Republic of the Marshall Islands

nems

national environmental management strategy

PART A

State of the Environment report 1992

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Republic of the Marshall Islands

national environmental management strategy

PART A

State of the Environment Report 1992

Written by

Martha J. Crawford
Consultant to General Manager
RMI Environmental Protection Authority

Prepared under the Supervision of

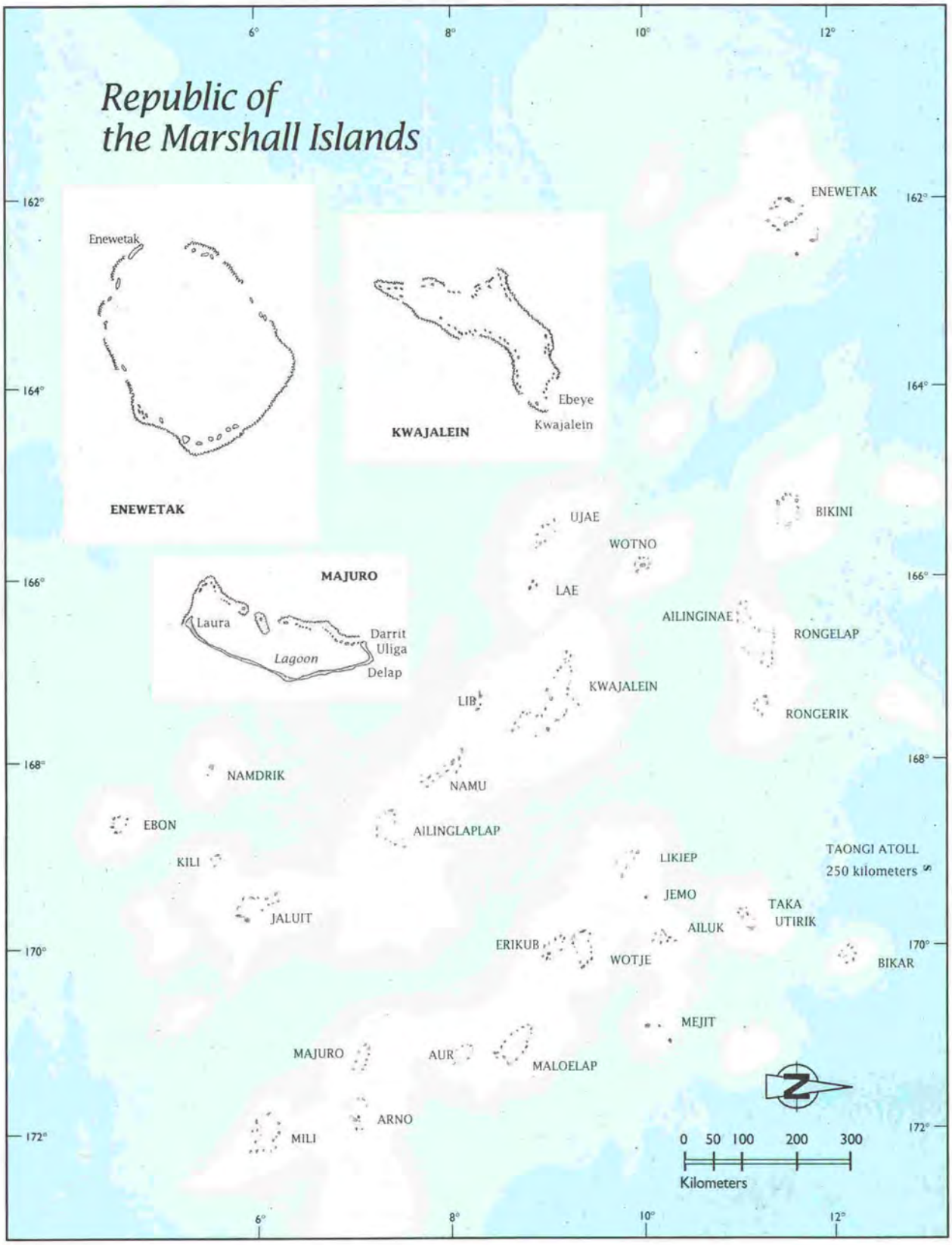
The National Task Force on
Environmental Management &
Sustainable Development

Adopted & endorsed by

RMI Cabinet
Cabinet Minute 095(92) May 4 1992

IUCN
The World Conservation Union

ASIAN DEVELOPMENT BANK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Foreword

This document represents the first ever government-wide effort to evaluate environmental management needs and establish future priorities for improving management capabilities. Developed as the product of a lengthy consultative process between government leaders, the unique aspect of this report is its incisive accuracy and thorough treatment of the subject matter. The National Task Force on Environmental Management and Sustainable Development, created especially to develop this two-part National Environmental Management Strategy (NEMS), has provided the impetus and oversight which saw this project to completion. In presenting this document as an official government document, I must acknowledge the invaluable role that the Task Force has played.

The author of this report, Ms Martha Crawford, also bears special mention. She has lived and worked in the Marshall Islands, as Consultant to the General Manager of the Environmental Protection Authority, for over two years. Serving as Coordinator of the Regional Environment Technical Assistance (RETA) Project during 1991, she worked tirelessly with the National Task Force on Environmental Management and Sustainable Development in examining all of the issues described herein. In addition to her professionalism and dedication, Ms Crawford's never-ending energy and enthusiasm largely account for the unqualified success of this project.

This document also represents a significant cooperative effort at the international level. Funding for the RETA Project was generously provided by the Asian Development Bank. The South Pacific Regional Environment Program (SPREP) provided coordination at the regional level, and technical assistance during the National Seminar on Environmental Management held in Majuro in October 1991. Additional funds were provided by the World Conservation Union (IUCN) and the United Nations Environment Programme. The funding and coordination provided by these agencies served as the initial impetus to take on the mammoth task of developing this two-part National Environmental Management Strategy (NEMS), a task which has consumed the better part of a year.

Here I proudly present to you the two-part result of our work, NEMS Part A: State of the Environment Report 1992 and Part B: Action Strategy for Strengthening Environmental Management, 1992–1996. I am even more proud, however, to state that in the process of developing the NEMS, a permanent partnership between the development and environment sectors has been forged. An inter-sectoral dialogue was initiated to facilitate the analysis of the issues and development of the principles presented in this document. This important communication link will no doubt prove helpful in implementing the Action Strategy (Part B) during the period 1992–1996.

