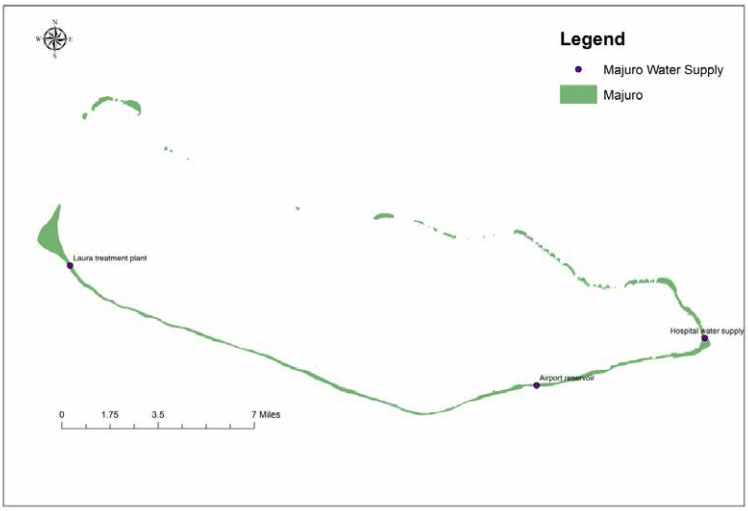


FIGURE 139. MWSC water stations in Delap, airport and Laura (SPREP EMG/GIS, 2016).

The main sources of fresh water are rainfall harvesting and groundwater. Despite relatively high rainfall, the limited storage capacity and aging reticulated water system means the public water supply is rationed. Under non-drought, normal operating conditions, the public water operates three days a week for four hours a day. There is a need to upgrade and improve the city water system in order to make water more available. During the El-Nino in 1998–1999, the public water supplies were exhausted to the extent that Reverse Osmosis (RO) Units had to be brought in to help relieve the water crisis. The RO units are expensive to operate and maintain – they are economically unsustainable and produce harmful CO_2 emissions.

The sources of water in the urban centres include rainwater, groundwater, desalination and imports. In the outer islands, the main water resources are rainwater and groundwater.

According to the RMI Census 2011, the main source of drinking water in the country is rainwater catchments and tanks which are used by almost four-fifths of households. A smaller number use public piped water, bottled water and well water (Figure 138).

The 2011 census notes that 88 percent of the population has access to improved drinking water which is defined as household connections, public standpipes, boreholes, protected wells, and rainwater collection. Unimproved water sources are unprotected wells, vendor-provided water, bottled water (unless water for other uses is available from an improved source) and tanker truck-provided water (WHO, 2012).

In the two urban centers, Ebeye and Majuro, water is distributed through a reticulated water system. Water supply is supplemented by reverse osmosis units. During droughts, Ebeye and some outer islands depend entirely on reverse osmosis for freshwater. The water utility, Majuro Water and Sewer Company (MWSC), operates three freshwater treatment plants (Figure 139): (1) Treatment

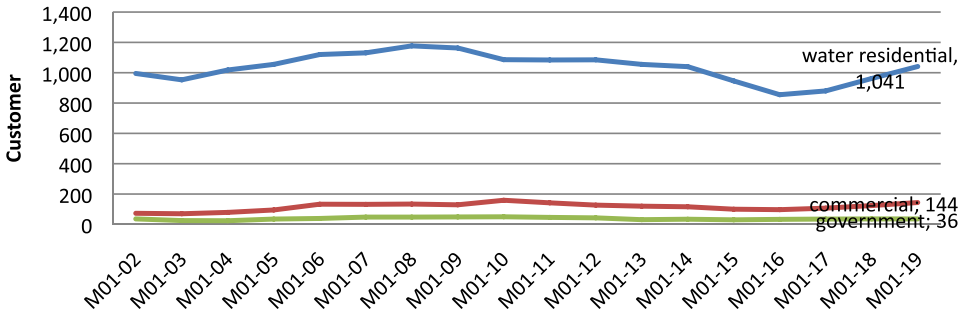


FIGURE 140. Number of MWSC customer connected to the city water (MWSC).

Plant A (Hospital), Treatment Plant C (Airport reservoir) and Laura Treatment Plant B (Laura Village). Treatment Plant A supplies freshwater to the Majuro Hospital and the Capital building. Treatment Plant C supplies the Darritt (Rita), Uliga and Delap (DUD) area with the Laura Plant servicing areas west of the Majuro airport.

The 2009 Water survey revealed that 51 percent of people on Kwajalein and 38 percent of people on Majuro are connected to the city water, with taps typically outside the house. Figure 140 shows that the customer numbers connected to the MWSC's city water have been stable with a slight drop towards December 2011. On Majuro, the RMI EPA monitors water quality with nine sampling sites from Treatment Plant C, three sampling sites from Treatment Plant A and five for the Laura Treatment Plant, including the Laura groundwater lens. Fresh water sources are regularly tested for quality – about half the tests return unacceptable results, based on drinking water standards (Figure 37). The RMI EPA tests for coliform bacteria, chlorine residual, turbidity, conductivity, pH, total dissolved solids and salinity about three times a week. Figure 141 shows the city water quality control monitoring site for Majuro.

Water studies by SOPAC and EPA between 1999–2003 show serious quantity and quality problems related to household drinking water, in terms of contamination (Table 29) (Hicking, A., "Marshall Islands Community-Base Water Quality Monitoring Program report", RMI EPA, 2003).

FIGURE 141. Map of city water quality control sampling sites in Majuro (EPA, 2016).

TABLE 29. Percentage of Outer Islands unsafe water (RMI EPA).

Name of Atoll / Year tested	No. of tanks tested	Found safe	Found not safe	Percent not safe
Jaluit 2003	28	9	19	68
Wotje 2003	24	3	21	88
Kili 2003	54	5	49	91
Mili 2003	98	21	77	79
Likiep 2003	42	9	33	79
Namdrik 2011	102	65	37	36
Ebon 2012	128	46	82	64
Mejit 2014	60	38	22	37
Maloelap 2014	112	47	65	58
Aur 2014	99	15	84	85
Total	**246**	**47**	**199**	
Percentage (%)		**19**	**81**	

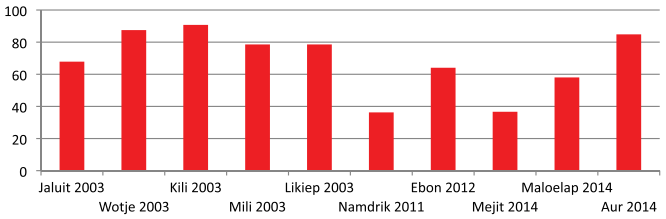


FIGURE 142. Water samples in outer islands (RMI EPA).

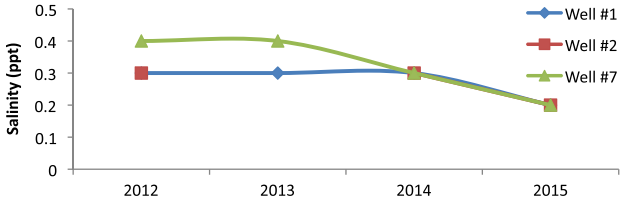


FIGURE 143. Average salinity in Laura Wells #1, #2, and #7 (RMI EPA).