The National Task Force on Environmental Management and Sustainable Development (EMSD), a body with high-level membership from all government sectors which was established by Cabinet Paper to oversee the development of the NEMS, has served extremely well. In recognition of the important role that the Task Force has assumed, that of bridging the gap between the development and environment sectors and promoting the ideals of sustainable development, it will be established as a permanent body to oversee the implementation of the Action Strategy (NEMS Part B) during the period of the Second Five Year Development Plan, 1992–1996.

In recognition of the new world order, which calls for all nations to take responsibility for their environmental impacts, and to cooperate in finding global solutions to global problems, our nation presents this document as an affirmation of its commitment to integrating the principles of sustainable development into national policy. As a nation composed entirely of low-elevation atolls, we depend on reciprocal cooperation from developed and developing countries alike to halt global warming and prevent a devastating

rise in average sea level. We presented this document at the United Nations Conference on Environment and Development to signal our commitment to the goals of the Earth Charter and Agenda 21.

Sincerely,

The Honorable Amata Kabua
President, Republic of the Marshall Islands

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Dennis Alessio
Director
Waan Aelon Kein Canoe Project

Jan Alfred
Deputy Secretary
Ministry of Health Services

William Allen
Secretary
Ministry of Transportation & Communication

Kinja Andrike
Secretary
Ministry of Health Services

Abel Anien
Public Education Officer
RMI Environmental Protection Authority

Abacca Anjain
Acting Secretary
Ministry of Interior and Outer Islands Affairs

Totha Arelong
Public Health Administrator
Majuro Hospital

Barbara Barber
Director of Water Quality Monitoring
RMI Environmental Protection Authority

Gordon Benjamin
Chief of Division of Manufacturing Trade, Industry & Tourism
Ministry of Resources & Development

Carmen Bigler
Secretary
Ministry of Interior and Outer Islands Affairs

John Bungitak
Deputy-Director
Marshall Islands Marine Resources Authority

Donald Capelle
Secretary
Ministry of Resources & Development

Alfred Capelle
Chief Executive Officer
Alele Museum

Theodore Carner
Medical Coordinator
177 Health Plan

Raymond Clarke
Fishery Development Specialist
National Marine Fisheries Service, Hawaii

Carol Curtis
Accountant
Alele Museum

Thomas DeBrum
Vice-President & Deputy General Manager
National Telecommunications Authority

Alan Fowler
President & General Manager
National Telecommunications Authority

V. N. Ghanathurai
Economist
Asian Development Bank

H. M. Gunasekera
Senior Economic Advisor
Office of Planning & Statistics

Elizabeth Harding
Legal Counsel
RMI Environmental Protection Authority

Larry Harris
Visiting Fullbright Professor
College of the Marshall Islands

Hilda Heine
President
College of the Marshall Islands

Kasuo Helgenberger
General Manager
RMI Environmental Protection Authority

Abraham Hicking
Laboratory Specialist
RMI Environmental Protection Authority

Alvin Jacklick
Mayor
Kwajalein Atoll Local Government

Bujen Jacob
Chief of Environmental Sanitation
RMI Environmental Protection Authority

Abon Jaedrik
City Manager
Kwajalein Atoll Local Government

Carl Jaedrik
RMI Environmental Protection Authority Board Member

Seagull James
L'Erooj Kwajalein Atoll

Helen Jetnil
Director
Maternal & Child Health Care

Jimmy Joseph
Chief of Division of Agriculture
Ministry of Resources & Development

Amatlain Kabua
Mayor
Majuro Atoll Local Government

Jiba Kabua
Secretary
Ministry of Foreign Affairs

Mack Kaminaga
Under-Secretary
Ministry of Foreign Affairs

Jackie Kijidrik
Chief of Division of Programs & Projects
Ministry of Resources & Development

Bruce Kijiner
Chief of Administrative Services
Ministry of Public Works

Tom Kijiner
Jr. Under-Secretary
Ministry of Foreign Affairs

Bette Kirchner
Forum Fisheries Agency

Isao Kisino
Public Health Medical Officer

Grant LaBaun
RMI Environmental Protection Authority Board Member

Ken Laupepa
Director
Rural Sanitation Project

Daniella Lokeijak
Director of Women's Interest Office
Ministry of Social Services

Wilson Lokeijak
Division of Records & Licenses
Public Safety Department

Jewon Lemari
Chief Planner
Office of Planning & Statistics

Marie Maddison
Secretary
Ministry of Education

Bunny McDiarmid
Pacific Campaign Coordinator
Greenpeace

Robyn McDowell
Pacific Islands Marine Resources Information System

Rien Morris
Secretary
Ministry of Public Works

Steve Muller
General Manager
Marshall Islands Development Authority

Junior Nashon
Outer Islands Liaison Officer
Ministry of Interior and Outer Islands Affairs

Roswitha Newels
Planning Consultant
Ministry of Interior and Outer Islands Affairs

Annie Orcutt
Secretariat
Pacific Islands Network

Don Piepgras
Program Manager
Capital Improvements Project

Jebon Riklon
Executive Officer
Kwajalein Atoll Development Authority

Joe Riklon
Solid Waste Specialist
RMI Environmental Protection Authority

Nancy Salomon
Grant Programs
Public Health Division

Neil Skinner
President
Marshall Islands Aquaculture Company

Dirk Spennemann
Chief Archeologist
Historic Preservation Office

Jorelick Tibon
Chief of Sea Transportation
Ministry of Transportation & Communication

Ingrid Vet United Nations
Volunteer
Ministry of Social Services

Danny Wase
Director
Marshall Islands Marine Resources Authority

Jurelang Zedekiah
Executive Officer
Majuro Atoll Local Government

I would especially like to express my sincere thanks to Mr Jiba Kabua, Chairman of the RMIEPA Board, and Mr Kasuo Helgenberger, General Manager of RMIEPA, for their consistent enthusiasm and support for the RETA Project, and to Dr Theodore Carner, for his steadfast moral support and relentless editing. I would also like to specially acknowledge the valuable input of the National Task Force on EMSD, which developed its own spirit halfway through the project, infusing our work with the positive energy which has made it fun. It has been my great pleasure to live and work in the Marshall Islands for the past two years. I cannot say goodbye, only *yokwe kom*. I will always be able to close my eyes and once again wander the coral-strewn paths of an outer atoll, to watch the sun sink into a silent glistening lagoon, to hear your carefree laughter, to taste your fresh sashimi. I take something of you with me, and I leave something of me behind.

Komol Tata,

Martha J. Crawford
Consultant to the General Manager
RMI Environmental Protection Authority

Message from the ADB

The Asian Development Bank is pleased to associate in assisting one of the Pacific region's most ambitious undertakings — the preparation of National Environmental Management Strategies (NEMS) in a number of Pacific countries. This assistance has been provided through a Regional Technical Assistance grant to the South Pacific Regional Environment Programme (SPREP). The World Conservation Union (IUCN) has also collaborated in providing technical advisory services.

Our involvement reflects two factors. Firstly, our confidence in SPREP as one of the prime sub-regional, environmental organisations in the Asia Pacific region. The Bank has been pleased by the way in which SPREP has cooperated closely with member governments in addressing environmental issues in island countries and by the caliber of SPREP's staff work as well as the work of the national task forces which guided the country level activities.

The second factor is a commitment by the Bank to sustainable development. We are acutely aware of the vital importance of economic development for the Pacific Island countries and are equally concerned for the limited natural resources and often fragile nature of the environment of these countries. It is thus critical that development continues, but in a manner which is truly sustainable ecologically. Only by following such a course of action can the quality of life currently enjoyed by Pacific people be assured for future generations.

The need for sustainable use of natural resources has been the underlying theme of the NEMS documents. The preparation of NEMS has been a challenging task and has involved a wide range of government and non-governmental organizations in each country. The nature of the issues and the complexity of the challenges faced have been great. As ever, Pacific countries have risen to the challenge and I believe the commitment shown in the development of the Strategies is a true reflection of the intimate bond which Pacific Island peoples have with their environment. Nonetheless, this "commitment" and "challenge" has now to be put to visible action programmes.

The Asian Development Bank welcomes the publication of the National Environmental Management Strategy for the Republic of the Marshall Islands. It is an important event for environmental management in the Republic of the Marshall Islands and the Bank will be pleased to consider ways and means of assisting with its implementation.

Dr Kazi F. Jalal
Chief, Office of the Environment
Asian Development Bank

Message from SPREP

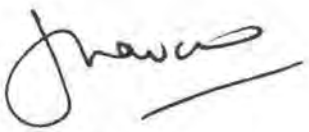
We Pacific Islanders share a common aspiration for economic development and improved living standards for our people. However, we are aware that this development cannot be at the cost of the environment. We have lived in close harmony with our island environment for thousands of years and we are well aware of its importance to our way of life. We face the complex challenge, in common with many other countries of the world, of achieving economic development in a way which will not significantly affect our environment. This major challenge must be addressed if our Pacific way of life is to survive.

The development of National Environmental Management Strategies (NEMS) has been a major tool in addressing these issues. This development was made possible through the generous financial and technical assistance of the Asian Development Bank and the World Conservation Union (IUCN). This assistance is gratefully acknowledged.

This NEMS is a practical document which aims to identify the major environmental issues in the Marshall Islands and the priority environmental programs which are required to address them. The emphasis has been on ownership of the NEMS by the government and people of the Marshall Islands. The process which has resulted in the preparation of the NEMS has involved many participants and has been directed by a National Task Force on Environmental Management and Sustainable Development, comprising relevant government and nongovernmental organizations in the Marshall Islands.

The NEMS process has proved most useful in raising awareness of environmental issues. In the wake of the United Nations Conference on Environment and Development (UNCED) the NEMS also provides the foundation for implementing much of Agenda 21 in the Marshall Islands. However, the success of the NEMS exercise will ultimately be judged by its implementation. If the NEMS Report sits on a shelf and gathers dust, then the exercise has failed.

SPREP looks forward to working with the Republic of the Marshall Islands and with other regional and international organizations in the implementation of the NEMS.



Vili A. Fuavao
Director
South Pacific Regional Environment Programme

Acronyms & abbreviations

ADB	Asian Development Bank
AIDAB	Australian International Development Assistance Bureau
Alele	Alele Inc.
AOSIS	Alliance of Small Island States
ARP	Aquaculture Research Program
CCA	Coast Conservation Act
CIP	Capital Improvements Project
CITES	Convention on International Trade in Endangered Species
CMI	College of the Marshall Islands
COM	College of Micronesia
Compact	Compact of Free Association between the RMI and US
CTSA	Center for Tropical & Subtropical Aquaculture
CZM	Coastal Zone Management
DOI	Department of the Interior (US)
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMSD	Environmental Management & Sustainable Development (as in Task Force on EMSD)
EPA	Environmental Protection Authority
ESCAP	Economic & Social Commission for Asia & the Pacific
EWC	East–West Center
FFA	Forum Fisheries Agency
FSM	Federated States of Micronesia
GDP	Gross Domestic Product
GEF	Global Environment Facility
GNP	Gross National Product
HPO	Historic Preservation Office
INC	Intergovernmental Negotiating Committee
IOIA	Interior & Outer Islands Affairs (Ministry of)
IPCC	Intergovernmental Panel on Climate Change
IUCN	World Conservation Union (IUCN)
JICA	Japanese International Cooperation Agency
KADA	Kwajalein Atoll Development Authority
KALGov	Kwajalein Atoll Local Government
MALGov	Majuro Atoll Local Government
MEC	Marshalls Energy Company
MIA	Marshall Islands Aquaculture
MIDA	Marshall Islands Development Authority
MIDB	Marshall Islands Development Bank
MIJ	Marshall Islands Journal
MIMRA	Marshall Islands Marine Resources Authority
MIVA	Marshall Islands Visitors Authority
MWSC	Majuro Water & Sewer Company
NEMS	National Environmental Management Strategy
NEPA	National Environmental Protection Act
NOAA	National Oceanic & Atmospheric Administration
NPCC	National Planning Coordination Committee
NTA	National Telecommunications Authority
OEA	Office of Economic Adjustment
OPS	Office of Planning & Statistics
OTEC	Ocean Thermal Energy Conversion
PCBs	Polychlorinated Biphenyls
PIMRIS	Pacific Islands Marine Resources Information System