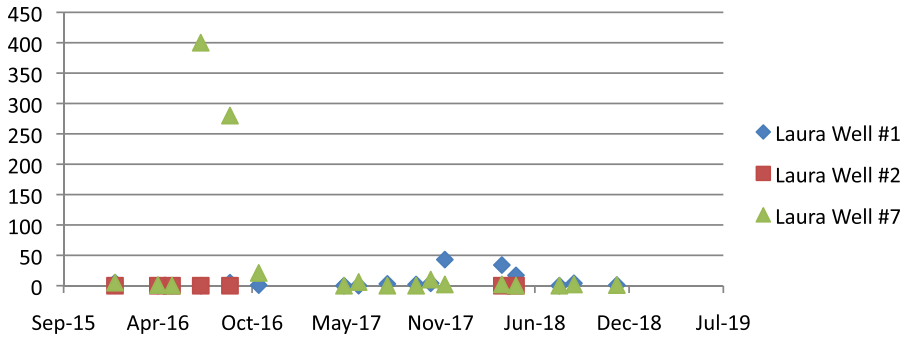


FIGURE 144. Average Escherichia coli (E.Coli) count for Laura wells in 2015 (RMI EPA).

The report showed that during the same period, tests were also conducted on a small sampling of groundwater sources on eight rural atolls (Aur, Jaluit, Kili, Likiep, Mili, Wotje, Maloelap, Mejit, Ebon and Namdrik). A similar pattern was observed, where a significant proportion of samples tested were found to be contaminated (Figure 142). Of the 698 water catchments tested in outer atolls, 81 percent were contaminated. Testing of groundwater wells, particularly in densely populated urban areas, show similar results. These findings suggest that a significant proportion of water sources are unsafe for human consumption without pre-treatment, boiling or chlorination (RMI MDG 2009 Progress Report).

Figure 143 shows the average salinity levels for MWSC pumping wells #1, #2 and #7 during 2012–2015. In 2015, all wells were diluted to about 0.2 salinity – a very fresh and good source of drinking water. This may have resulted in slow recharge of the lens with rainfall and decreased pumping of wells by MWSC. The standard for salinity level in drinking water is 0.5ppt and 10mg/L of Nitrate (nitrogen) in drinking water. The Laura groundwater, airport reservoir (runways) and Delap wells have been tested for all potential chemical contaminants and none exceeded the maximum contaminant levels (MCLs). The chemical that people feared the most, embalming fluid, was also tested and found below detectable limit (RMI EPA).

According to EPA the acceptable conductivity range of 0–1000μS/cm is the international standard which is considered safe for human consumptions. However, in the RMI, during drought periods, the accepted limit is up to 2000μS/cm. This level is restricted to people with health problems, the elderly and infants. Bottled or processed water is the alternative source for drinking water.

According to the WHO Guideline for Drinking Water quality, 2011, E.coli must not be detected in any 100 ml sample and immediate action must be taken if E.coli is detected. Figure 144 shows the presence of E.coli in most wells as these are raw and untreated water sources. MWSC, the provider for the public drinking water, treats the well water by chlorination before distributing to consumers in Laura village and up to Ajeltake. At the beginning of 2015, MWSC repaired most of the pipe problems (leakages and cross connections) of Laura distribution water and no more coliform bacteria have been detected in recent tests. Since all leaks and water line problems have been repaired from Laura to Ajeltake, the chlorine residual from Laura Treatment Plant now reaches Ajeltake village, ensuring the delivery of clean and safe drinking water. Chlorination is a water treatment process done at the Laura Treatment Plant which disinfects and protects the water from bacterial contamination.

During 2011–2015, Japan (JIRCAS) provided another study for the Laura Lens which matches with the findings recorded by the USGS. Bacterial contamination sources were identified as mainly from the farming area. The 'up-coning' of the groundwater was also noted in the study.

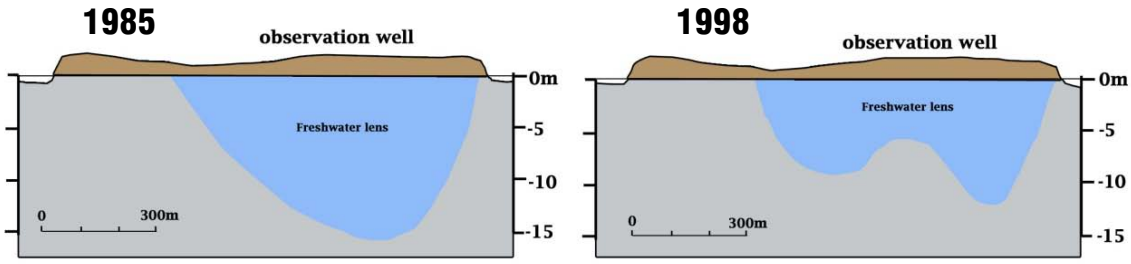


FIGURE 145. Comparison of Laura lens between the years 1985 and 1998, study made by Islands Environment Conservation Project by JIRCAS, 2015 (Koda et al, 2015).

The 'up-coning' of the lens occurred somewhere in the centre of the village where much groundwater abstraction was taking place during the drought of 1998 (Figure 145). The Laura lens cross-section shows a well shaped lens in 1985, but after or during the drought, the central part of the lens showed an up-coning structure. This shows the salinity level of the water whereby the fresh and salt water interface has been raised up, due to excessive pumping of the freshwater lens.

In 2015, RMI submitted another proposal to USEPA through the US Embassy in Majuro to assist in the predicted drought in 2016. A USEPA Hydrological Research Scientist, William Shuster, provided a test unit (sonde) for chemical tests and field analysis. USGS have been requested to undertake another study of the lens before the onset of the El Nino drought in 2016. The Water Division from the US will provide training and more water quality monitoring to assist decision makers in the control and management of Laura groundwater.

IMPACT

The health effects of a contaminated water supply include illnesses such as diarrhoea and skin infections. A clean water supply is a major public issue since water is limited throughout RMI, with the exception of Majuro and Ebeye.

RESPONSE AND RECOMMENDATIONS

There is no sewage system in Laura. This leaves the groundwater lens highly susceptible to coliform contamination from animal and human wastes as well as from other anthropogenic activities on land. Several projects have been undertaken to protect and manage the groundwater resources in a sustainable manner. The protection of the freshwater lens at Laura is a priority action for the RMI Environmental Protection Agency (RMI EPA) and the Majuro Water and Sewage Company (MWSC).

In response to the El-Niño-related drought in 1998, a team from the Water Resources Division of the United States Geological Survey (USGS) installed a monitoring network of 36 wells at eleven locations and helped to monitor six wells. The Water Resources Division is helping MWSC to advise on maximum extraction rates and safe yield.

Recommendations to maintain clean and safe water include:

- improve maintenance and services of Reverse Osmosis (RO) units in the outer islands.
- replicate PACC project (solar stills, and liners at the Majuro reservoirs as rain harvesting and catchment improvement, 186 solar stills, 35 regular sampling and testing of the parameters such as metals etc.
- community education programs and hygiene programs need to be incorporated into national plans.
- implementation of water policy and water safety plan, with particular attention to integrated rainwater harvesting, and improved management of the Laura lens.
- Enhancement of the public water supply and sanitation in Ebeye.

SOURCES

Abraham Hicking, Chief of Water Quality Monitoring, Environmental Protection Authority.

Halston Debrum, Operation Manager, Majuro Water and Sewer Company (MWSC) database.

Hicking, A., "Marshall Islands Community-Base Water Quality Monitoring Program report", RMI EPA, 2003.

RMI EPA Annual Reports, 2011, 2012 and 2014.

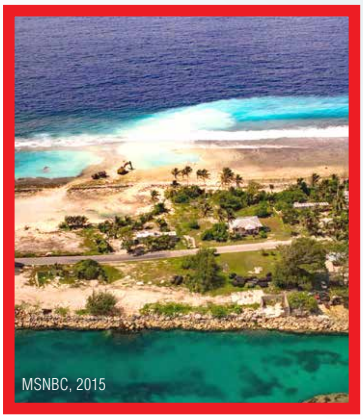
Republic of the Marshall Islands. "Millennium Development Goals Progress Report ". 2009.