PIN	Pacific Islands Network
PSC	Public Service Commission
R&D	Resources & Development (Ministry of)
RETA	Regional Environment Technical Assistance Project
RMI	Republic of the Marshall Islands
RMIEPA	Republic of the Marshall Islands Environmental Protection Authority (also EPA)
RSP	Rural Sanitation Project
SPC	South Pacific Commission
SPREP	South Pacific Regional Environment Programme
TNC	The Nature Conservancy
T&C	Transportation & Communication (Ministry of)
TTPI	Trust Territory of the Pacific Islands
UH	University of Hawaii, Manoa
UN	United Nations
UNDP	United Nations Development Programme
UNCED	United Nations Conference on Environment & Development
UNEP	United Nations Environment Programme
UNFPA	United Nations Fund for Population Activities
USAKA	United States Army at Kwajalein Atoll
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service
USP	University of the South Pacific
WHO	World Health Organization
WMO	World Meteorological Organization
WQML	Water Quality Monitoring Laboratory (of RMIEPA)
WWF	World Wildlife Fund

Executive summary

Introduction

This report identifies and describes the major environmental challenges presently facing the Republic of the Marshall Islands. The national context is developed in the first two chapters, Chapter 1 providing a brief review of the nation's natural environment and Chapter 2 describing current development trends. Major environmental challenges and their root causes are identified and described in Chapter 3. Chapter 4 then presents a discussion of current institutional and legal responses to the environmental problems described. The report concludes in Chapter 5 by defining five Program Areas for future action directed toward strengthening the nation's environmental management capabilities. Action strategies which follow from Chapter 5 are contained in NEMS Part B: Action Strategy for Strengthening Environmental Management, this report's accompanying document. A parallel discussion on the state of the cultural environment is contained in Appendix 3, and Appendixes 1 and 2 contain supplementary information on the nation's natural and political history.

Summary

While the Republic's Exclusive Economic Zone (EEZ) encompasses over 750,000 square miles of the central Pacific Ocean, its land area totals less than 70 square miles—a ratio of land to water of less than 1 to 10,000. Understandably, the Republic's natural resources are primarily marine. The nation's abundant and extremely biodiverse coral reefs provide habitat for robust populations of fish and other marine life, which support subsistence and incipient commercial reef fisheries. The extensive pelagic fishery that is part of a regional fishing industry may be reaching optimium sustainable production. No endemic species of terrestrial flora or fauna are known, and no endemic aquatic species have yet been identified, but the Marshall Islands offer important natural sanctuaries to several endangered mammals, birds, and turtles.

The national economy is characterized by a reliance on foreign aid and a historic reliance on natural-resource based exports. The Gross Domestic Product has increased two-and-a-half fold during the past decade. But with over two-thirds of the current GDP comprising foreign aid, real per capita GDP shrinks from the official estimate of $1600 to less than $500 when the aid component is subtracted. A profound disparity between rural and urban economic opportunities exists, with the real annual per capita revenue generation (absent aid monies) in rural areas equalling less than six dollars. Reflecting a weak agricultural base, a significant trade imbalance has resulted from a heavy reliance on imported goods, primarily foodstuffs. National debt has increased significantly over the past five years, with 18 per cent of total annual government revenues now dedicated to debt-servicing expenses. Faced by dwindling copra revenues, the Republic is presently emphasizing the development of marine resources to meet future economic needs.

Current demographic trends are dominated by rapid population growth and urbanization. During the period 1980–1988, the population grew by 40 per cent—equating to an annual increase of 4.2 per cent. Meeting the needs of the extremely young population can be expected to require increasingly the redirection of funds designated for development or environmental protection activities to education, health and social programs. Discrepancies in work opportunities and important services between rural and urban communities, together with rapid population growth, have encouraged rapid urbanization. At present, two-thirds of the nation's population lives on roughly ten per cent of the nation's total land area, creating unique environmental challenges. Clearly, any serious attempt to strengthen the nation's environmental management capabilities must cooperate with family planning and population redistribution programs.

The major environmental challenges currently facing the nation include the:

1) potential for a devastating rise in average sea level,
2) accumulation of solid and hazardous wastes,
3) contamination of fresh water supplies,
4) destruction of coral reefs,
5) eutrophication and pollution of coastal waters,
6) coastal erosion, and
7) the potential for over-exploitation of renewable resources.

Root causes underlying the environmental challenges stem primarily from deficiencies in the areas of:

1) infrastructure,
2) planning and coordination,
3) regulation enforcement,
4) managerial capabilities, and
5) human resources development.

The extremely high population densities of the two urban centers magnify the environmental challenges, calling for innovative, multi-agency solutions.

Present responses to environmental challenges take the form of pertinent legislation, institutions, and specific programs and projects. Although the private sector has played a responsive role, the majority of the responses to the nation's environmental challenges have originated within the public sector. Limitations to the effectiveness of these responses include:

1) limited interagency coordination and managerial capabilities,
2) inadequate public support stemming from a lack of public awareness of environmental problems, and
3) ineffective enforcement of existing environmental regulations.

Strengthening the nation's environmental management capabilities is necessary in five program areas:

1) maintaining clean water, land and air,
2) conserving renewable resources,
3) ensuring environmentally sensitive decision-making,
4) protecting special spaces and species, and
5) minimizing the impacts of environmental emergencies.

Chapter 5 describes specific priorities for action under the heading of each of these program areas. Strategies and programs which spring from these priorities are contained in the accompanying document, Part B: Action Strategy for Strengthening Environmental Management.

Two general forces threaten to undermine environmental management efforts, given the nation's present economic and social dynamics. First, rapid population growth and the attendant increase in the number of "urban poor" will intensify the need to develop the primary production sector, encouraging the pursuit of environmentally insensitive programs to meet immediate, economically driven needs. With new emphasis placed on artisanal fisheries development, natural resource exploitation at the local level will become a significant challenge as well. Second, the increasing involvement of private foreign parties (who often have no vested interest in sustaining the nation's resources) in the nation's development will enhance existing pressures to exploit resources in destructive, nonrenewable ways. Strong, visionary national leadership will be required to withstand these pressures and prioritize environmentally responsible development to assure a self-reliant and environmentally healthy future for the Republic and its citizenry.

Description of the environment

The Republic of the Marshall Islands is composed of twenty-nine atolls and five low-elevation islands located in the north-central Pacific Ocean. Twenty-two of the atolls and four of the islands are inhabited. Scattered in an archipelago consisting of two roughly parallel island chains—the western "Ralik" ("sunset") and eastern "Ratak" ("sunrise") chains—the atolls extend about 700 miles (1130 km) north to south, from 14°43'N to 4°34'N, and about 800 miles (1290 km) east to west, from 160°48'E to 172°10'E. Isolated by ocean, the Republic is more than 2,000 miles (3230 km) from the nearest trading centers, Honolulu and Tokyo. Geographically, its nearest neighbors are Kiribati to the south and the Federated States of Micronesia to the west. The map on page iv shows the two chains of the archipelago.

With a total land area of just under 70 square miles (110 square km), a mean height above sea level of only seven feet (two meters), and soils which are nutrient-poor, the nation's agricultural base is limited. The Republic's marine resource base is broad, however, with its combined lagoon area totaling 4,037 square miles (6511 square km), and its Exclusive Economic Zone encompassing over 750,000 square miles (1.2 million square km) of the Pacific Ocean. This chapter provides an introduction to the natural environment of the Marshall Islands. Supplementary, more detailed information may be found in Appendix 1, and an examination of the state of the cultural environment may be found in Appendix 3.

1.1 Physical conditions

1.1.1 *Climate*

The moist, tropical climate of the Republic of the Marshall Islands is heavily influenced by the northeast trade wind belt. While the trade winds prevail from December through April, periods of weaker winds and doldrums occur from May through November. Annual rainfall varies considerably from

north to south within the archipelago, the southern atolls receiving 120–170 inches (300–430 cm), and the northern atolls receiving 40–70 inches (100–175 cm) (NOAA 1989a-b). (See Appendix 1 for further details.)

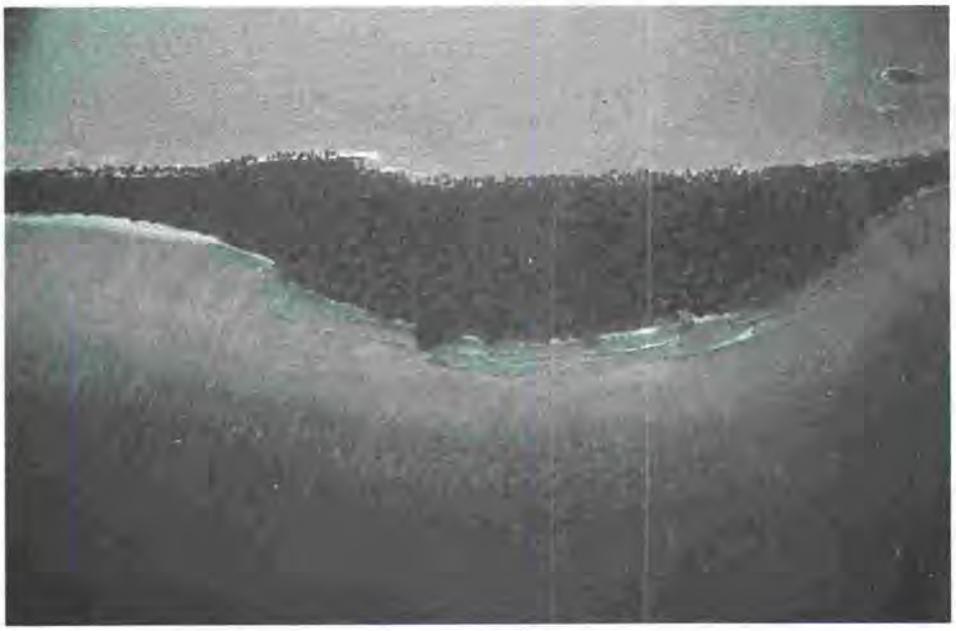
1.1.2 Geomorphology, soils & hydrology

Geomorphology

Generally speaking, an "atoll" consists of a series of low-lying islets and submerged reefs arranged about a central lagoon, which typically mixes with the open ocean via one or more channels and/or shallow passes. In the Marshall Islands, the islets composing an atoll usually form an elliptical or circular shape around a central lagoon of 150-foot (45 m) average depth. The surrounding ocean depth plunges to over 5,000 feet (1525 m) within two miles (3 km), and to 10,000 feet (3050 m) within ten miles (16 km) of the typical atoll (Fosberg 1990; Wiens 1962).

Approximately 1,225 low-lying islets make up the twenty-nine atolls of the Marshall Islands. The low islets which form each atoll are composed of carbonate reef sands and rock, and are formed by the interaction of ongoing organic and physical processes (Darwin 1896; Fosberg 1990). Marine animals and plants, mostly corals, foraminifera and calcareous algae, secrete calcium carbonate which through compaction becomes a limestone reef. Gradually, a surface of flat hard coral limestone forms and, by accumulating organic debris, may eventually extend above sea level. If storms and large waves continue to deposit materials on the exposed flat, which is typically no wider than 500 yards (459 m), an islet emerges.

The topography of the islets is uniformly low and flat, with maximum natural elevation rarely exceeding ten feet (3 m). Around the edges of the typical islet there is generally a small tidal ridge, most pronounced on the ocean side. On the lagoon side, this ridge is generally composed of sand and fine gravel deposits,



A typical Islet, with low average (6–8 feet above sea level) and unconsolidated shorelines render the Marshall Islands extremely vulnerable to sea level rise. (photo: Ministry of R&D)

while on the seaward side it is more commonly made up of a coral limestone reef surface, overlain by cobbles (Devaney et al 1987a-b; Maragos et al 1990 a-b).

Soils

With few exceptions, the soils present in the Marshall Islands are nutrient-poor, frustrating large-scale agricultural development. Moreover, salt spray resulting from turbulence at the windward reef margin is continually carried by winds across the islands. This, in combination with high evaporation rates fostered by abundant solar radiation and high average wind speeds, results in high surface salinity which further impedes the growth of plant life (Fosberg 1990). (See Appendix 1 for further details.)

Hydrology

Freshwater lakes are rare in the Marshall Islands. Only one island, Mejit (170°53'E and 16°48'N), features a fresh to brackish water lake. Several large islets have central depressions with small brackish water swamps. For the most part, however, fresh water resources are limited to sub-surface, Ghyben-Herzberg lenses, generally located on larger islets (OEA 1989). Such lenses consist of fresh water "floating" on a denser seawater layer just below the surface. Regularly replenished by rainfall, the lenses can usually be accessed by digging down one to eight feet. Although the water is often "hard," or "limey," it is not brackish. As these lenses are not uniformly present, most of the inhabited islands rely heavily on rainwater catchment systems to help meet fresh water needs (Mosley 1989; OPS 1988). (See Chapter 3, Section 3.2.5, "Contamination of freshwater supply" for a detailed discussion of water supply issues.)