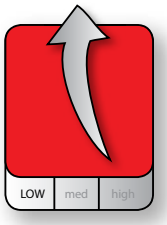
Sustainable Use of Laura Lens during Drought.

SEWERAGE AND SANITATION

Sewage is one of the most significant sources of marine pollution in urban centres in the Pacific region. Nearly every Pacific island nation has identified critical environmental and public health problems resulting from the disposal of human excrement.

Globally, sewage is a major component of marine pollution from land-based activities, which account for roughly three-fourths of all pollutants entering the world oceans (Rapaport, D. 1995). Land-based sources of marine pollution are contributing to an alarming decline in the health of the world marine ecosystems and their ability to provide for human needs. There are minimal sewerage impacts in the outer islands, mainly due to less population. This indicator covers the state of water and sanitation throughout the RMI.





Status
Poor

Trend
Improving

Data confidence
Low

Status: Poor Trend: Improving Data Confidence: High

According to the RMI Census 2011, almost three-fourths of all households use a sanitary-type toilet facility, with a flush toilet either connected to a central sewerage system (37.8%) or to their own septic tank (36.3%) (Figure 146). A water sealed toilet without flush is used by 10.3 percent of households and a pit latrine by 6.2 percent. However, 7.4 percent of households use another toilet facility and 2.1 percent have no toilet facility. All households in Kili, and over two-thirds of households in Ailuk (68.3%), Aur (67.4%), Mejit (73.7%), Namdrik (79.4%), Ujae (86.5%), Wotho (72.7%) and Wotje (81.8%), have sanitary-type toilet facilities. Sanitary-type toilet facilities are most common in Majuro (94.2%) and Kwajalein (96.4%). Most households use a pit latrine in Arno (44.4%), Enewetak (43.4%), Lae (52.1%) and Likiep (41.9%).

In Ebeye, an Infrastructure Survey Report 2010 revealed that the sanitary sewer treatment plant has not operated in five years and it needs an overall. Raw sewage is released directly to the lagoon 500 feet offshore. Sanitary sewer equipment is unsuitable and lacks maintenance and spare parts. Storm sewers are blocked. In addition, heavy rain results in flooding of various areas on Ebeye (U.S Army Infrastructure Survey Report, 2010).

In Majuro, the US Corps of Engineers Majuro Infrastructure Survey report in 2011 revealed that the overall condition of the infrastructure is marginal to poor. Storm sewers are blocked, which causes areas to flood during heavy rains, posing health risks. Standing water compromises the life of the main road on the atoll. The main sewage system's outfall in Majuro is broken at the reef crest, resulting in excessive growth of rooted vegetation and dead algae washing ashore, causing concerns for health and quality of life.

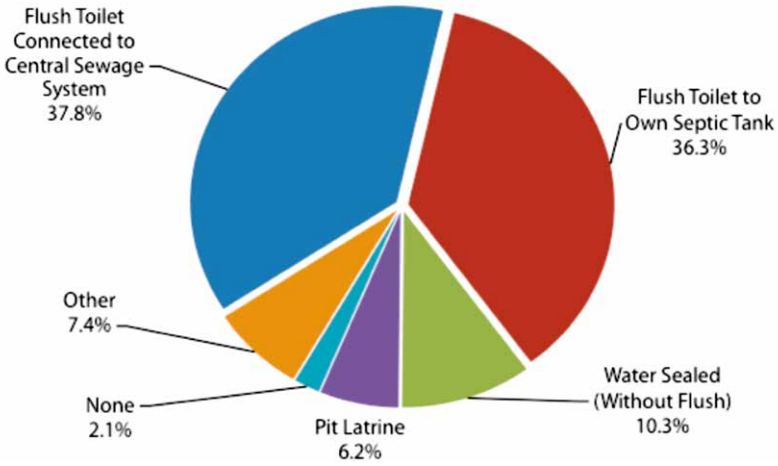


FIGURE 146. Household by type of toilet facilities (2011 RMI Census).

IMPACT

- Inadequate sewage disposal, poor sewerage management and sanitation causes Eutrophication of coastal waters, dying reefs, pollution of ground wells, spreads vector borne diseases, outbreaks of gastro-intestinal disease, and other environment problems.
- Dying algae along the northern to the south coast of Majuro due to bursting sewer pipes. The seaweed outbreak is spread roughly six miles from the eastern point of Majuro (Uliga to Delap point) down to the southern coast of Rairok.
- Sewage, and other forms of pollution from land-based activities, add to the degradation of the environment.

RESPONSE AND RECOMMENDATIONS

- Replace the Majuro outfall pipe. A proposal for a new treatment plant is with the US Department of Agriculture.
- Ebeye has a Water & Sanitation Project that includes improvement to the sewer system. A total overall is needed for the sewerage system.
- Through JICA training, EPA staff from Ebeye and Majuro can now test near the outfall.

Ebeye Island on Kwajalein Atoll. Photo credit: Kwajalein Atoll Development Authority, 2015.

SOURCES

Economic Policy, Planning and Statistics Office, Republic of the Marshall Islands Census Report, 2011.

United States Army Corps of Engineers, Ebeye Infrastructure Survey Report, 2010.

Kwajalein Atoll Joint Utilities Resources Inc., Ebeye Water Supply and Sanitation Project

Initial Environmental Examination, 2015.

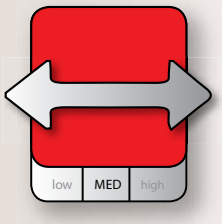
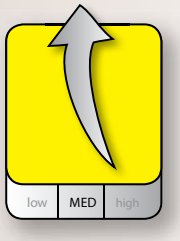
Rapaport, Dave. “Sewage Pollution in the Pacific Islands Countries and How to prevent it”. Center for Clean Development, Greenpeace Pacific, 1995.

Newly installed solar panels at the Majuro reservoirs. Photo credit: MWSC, 2015.

For more than ten years, the U.S military conducted a total of 67 thermonuclear weapons tests in the Marshalls Islands. During this event, native Marshallese from Bikini and Enewetak atoll were relocated from their islands to make way for the testing. On March 1, 1954, the biggest and most powerful nuclear test by the US was detonated on Bikini atoll (Figure 145), causing a massive nuclear fallout in the northern islands of the Marshalls. This chapter describes the nuclear history in the RMI and how it has affected and changed the environment and way of life.

FIGURE 145. Operation Crossroads' code name Baker sets off at Bikini's lagoon (Photo: Provided by RMI Officials).

NUCLEAR LEGACY HIGHLIGHTS

TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
 RMI Government	 **Status** Poor **Trend** Stable **Data confidence** Medium	Bikini's three islands of Namu, Bokonejien, and Bokobyaadaa, have been vaporised leaving a one mile crater on the reef. In the late 1970s, the US government conducted an eight-year project to rehabilate Bikini and Enewetak for human resettlement by removing or neutralizing contaminated soil and radioactive surface debris.	• The vaporising of the three islets on Bikini is irreversible. • Continue the remediation of the soils in the 4 atolls
 Coleen Jose, 2015	 **Status** Poor **Trend** Deteriorating **Data confidence** Medium	Runit Dome was intended to be a temporary structure to house the radioactive waste until a permanent solution could be found. Now, decades later, no solution or plan has been posited. There is significant local concern that with a lack of maintenance, normal weathering will take its toll on the dome and eventually the radioactive waste will be re-exposed to the environment.	Find permanent solution for the Runit dome storage facility.
 Alamy, 2015	 **Status** Fair **Trend** Improving **Data confidence** Medium	Some coral species appeared to be locally extinct. However coral regrowth and diversity is recovered and improving. A study conducted in 2008 indicated that 28 species of coral are extinct from Bikini Atoll.	The corals in Bikini are recovering, however it is highly recommended that further monitoring is needed to help determine the state of the coral reefs in Bikini.