1.2 Terrestrial resources

1.2.1 Vegetation

There is no written record of the original vegetation of the Marshall Islands, and no endemic species are known today. Archeological evidence suggests that humans have inhabited the atolls for over 3000 years (Craib 1983) and that these early inhabitants probably altered the vegetation of the atolls by introducing plants used for food and craft materials (Spennemann & Lajuan 1990). Furthermore, during the twentieth century, coconut plantations developed by the German, Japanese and American administrations replaced most of the original vegetation of many atolls (Fosberg 1990). Today over 60 per cent (about 22,000 acres) of the nation's total land area is covered by forests of coconut palms *(Cocos nucifera)* (OPS 1991c).

Many areas not dedicated to coconut plantations have been put to other uses. Shallow pits and swampy patches have been dug in the interior of large islands to cultivate taro (primarily *Colocasia* and *Cyrtosperma*, and other marsh plants utilized for food, medicine and weaving materials (Spennemann & Lajuan 1990). In general, species which have been naturalized are pioneer species dependent on the presence of humans for propagation (Fosberg 1990). (See Appendix 1 for further details.)

Land has been cleared to cultivate taro plants resulting in the degradation of the soil. Exposed and dried out by the sun the top soil runs away. (photo: J. Connell)

1.2.2 Birds

Although no comprehensive study of the avifauna in the Marshall Islands has been undertaken, seventy bird species have been identified in the literature, most of them seabirds or migratory birds. Of the thirty-one species of seabirds found, fifteen reportedly breed in the Marshall Islands, primarily on the northern atolls (Amerson 1969; Berger 1987a-b; Thomas 1989). (See Appendix 1 for further details.)

1.2.3 Mammals

Beside humankind, the Polynesian rat (*Rattus exulans*) is the only terrestrial mammal native to the Marshall Islands. According to Reese (1984), the Polynesian rat probably arrived with early Marshallese settlers. (See Section 1.3.2 below for a discussion of marine mammals.)

1.2.4 Reptiles

No comprehensive study of the herpetofauna of the Marshall Islands has been undertaken, although Lamberson has made certain observations on Enewetak atoll (Lamberson 1984). In particular, she records the presence of seven species of lizards and one species of blind snake, based on comparison with specimens present in the Smithsonian Museum of Natural History, the Museum of Comparative Zoology, the B. P. Bishop Museum, and the Mid-Pacific Research Laboratory. None of the species recorded is endemic to either the Marshall Islands or the Micronesian region although geckos in particular are abundant. (See Appendix 1 for further details.)

1.2.5 Arthropods

Insects, spiders, and land crabs abound in the Marshall Islands but, as with most of the nation's fauna, these organisms have been little studied. Coconut crabs (*Birgos latro* and *Coenobita rugosa*), sometimes growing carapaces of five-inch widths, are found on coconut plantations throughout the Republic, and are highly valued for their tasty meat. Relatively easy to find and catch, coconut crabs are endangered. Attempts to cultivate them have been frustrated by their elaborate larval stage which requires pelagic circulation (Helfman 1973). Other small land crabs reaching two to three inches in carapace width are common on islands with dense canopy cover. These small crabs are likewise valued as a food source.

1.3 Marine resources

1.3.1 Marine flora

Comprehensive taxonomic studies of the algae of the Marshall Islands were undertaken in the 1950s. Algal studies since that time have been less extensive, and have identified only a few additional species. A compilation of the published records of marine algae found in the Marshall Islands (McDermid 1989) lists a total of 238 species of green, brown, red and blue-green algae. The Republic has just recently begun to explore the commercial potential for algae production.

Seagrasses are rare in the Marshall Islands. Limited stands of *Thalassia hemprichii* exist in Ailinglaplap and Ujelang. There is one bed of *Cymodocea rotundata* on the lagoon side of the western tip of Laura, Majuro, and *Halophila* seagrass beds exist on the lagoon side of several islets within Kwajalein atoll. None of these beds appear to be robust, and all are limited in extent.

1.3.2 Marine fauna

Corals & other invertebrates

All of the atolls and islands of the Republic are surrounded by fringing reefs, generally characterized by an ocean or seaward-facing slope, and a reef top or flat. The upper portion of the windward ocean slope features a system of finger buttresses, sometimes called "spur and grooves", usually dominated by

Clams, found in the coral reefs or burrowed in the sands, are utilized for food. Mariculture programmes are reducing the harvesting pressures on natural populations. (photo: SPREP)

dense growths of a wide variety of corals and encrusting algae. The upper leeward slope of the ocean reef is traversed by deep gorges which contain benthic assemblages of coral and algae (Jones & Endean 1973a-b).

A diverse array of coral species occurs in the Marshall Islands. Surveys and collections have recorded a total of 146 species from 50 genera of stony corals in Majuro (Lamberts & Maragos 1989). At nearby Arno atoll, where sampling and collecting have been more intensive, 180 species from 60 different genera have been recorded (Maragos et al 1990b). Coral reefs have served as a "pantry" to the Marshallese people, as well as a source of organic material to build up and protect the islands, for millennia.

But marine invertebrate diversity is not limited to corals. Many other species can be found embedded in the coral reef structure or burrowing in the sands of the intertidal or nearshore zones. Sponges, clams, oysters, mussels, gastropods, whelks, tunicates, worms, crabs, shrimps, sea cucumbers, and starfish are found in abundance (Harris 1990). Many of these species are utilized for food and some, including giant clams, trochus, black-lip pearl oysters, and sponges, are the subjects of ongoing mariculture development projects (OPS 1991c; Dashwood 1991). (See Chapter 4, Section 4.1.2, "Mariculture program" for further details.)

Marine turtles

All five of the world's species of marine turtles are believed to occur in the Marshall Islands (USFWS 1991). At least two species, the green turtle (*Chelonia mydas*) and the hawksbill turtle (*Eretmochelys imbricata*), nest in the Marshall Islands (Thomas 1989). The green turtle is known to nest during the summer months throughout the archipelago. The female green turtle and her eggs are considered culinary delicacies. Although little is known about its nesting or breeding habits, the hawksbill turtle, which is considered rare and endangered, is sometimes found in lagoon waters. (Turtle conservation needs are touched on in Chapter 3, Section 3.2.9, "Over-exploitation of marine resources".)

Fish

Over 250 species of reef fish from 50 families are known to occur in the Marshall Islands (Myers 1989), and the majority are edible (Harris 1991). A detailed evaluation of the regional tuna resources undertaken by LMR Fisheries Research, Inc. (using data from the South Pacific Commission) indicated that over 1.2 million short tons of tuna were taken in the area during 1990, and that the current catch is much lower than the potential catch. The LMR study also indicated that about 96 per cent of the tuna caught by the United States fleet in the western Pacific was taken within an approximate radius of 1500 miles (2400 km) of Majuro. Skipjack, yellowfin, and bigeye tuna, the main targets of commercial fishing enterprises operating in the western Pacific, are abundant (LMR Fisheries Research 1991) in the waters of the Marshall Islands. Game fish, including marlin, are also plentiful.

Marine mammals

Many marine mammals reside in Marshallese waters, although their presence has not yet been well studied. Reese confirms the presence of the spinner dolphin (*Stenella longirostris*) and the striped dolphin (*Stenella coeruleoalba*) also suggested by Hubbs et al (1973), and suggests that as many as twenty-seven species of whales, dolphins, and porpoises occur in the Marshall Islands. (See Appendix 1 for further details.)

1.3.3 Deep-sea minerals

Several preliminary studies undertaken by foreign researchers have confirmed the presence of limited phosphate deposits and extensive quantities of manganese in sea mounts located within the Marshall Islands Exclusive Economic Zone (Geomarex 1976; Hein et al 1988, 1990; Moritani & Nakao 1981). A report published by the University of Hawaii at Manoa and the East-West Center in 1989 identified the Marshall Islands EEZ as one of the three most important areas for manganese crust deposits in the Pacific, and perhaps in the world (Callies & Johnson 1989).

Although the deposits of manganese, cobalt, nickel and platinum may ultimately be commercially exploitable, the feasibility of mining these resources is dependent on the development of cost-efficient mining techniques. Current deep-sea mining technology is limited and relatively costly. Participation in a project to test the Continuing Line Bucket (CLB) system for mining high cobalt metalliferous oxides is planned during the Second Five Year Development period, 1992–1996. This project will be undertaken by the Mining Panel of the United States–Japan Coordinating Program in Natural Resources. However, it is estimated that at least a decade will be required to develop a commercially viable mine.

1.4 Endangered species

There is no written record of the original flora of the Marshall Islands. Therefore, it is impossible to say whether any endemic species has become extinct as the result of human influence. No endemic species of flora or fauna is known to occur in the Marshall Islands today. However, several species of fauna which occur in the region have been listed as endangered. The Endangered Species Act of 1975, which originated as Trust Territory Code, is still in effect in the Marshall Islands (RMI Nitijela 1983a). Species which occur in the Republic and which are listed as endangered include the blue whale (*Balaenoptera musculus*), sperm whale (*Physeter catadon*), Micronesian pigeon (*Ducula oceanica ratakensis*), leatherback turtle (*Dermochelys coriacea*), and the hawksbill turtle (*Eretmochelys imbricata*) (USFWS 1991). The crimson-crowned fruit dove (*Ptilinopus porphyraceus*) and the Wake rail (*Rallus wakensis*), both believed to have once occurred in the Republic, are now thought to be extinct. The Republic is not yet a signatory to the Convention on the International Trade in Endangered Species (CITES).

Development trends

2.1 Economic trends

Growth of the nation's economy is restricted by an inadequate supply of skilled labor, an underdeveloped manufacturing sector, geographical isolation from world markets, and a relatively narrow natural resource base. Relying heavily on foreign aid, expertise and imports, the nation is quickly moving away from its subsistence base, with rapid urbanization being encouraged by a profound disparity between rural and urban income levels. Youth and women are under-represented in the work force and urban unemployment is on the rise. Faced by a rapidly expanding population and limited land resources, the Republic has proclaimed the fisheries and maricuiture sectors the keys to future economic independence (OPS 1991c). Several economic trends are discussed in the first section of this chapter, and demographic trends in the second section. All monetary values are in United States dollars. A fiscal year spans the period October 1 – September 30; FY 1992 refers to the fiscal year 1991–1992.

2.1.1 *Increasing gross domestic product*

The Gross Domestic Product (GDP), as estimated by the Office of Planning and Statistics with UN/ESCAP assistance, increased more than twofold during the past decade, from $31.9 million in 1981 to $68.7 million in 1988 (OPS 1989). This represents an annual rate of increase of nearly 12 per cent, although actual year-to-year growth rates were extremely variable. For example, the reported growth rate was 0.2 per cent in 1985, 24.5 per cent in 1986 (the year of Compact implementation), and 5.4 per cent in 1988. The economy features a large service sector which is mainly sustained by the national government and the US Army at Kwajalein Atoll (USAKA), and a small production sector which is primarily agriculture-based. Per capita GDP, according to the 1988 Census, was nearly $1600. Gross National Product (as estimated by the Office of Planning and Statistics) was nearly $75