"For the good of mankind and to end all world wars"

– Commodore Ben H. Wyat, 1946
(Bikini Atoll World Heritage Nomination, 2010)

At the end of the World War II the RMI, along with other Micronesian countries, was entrusted to the care of the United States of America by the United Nations Security Council under the International Trusteeship System. This mandate came to be known as the Trust Territory of the Pacific Islands.

Under its Trusteeship, the US government selected the Enewetak and Bikini Atolls to conduct nuclear weapons testing during the Cold War. The populations of Bikini and Enewetak were relocated to other parts of the RMI prior to the testing exercises. During this era, Operation Crossroads and Operation Castle, along with other nuclear bomb testing, were conducted by the US. A total of 67 nuclear test explosions took place both on Bikini and Enewetak from 1945 to 1958. The chart below (Figure 148) shows a comparison of the yield of all tests conducted in the RMI, in descending order of yield. The numbers on the x axis correspond to the test numbers in the first column of the table of US nuclear tests. Due to the large range of yields, many of the smaller tests are not able to be plotted at the current chart scale. Please see the table for a listing of all tests and yields. For comparison, the yield of the Hiroshima bomb and the largest atmospheric test at the Nevada Test Site are also plotted. (http://www.rmiembassyus.org/Nuclear%20Issues.htm)

On March 1st, 1954 the Castle Bravo nuclear bomb, which was over 1,000 times more powerful than the atomic bomb that was dropped on Hiroshima, was detonated on Bikini atoll: it vaporised several small islands and other parts of Bikini and left a mile wide crater on the reef (Figure 149). On Rongelap, located about 125 miles east of Bikini, the nuclear fallout began hours after the Bravo shot was detonated, exposing 64 residents living on Rongelap and eighteen living on Ailinginae Atoll (Figure 150) to high levels of radiation (Richards ZT at el, 2008).

The testing has changed the lives of the locals forever: it has altered the gene pool of the locals and increased the incidence of diseases such as cancer, as well as causing lasting and unprecedented changes in the geographic and ecological systems.

Indicators

Four sub-indicators have been used to investigate the state of the legacy nuclear testing: 1) the loss of islets which measures the permanent destruction of islets, 2) soil loss and loss of productivity which measures the condition of soils, 3) nuclear waste storage which measures the state of the large nuclear waste storage facility on Runit, and 4) coral species which measures species diversity on impacted atolls. These four indicators have been combined as a single state indicator given the paucity of data.

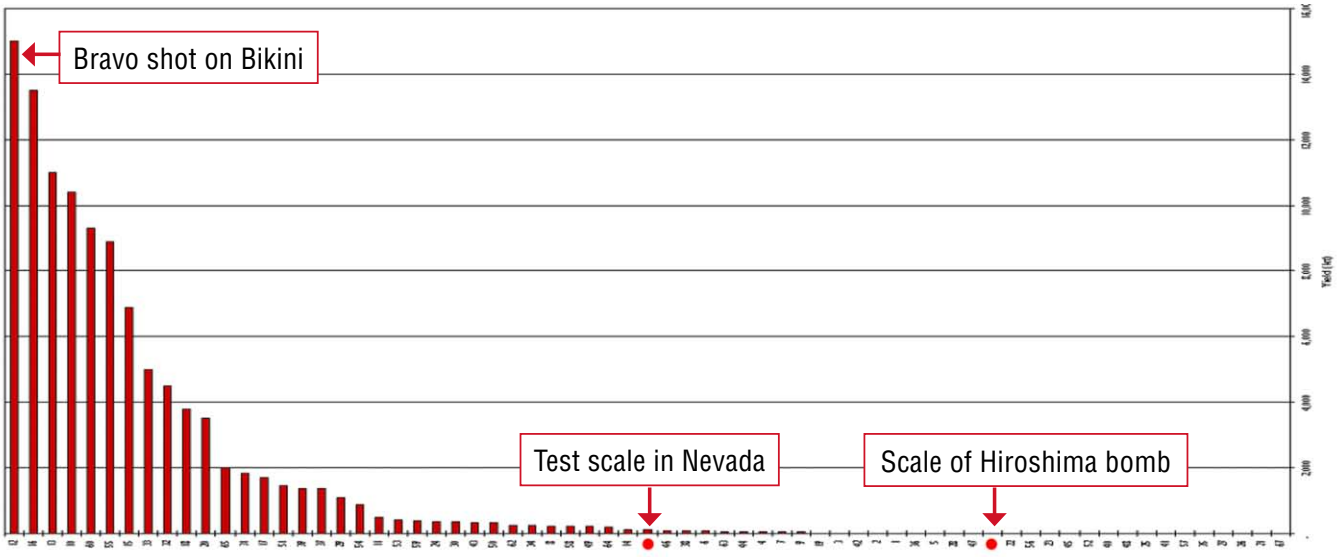


FIGURE 148. Scale of Nuclear explosives carried out by the US in the Bikini and Enewetak-Marshall Islands, Nevada-USA and Hiroshima-Japan (Kilo Tonnes).

FIGURE 149. Bravo crater clearly seen from space, Bikini Atoll (Google Maps).

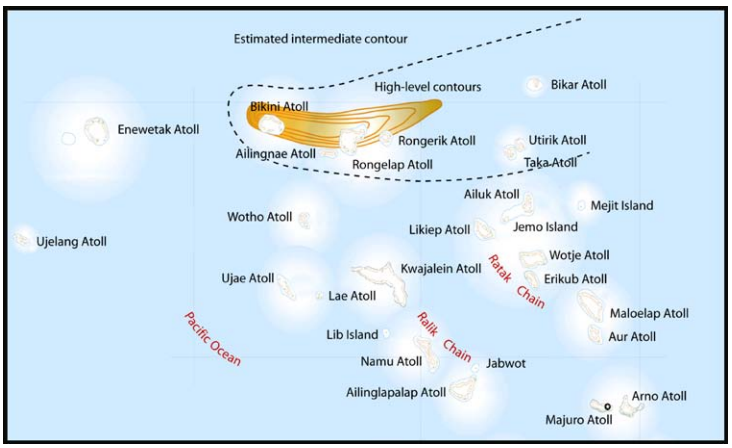


FIGURE 150. Local and intermediate fallout following the detonation of a 15 Mt thermonuclear test Bravo on Bikini Atoll on 1 March 1954 in the northern Marshall Islands. (M.Ragheb,2014)

HUMAN IMPACTS OF THE NUCLEAR TESTS: RELOCATION AND RESETTLEMENT

Prior to the testing, the residents of Enewetak were relocated to the nearby atoll of Ujelang, and Bikinians to Rongerik, with the expectation of returning to their islands shortly. More than 20 years later, in 1967, a US blue-ribbon committee reviewed the results of a radiological survey of Bikini and declared the atoll "once again safe for human habitation". In 1968 President Johnson proclaimed Bikini to be safe and ordered that the island be rehabilitated.

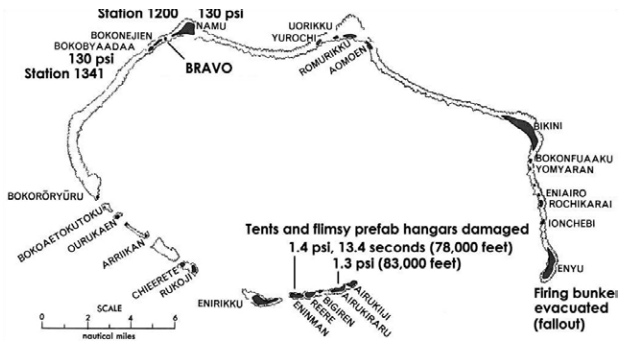


FIGURE 151. Bikini Atoll before Castle.

The Bikinians returned the following year to assist the resettlement project. Bikini and Eneu island were bulldozed and their topsoil was turned over to reduce the level of radiation. Forty homes were constructed.

During 1975 and 1978 accurate radiological studies found that the Bikini interior was in fact highly radioactive, too hazardous for habitation. Wells were contaminated with plutonium which in turn exposed locals to high levels of radiation. Local crops consumed for food were similarly contaminated. The recommendation was made that Bikini was unfit for permanent resettlement due to the fact that radiological conditions remained excessively dangerous. Consuming local crops would lead to an annual effective dose of 15m mSv. (The millisievert and milligray measures radiation doses and exposure. In the SI system, a millisievert (mSv) is defined as "the average accumulated background radiation dose to an individual for one year, exclusive of radon, in the United States.") Consequently, the Bikinians were removed from their home atoll for the second time and placed on Ejet Island in Majuro and Kili Island where they reside today.

The 327 residents of Rongelap were evacuated to Mejatto Island in Kwajalein Atoll due to the deathly nuclear fallout of Castle Bravo onto Rongelap and Utrik. To this day,

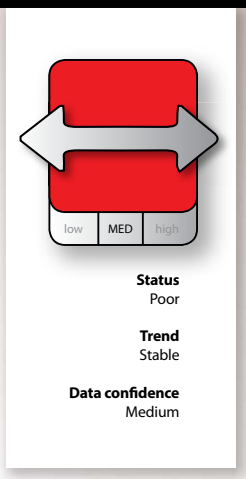
FIGURE 152. Bikini Atoll after Castle.

FIGURE 153. Bikini Atoll recent aerial image of Bravo.

NUCLEAR LEGACY DAMAGE AND DESTRUCTION OF SOIL FERTILITY

Rongelapese people are still trying to reinhabit Rongelap: however their lives will not be the same as they will never be able to harvest local crops on their land. Utrikese suffered the same way, however they resettled Utrik just a few days after the fallout. (IAEA, accessed 2015: http://www-ns.iaea.org/appraisals/bikini-atoll.asp)

The people of Enewatak were exiled to Ujelang for more than thirty years where they suffered from malnutrition and hardship. According to Marshallese beliefs, Ujelang Atoll is cursed by spirits and forbidden for man to inhabit. From 1977 to 1980, three islands on Enewetak were extensively cleaned up for rehabilitation and resettlement. However the remaining high levels of radiation contamination limits human dwelling to the southern half of the atoll.



Status: Poor **Trend: Stable** **Data Confidence: Medium**

VAPORISED ISLANDS

The ramifications of the US nuclear testing legacy on Bikini and Enewetak are still visible today and will never be reversed. The scars on the atolls can be seen from space – on Bikini three islands, Namu, Bokonejien, and Bokobyaadaa, have been vaporised, leaving a one mile crater on the reef (Figure 151, 152 and 153). With the destruction of these three islands, Bikini Atoll lost about seven percent of its already limited landmass.

The people of Enewetak also suffered the loss of four islands – Bokinwotme, Eluklap, Dridrilowij, and Bokaidrikoaik – resulting in permanent ecological and geographic changes and the loss of four percent of their land (Figures 154 and 155). Another island, Runit, while not fully vaporised, has essentially been lost. The Island is now dominated by a massive nuclear waste dump (discussed below) that fills the 350-foot wide crater created by the "Cactus" nuclear test in 1958. Figure 156 shows the total land mass that was vaporised by the hydrogen bombs that were tested, which resulted in five percent of land lost on Bikini and Enewatak.

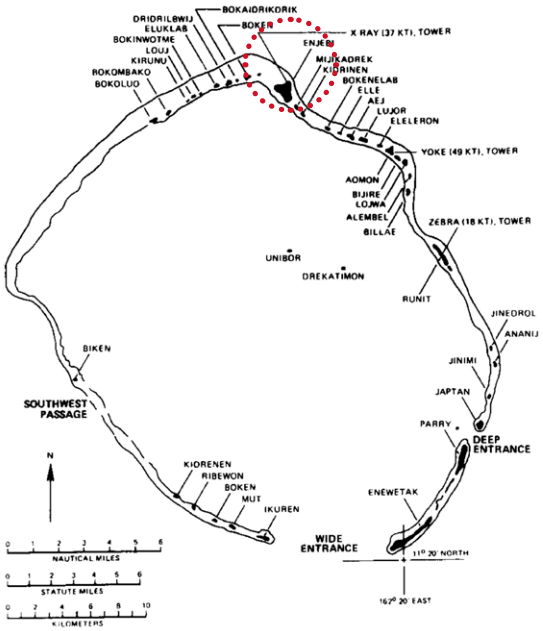


FIGURE 154. Enewetak before the atomic testings. (Defense Nuclear Agency, Operation Sandstone, 1948).

FIGURE 155. The crater formed by the Ivy Mike nuclear test can be seen on the northeast cape of the atoll, with the smaller Castle Nectar crater adjoining it. Smaller Cactus and LaCrosse craters on the eastern side of the Atoll. Cactus is now the famous Runit Dome. (Defense Nuclear Agency, Operation Sandstone, 1948).

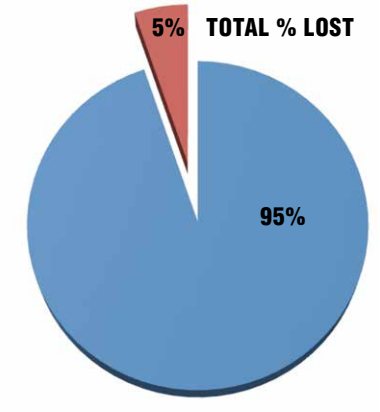


FIGURE 156. Total land lost for Bikini and Enewetak due to the nuclear tests.

FIGURE 157. Garden for testing the amount of radioactive materials in the soil, Rongelap (Lawrence Livermore National Laboratory).

CONTINUING ENVIRONMENTAL IMPACTS

During the late 1970's, the US government conducted an eight-year project to rehabilate Bikini and Enewetak for human resettlement by removing or neutralizing contaminated soil and radioactive surface debris. One of the primary efforts of the remediation project was the removal of topsoil from Enewetak, where 84,000 cubic metres of contaminated soil were scraped off (Hamiltion. T., 2013).

On Bikini, an alternative cleanup plan to excavate and remove 30 to 40 cm of topsoil was also recommended, however this type of remedial process would have been much more expensive to implement over such a large area. The compromise was to remove soil around human habitation areas. However the exact volumes of soil removed from Bikini are not available. The excavation of the soil has impacted the soil fertility on parts of main island of Bikini and Eneu (M. Ragheb, 2014). Furthermore, the organic matter in the soil required to maintain the water

retention capacity of coral soils and supply essential nutrients to support plant growth was reduced. It was noted that soil excavation also requires a very long-term commitment to rebuild the soil and revegetate the land. (https://marshallislands.llnl.gov/bikini.php). In Enewetak one long term remediation approach has been to build raised beds, forgoing actual rebuilding of soils.

Rongelap more recently considered a topsoil removal of seven cm to extend the runway, using coral pebbles applied on top of the contaminated soil in the scraped areas, as a means to reduce the level of radiation. This approach is limited in geographic area, yielding only limited benefits. This proposed activity is indicative of the ongoing human and environmental impacts of testing 60-odd years ago. The Rongelapese have raised the concern that restricting people's movements on a small island is impractical. Currently about one third of the main island has been remediated and people claim to have received instructions from US authorities not to venture into the other parts of the island. Locals insist that the island should be remediated fully so people are not exposed to potential harm. People have also been warned not to consume food from the non-remediated areas of the island (Georgescu. C., 2013). Utrik, on the other hand, received no cleanup efforts after the fallout from the Castle Bravo shot. According to the Utrik Mayor John Kaiko and the local Council, the people of Utrik resettled their island a few weeks after the nuclear fallout.

As observed in a recent study: "It is noteworthy that while there have been numerous measurements made over the decades of radioactivity in soil collected from many of the atolls (particularly the northern atolls and primarily for 137Cs), no assessment of the deposition of all of the many radionuclides contributing to radiation exposure from each test has ever been made for all of the atolls of the Marshall Islands" (Fallout Deposition in the Marshall Islands from Bikini and Enewetak Nuclear Weapons Tests; Harold L.B., August 2010).

Agriculture in atoll environments has always been challenging, as illustrated by the Pat (traditional taro pit). The Marshallese have a long history of making major investments to grow staple crops. This reduction of soil fertility through the loss of organic matter and nutrients has further eroded the ability of the Marshallese on these islands to be food secure. In addition, the risk of radioactive exposure for key traditional crops, including coconuts, has degraded the normal ecosystem on these atolls and changed the way the Marshallese people relate to their natural environment.

The tests of the 1940s and 1950s have forever changed the terrestrial environment and human interaction with the environment by reducing the already scarce area available to grow annual and perennial crops, by rendering crops such as coconuts unusable, by removing thousands of metric tons of topsoil, and by the vaporization of several islets. While comprehensive vegetation studies are not currently available (Figure 157), the tests and subsequent remediation have had a lasting impact of the natural habitats of these islands.

RADIOACTIVE WASTE LEGACY AND THE RUNIT DOME

One hundred and eleven thousand cubic yards of radioactive debris lies within Runit Dome in the RMI, a "hulking legacy of years of US. nuclear testing" whose fragile structure is vulnerable to breaking from violent weather associated with climate change.

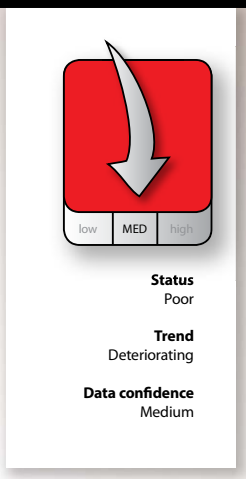
"Runit Dome (Figure 158) represents a tragic confluence of nuclear testing and climate change," Michael Gerrard, director of the Sabin Center for Climate Change Law at Columbia University, who visited the dome in 2010, told The Guardian.

Now locals, scientists and environmental activists fear that a storm surge, typhoon or other cataclysmic event brought on by climate change could tear the concrete mantel wide open, releasing its contents into the Pacific Ocean. The detonations blanketed the islands with irradiated debris, including Plutonium-239, the fissile isotope used in nuclear warheads, which has a half-life of 24,000 years.

When the testing came to an end, the US Defense Nuclear Agency (DNA – later the DTRA) carried out an eight-year cleanup, but Congress refused to fund a comprehensive decontamination programme to make the entire atoll fit for human settlement again (Hamiltion.T. et at, 2013., Beck, Harold L. et al, 2010.; Coleen. J 2015)

Enewetak Atoll suffered extensive damage, with its geographic and geological surrounding changed forever, after 43 atomic bombs were tested there. Runit Island, on the eastern side of Enewetak, is permanently defaced by craters from Cactus and LaCrosse nuclear tests. Cactus crater is now the site of the infamous dome of Runit which stores 84,000 cubic meters (approximately 110,000 cubic yards) of radioactive waste. From 1977 to 1980, three islands in Enewetak were extensively cleaned up for rehabilitation and resettlement, however, the remaining high level of radiation contamination limits human dwelling to the southern half of the atoll. In addition, locals fear that excavated radioactive materials continue to pose a serious risk of further radioactive contamination.

Runit Dome was intended to be a temporary structure to house the radioactive waste until a permanent solution could be found. Now, decades later, no solution or plan has been made. There is significant local concern that with a lack of maintenance, normal weathering will take its toll on the dome and eventually the radioactive waste will be re-exposed to the environment (Figure 159, 160). In addition, the projected sea level rise from global climate change raises major concerns regarding the permeable interface between the dome and the surrounding reef.



Status: Poor Trend: Deteriorating Data Confidence: Medium

Also alarming is the fact that, according to a 2013 study, "the radiologic inventory buried beneath Runit Dome is dwarfed by the current inventory of fallout radionuclides in atoll lagoon sediments" (Hamilton T., et al, 2013). Although the radionuclides are not as concentrated in the lagoon as they are in the dome, it is clear that nuclear contamination remains widespread. In July 2015, when Tropical Storm Nangka caused a surge of lagoon water to flood across the resettled island of Enewetak, local residents were concerned that contamination from the lagoon would be deposited onto their land.

FIGURE 158. Runit Island's Dome, Enewetak Atoll. Photo credit: US Defense Special Weapons Agency.

FIGURE 159. Seabirds nesting on the Runit Dome, 2015. (Source: Hon. Minister Jack Ading)

FIGURE 160. Recent visit in 2015 showed cracks on the Runit Dome, (Source: Hon. Minister Jack Ading)

Redwing Seminole nuclear test, Bokon Island, Enewetak Atoll. Photo credit: US Defense Special Weapons Agency, 1956.

NUCLEAR LEGACY IMPACTS ON CORAL SPECIES

A 2002 study conducted in Bikini Atoll concludes that about 80 percent of aooxanthellate coral assemblages show resiliency or can recover over long time spans from thermonuclear environmetal disturbance, while the remaining 20 percent is not resilient to thermonuclear disturbance (Richardson et al, 2008). The 2002 study compared the current Bikini Atoll species diversity to that of a survey conducted prior to the nuclear tests. The study suggests that 28 of 126 (Table 30) coral species have disappeared from the area since an earlier study was conducted in 1954 (Wells, 1954).

The study indicates that 42 coral species have gone missing, but up to 14 of those 42 species may be pseudo-losses due to inconsistent taxonomy between the two studies or insufficient sampling. The 28 species referred to above do appear to be genuine losses (Figure 161). These 28 species, or approximately 22 percent of the coral species previously present in and around Bikini Atoll, have gone locally extinct, providing some of the only time-series evidence from the nuclear testing program of irreversible biological losses. While similar trends may be observed in other marine species as well as terestrial ecosystems, a lack of historical data combined with a lack of access to contemporary data sets, make additional assements impractical.

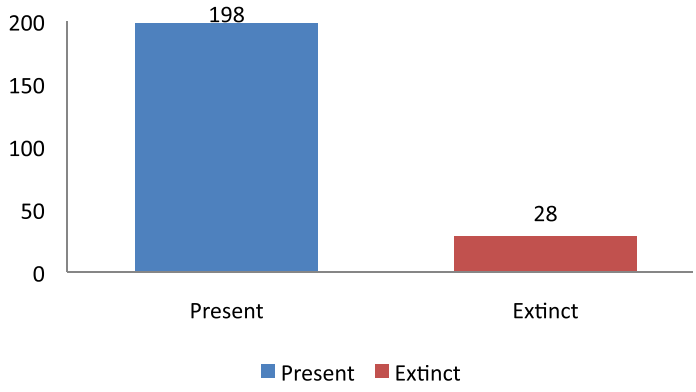
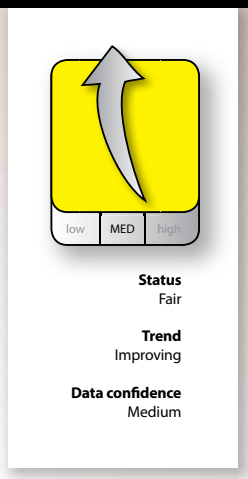


FIGURE 161. Number of coral species present and extinct at Bikini Atoll (Richardson et al, 2008).



Status: Poor Trend: Improving Data Confidence: Medium

IMPACT

There are few reports of environmental impact from nuclear testing in RMI. The US government still refuses to release classified documents, therefore RMI cannot fully understand the impact of the nuclear tests conducted by the US. This also raises concerns regarding the agreements through which the US has purported to compensate RMI for the destruction caused by the tests. The people of RMI feel that the US government is holding back on data which could reveal the true extent of damage inflicted by the US nuclear testing program (Hon. Minister Jack Ading).

The hazardous nuclear waste from the nuclear testing era is still a threat to RMI and the rest of the region. The Runit Dome structure in Enewetak Atoll, originally intended to be a temporary solution to store and reduce the levels of radioactive contaminants, has been compromised with radioactive isotopes threatening to leak into the environment—exposing the local residents to highly dangerous radioactive waste. The deteriorating structure of Runit Dome, combined with rising sea levels resulting from climate change, could cause a major environmental catastrophe (Hamilton T., et al, 2013; Harold L.B., et al, 2010).

Radiation was not the only source of contamination from the nuclear tests. A total of 96 warships were purposely sunk during the testing. These warships were all fully operational at the time, which means they were fully fuelled and full of numerous contaminants. Generators and capacitors were shattered from the detonations, causing man-made compounds such as polychlorinated biphenyls (PCBs) to be released over these years and to accumulate in the soils (Wung J., et al, 2011. M. Raghe, 2014).

The combination of these impacts has resulted in the loss of use of the islands and has hugely disrupted the cultural practices of the islanders. Traditional food gathering sites have been either contaminated or permanently wiped out, making it much more difficult for people to gather food and grow crops.

TABLE 30. 1954 and 2008 survey assessment

Species	This study (2008)	Wells (1954)
Acropora echinata		x
Acropora microphthalma		x
Acropora palmerae		x
Acropora spicifera		x
Acropora squarrosa		x
Acropora tenella		x
Acropora vaughani		x
Anacropora forbesi		x
Astreopora suggesta		x
Cycloseris distorta		x
Cyphastrea chalcidicum		x
Diaseris distorta		x
Diploastrea heliopora		x
Echinophyllia orpheensis		x
Favia helianthoides		x
Leptoseris incrustans		x
Leptoseris scabra		x
Leptoseris solida		x
Lobophyllia corymbosa		x
Madracis sp.		x
Montipora granulosa		x
Montipora venosa		x
Oxypora lacera		x
Pavona minuta		x
Pectinia africanus		x
Plesiastrea versipora		x
Pocillopora elegans		x
Porites murrayensis		x
Total	**0**	**28**

Note: x= the coral species recorded in the 1954 survey, which were not found in 2007. The loss of species is possibly an underestimate. With improved survey techniques and identification in 2007 it would be expected that missed species from 1954 would be identified. While biological data is sparse, this one instance of a time series demonstrates that the nuclear tests had very substantial lasting impacts on the biodiversity of the RMI (Richardson et al, 2008).

RESPONSE AND RECOMMENDATIONS

Most of the people of the four atolls that were affected by the nuclear testing program are still living elsewhere. The Bikinians petitioned the US Congress to use their resettlement fund to relocate themselves to the United States. This is due to the ongoing climate-related problems which are affecting Kili Island, where they have been living ever since they were exiled from their home islands.

The failed lawsuits against the US have forced the people of the four atolls and the RMI government to seek other avenues to increase the nuclear compensation funds and to make their islands habitable once more. Ongoing remediation projects, such as the use of potassium fertiliser to lower the Caesium-137 in the soil and using raised-bed gardens with uncontaminated soil, provide other ways of increasing the safety of crops grown in former nuclear test areas.

There is a need for RMI to look for a permanent solution to solve the temporary nuclear radioactive waste storage facility (Runit Dome) that was built in the late 1970s on Runit islet.

Hazardous signs on Runit Island, Enewetak Atoll.
Photo credit: Enewetak Local Government.

Enewetak Radiological Laboratory, Enewetak Atoll. Photo credit: Lawrence Livermore National Laboratory.

SOURCES

Ading, Hon. Minister Jack; Minister of Finance and Enewetak Atoll Senator, 2015.

Beck HL, Bouville A, Moroz BE, Simon SL. Fallout Deposition in the Marshall Islands from Bikini and Enewetak Nuclear Weapons Tests. Health physics. 2010;99(2):124–142. doi:10.1097/HP.0b013e3181bbbfbd.

Beck, Harold L. et al. "Fallout Deposition in the Marshall Islands from Bikini and Enewetak Nuclear Weapons Tests." Health physics 99.2 (2010): 124–142.PMC. Web. 19 Aug. 2015.

Bikini Atoll Nomination for Inscription of the World Heritage List, 2010.

Calin Georgescu, "Report of the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes", 2012.

Hamilton, Terry. 2013. A Visual Description of the Concrete Exterior of the Cactus Crater Containment Structure. Lawrence Livermore National Laboratory, LLNL-TR-648143.

Jun Wang, Sarah A.L. Caccamise, Liejun Wu, Lee Ann Woodward, Qing X. Li, "Spatial distribution of organochlorine contaminants in soil, sediment, and fish in Bikini and Enewetak Atolls of the Marshall Islands, Pacific Ocean", April, 2011.

M. Ragheb, Environmental Remediation of Radioactive Contamination chapter 6, 2014.

Pinca, S., Beger, M., 2002. Coral reef biodiversity community-based assessment and conservation planning in the Marshall Islands: baseline surveys, capacity building and natural protection and management of coral reefs of Rongelap Atoll. College of the Marshall Islands, Majuro, Marshall Islands.

RMI Nuclear Claims Tribunal. Annual Report to the Nitijelā (Parliament) For the Calendar Year 1996. Majuro: 1997.

US. Department of Energy. United States Nuclear Tests: July 1945 through September 1992. Document

No. DOE/NV-209 (Rev. 14), December 1994.

Wells, J.W., 1954. Recent corals of the Marshall Islands. Bikini and Nearby Atolls, Part 2, Oceanography. Geological Survey Professional Paper 260–1, United States Government Printing Office, Washington.

Yasuyuki Muramatsu, Satoshi Yoshida and Shinnosuke Yamazaki. "Isotope ratios Of 24OpU/239pU in soil samples from different area". JAERT-Conf 2003–2010.

Zoe. R., Beger. M., Pinca. S., Wallace. C.. Bikini Atoll coral biodiversity resilience five decades after nuclear testing, Marine Pollution Bulletin, 56, p 503–515, 2008.

Z.T. Richards, Maria Beger, Silvia Pinca, Carden C. Wallace. "Bikini Atoll coral biodiversity resilience five decades after nuclear testing", Marine Pollution Bulletin 56 (2008) 503–515

SUMMARY AND RECOMMENDATIONS

CONCLUSION

Several global and regional drivers are altering the environment in RMI. They include globalisation and exposure to world markets, rising incomes and population, urbanisation, rapid expansion and growth of technologies, new and existing cultural norms and global climate change. In turn, these drivers are creating pressures on the land, marine, freshwater, atmosphere and built up ecosystems. These pressures include land development, overcrowding of urban centres, waste generation and energy consumption and resource extraction.

These pressures are, in varying degrees, affecting the environment. This effect has been measured in this report by evaluating the state of key habitats, ecosystems, climate variables, and species. Overall the state of the environment is mixed news – some good, some fair and some poor – and the level of response is also varied.

While gaps exist, RMI has established laws, policies and regulations that promote sustainable use and protection of its environmental resources. Since the 1992 SOE report, RMI has had a number of assessment reports recommending action on biodiversity, agriculture, water, marine management, climate change, and others. The national implementation and enforcement of these efforts is inconsistent and, in some cases, non-existent. They are largely dependent on external funding from NGOs and international sources, most of which are short-term and determined by the current international priorities and agendas.

The best example of environmental management in RMI is the integration of contemporary and traditional conservation practices into the modern legislative framework. One example is the traditional management or MO which includes the conservation of both marine and terrestrial environments in the Reimaanlok process.

On their own, traditional practices are not enough to protect the environment from modern day pressures such as whole-scale resource extraction and population growth. Another example is the decline of forests, which is due to the gradual encroachment on the land with population growth and the decline in agriculture. Traditional practices of environmental management need to be integrated into, and supported by, a strong legislative framework of environmental protection for overall success.

RECOMMENDATIONS AND INTERACTING VARIABLES

The key recommendations are focused primarily on enhanced implementation of existing policies and initiatives as well as increased in systematic environmental monitoring. The decline of agricultural activities, in particular traditional crop production, is placing more pressure on the environment and society through loss of diversity and reduced food security. RMI has never conducted an agriculture census and it has been difficult to develop appropriate policies to guide planning and management of the agriculture sector. An agriculture census will greatly enhance food security policy.

Given that over 28 percent of the “state” conditions in this report are poor and 44 percent fair, it is advisable that RMI conduct a legislative review. This will help to determine if existing laws and regulations are sufficient to protect the environment and guide development, or if the challenges lie in the implementation of the existing policies (Figure 162). In addition, ensure that new and emerging issues are analysed and where appropriate are incorporated into RMI law including issues such as DSM and ABS.

A major challenge in conducting the 2016 RMI SOE was compiling, analysing and processing data held by various departments, agencies and ministries. A key recommendation for future work is to build off the base line set in this report and develop monitoring to fill the data gaps. A data storage solution is needed that will allow intra- and inter-department/ministry analysis and data sharing for the SOE and other reporting processes, including those to multilateral environmental agreements.

RMI should also consider an urban development planning policy to address the ongoing environmental issues caused by unplanned developments and overcrowding of urban areas. This unplanned development has resulted in insufficient sewage and solid waste treatment and infrastructure to accommodate the growing population from the outer islands to the urban centres. Systematic urban planning policies or strategic environmental assessments (SEA) can contribute to better housing and commercial development.

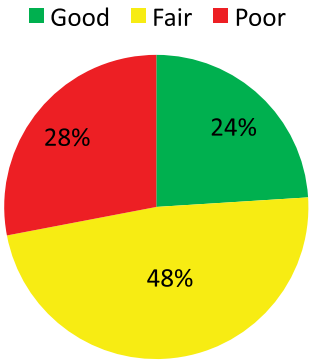


FIGURE 162. Percentage of indicators that are Good, Fair and Poor.

Most of the negative trends in the SOE indicators can be traced back to unplanned and unregulated development, settlement and commercial activities. RMI should consider complementing their environmental impact assessment (EIA) process with a targeted prgramme of mitigation for many of the indicators addressed in the SOE:

- Strengthen monitoring and enforce standards of septic systems to reduce sewage effluent.
- Improve waste collection, landfill management and recycling as waste generation rates are likely to increase with the rising urban population.
- Develop urban planning and policies, as well as SEA, to better address urban liveability and green spaces.
- Use an EIA to assist the regulatory focus on key projects and sites.
- The next step is to conduct a national environmental planning process using the SOE results and recommendations as a foundation. This report can serve as a key resource in National Environmental Management Strategy development and design. The SOE can also be used as a reporting tool for Multilateral Environmental Agreements (MEAs), such as the convention on biodiversity, or for updating RMI's National Biodiversity Strategic Action Plan (NBSAP).

RMI has played an instrumental role in securing the Paris Agreement. Future work and leadership by the RMI government can be supported by more completely accounting for its CO_2 emissions, including ships registered under the RMI flag. RMI should also consider developing regulations on air pollution and air quality as this sector needs to be monitored and it represents a gap. Some of the activities that could help include:

- Air monitoring of urban areas and nearby rural areas to determine annual CO_2 emission (e.g. Majuro, Ebeye and shipping).
- Prepare emission inventories of pollution sources.
- Established targeted policies and regulations to limit emissions (e.g. waste burning, polluting vehicles and monitor meteorological particulate pollution).

The biggest single habitat is the marine fishery resource. The increased commercial harvesting of tuna species has put more pressure on the offshore fisheries. It is highly recommended that RMI strengthens its enforcement, compliance and monitoring of tuna stocks, in particular the bigeye tuna and other endangered species which are caught as by-catch). The inshore fisheries of RMI are still intact. However, there is a need to monitor coral reefs and reef fish diversity and density to understand the trends in the inshore marine environment. A recent report from the US army indicates a high toxicity of all reef fish in Kwajalein and that an immediate ban on fish consumption should be considered. Given the overall good condition of RMI near shore fish stocks this is a major concern. This includes the concerns over coral bleaching and the apparent phase shift from coral-to-algae dominance that is currently taking place. It should be addressed by fully understanding the source of the contamination, taking steps to prevent additional contamination, remediating the Kwajalein lagoon, and ensuring that no additional areas in RMI are contaminated.

There is much that needs to be done in regards to RMI's biosecurity including better protection of threatened species and habitats in the terrestrial environment – this requires further effort and action from government.

The nuclear testing legacy in RMI is present throughout the Northern islands. It is imperative for the people of RMI to investigate a mutually acceptable solution for the ongoing nuclear waste storage challenges on Runit atoll. More research is needed on contaminated atoll soils and the effects on local fauna and flora.

RMI has an excellent track record with its urban water quality monitoring program. However, improvements can be made to data storage access and reporting to the public. The Water Monitoring Program should be maintained in an easy to use database to continue trend monitoring of water resources. One area that needs more resources and monitoring is the establishment of a sewage treatment system, including all of urban Majuro and the prioritising of the defunct Delap outfall.

One highlight for good data management and public access is the meteorological monitoring by the Majuro weather station, which has over 50 years of public records.

The area of land and water under protection has expanded over the last 25 years, which has its challenges. RMI should continue to use the Reimaanlok model for planning and managing protected and other areas, such as key terrestrial biodiversity sites. The major needs include funding to carry out community engagement and detailed management plans, including implementation and monitoring.

Another highlight for the RMI environment is that coral reef health, especially in the outer atolls, is some of the best in the region. The healthy coral has both extensive spatial and temporal range. Monitoring efforts and community outreach should be made to enhance fish biomass density.

Management of the offshore fishing industry has been a challenge for much of the region. Some recent successes include the establishment of the Parties to the Nauru Agreement and the introduction of the "Fishing Days Scheme". The increased number of observers, improved auditing and development of a sustainable status have led to better commercial fisheries management in RMI. The protection of the tuna fisheries should be continued, especially as global demand increases, to ensure a sustainable fishery and future incomes.

An initiative of the African, Caribbean and Pacific Group of States funded by the European Union

UNEP

SPREP
Secretariat of the Pacific Regional Environment Programme

ACP MEAs 2

our world
our dignity
our future

2015 European Year for Development