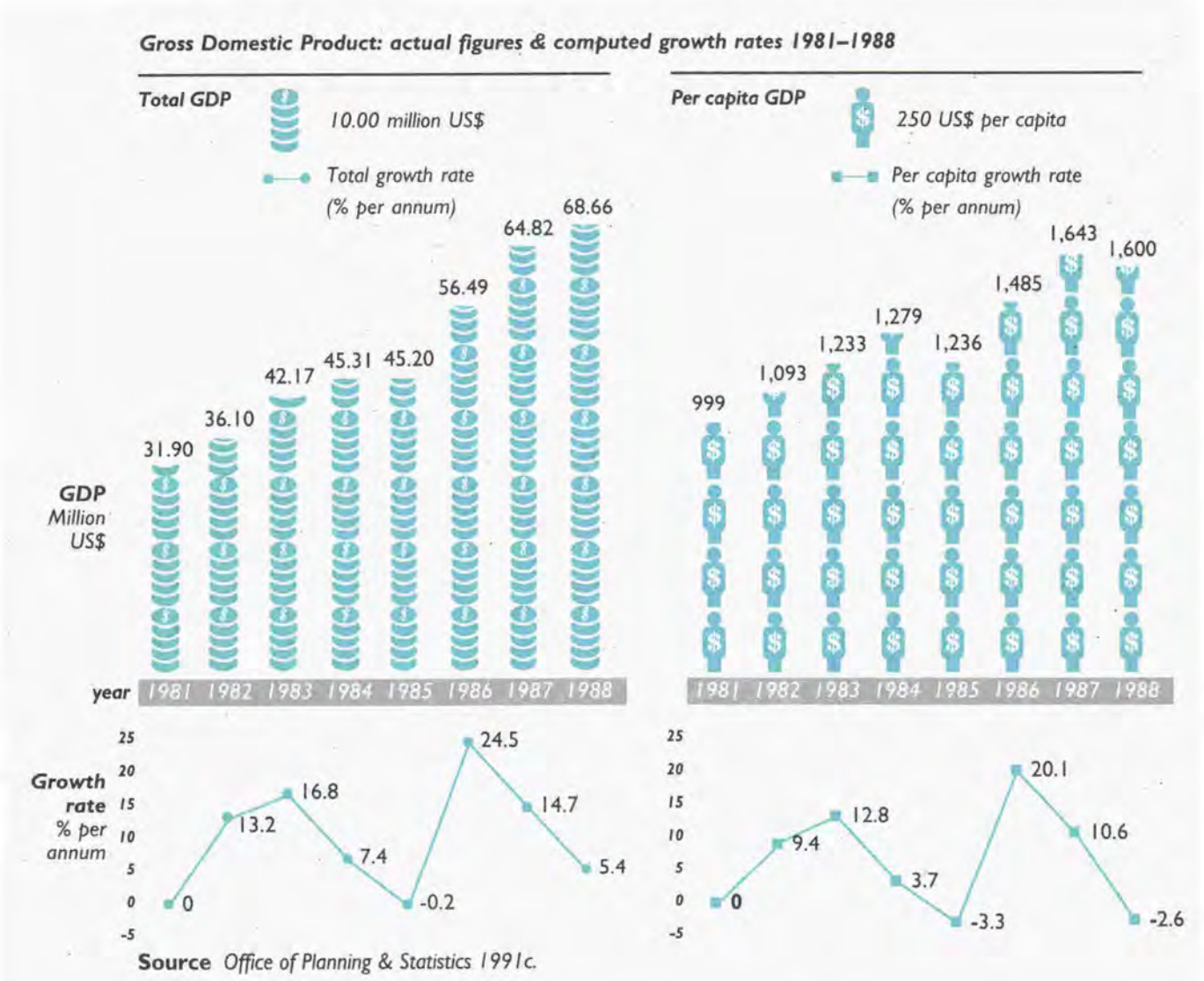


Table 2.1 *Gross domestic product: actual figures and computed growth rates, 1981–1988. Growth rates varied widely over the period, reflecting the major influence of external factors, including foreign aid, on the national economy.*

million for 1988. Table 2.1 above, shows actual figures and computed growth rates for GDP during the years 1981–1988.

With employee compensation constituting 56–63 per cent of GDP for the period 1981–1988, the service sector far outweighs the production sector in its contribution to GDP. Private sector wages accounted for 38 per cent of GDP in 1988, up from 25 per cent in 1981. Current estimates indicate that approximately 40 per cent of GDP originates in the public

sector. Overall, total employee compensation for both public and private sectors increased by approximately 14 per cent per annum from 1981 to 1988 (OPS 1989).

The small production sector accounts for approximately 5 per cent of GDP, with agriculture, fisheries, and handicraft production being the major contributors. As demonstrated by the 1988 Census, which indicated that fewer than 3 per cent of agricultural workers receive remuneration for their activities, most production is still subsistence based. In general, the development of the production sector has been hindered by an inadequate supply of skilled labor and natural resources, and by the nation's geographic isolation from world markets.

2.1.2 *Reliance on foreign aid*

It is important to note that the reported GDP discussed below is significantly inflated by foreign aid. In 1991, calculating that roughly 78 per cent of current total national revenue comprises foreign aid, the Asian Development Bank estimated real GDP (reported GDP less annual aid) at approximately $25 million, or a real per capita GDP of between $200 and $500 per annum (ADB 1991a). Most of this aid money is designated under the Compact for specific infrastructure projects or social, health, and education programs. Thus, although a comparison with GPSs of other developing countries reveals that the Marshall Islands per capita GDP is relatively high, it should be remembered that the greater part of this funding is directed toward specific programs, and most is spent in the two urban centers. The lifestyle of the average Marshallese is still very modest, and access to social, health, and education services is still a major concern.

Compact of Free Association

The Marshall Islands relies heavily on the United States for funding provided in the form of annual grants earmarked for capital improvements and development assistance (USPL #99-239). Compact funds constituted 81 per cent of the government's recurrent expenditures in 1987, and 58 per cent in 1988 (OPS 1988). Direct grants provided under the Compact during the period 1986–1991 totaled $130.5 million. As scheduled, this amount will decrease to $110.4 during the period 1992–1996, and to $95.5 million during 1997–2001. In 2001, funding is scheduled to end, provided that the Compact is not renewed. The above amounts do not include funds provided for special programs such as the Section 177 programs which compensate Marshallese victims of the US nuclear testing program carried out during the 1950s. (see Appendix 2 for more detail.)

Other foreign aid

Technical assistance and grant monies from regional, national and multilateral agencies contribute an estimated $2 million per year (OPS 1988). As a new member of the United Nations and the Asian Development Bank, the Republic is likely to receive more aid in this category in the future.

2.1.3 *Increasing national debt*

Direct debt incurred by the national government totals approximately $92 million. This debt is in the form of bond issues (1987 and 1989) secured by Compact funding, and a low-interest loan obtained from the Asian Development Bank. Inclusive of interest, the 2001 bond repayment obligations amount to $132 million. Presently, annual interest payments on outstanding bonds total approximately $12 million, or nearly 18 per cent of the Republic's annual expenditures. Payments are made upon receipt of the Compact grant funds, with the balance then being transferred to the Republic's capital account. A third bond issue planned for 1992 will total nearly $45 million (Finance 1991).

Both of the previous bond issues were undertaken to finance capital improvements and development projects. Funds from the 1987 bond issue ($65 million) were largely used to relieve outstanding debts

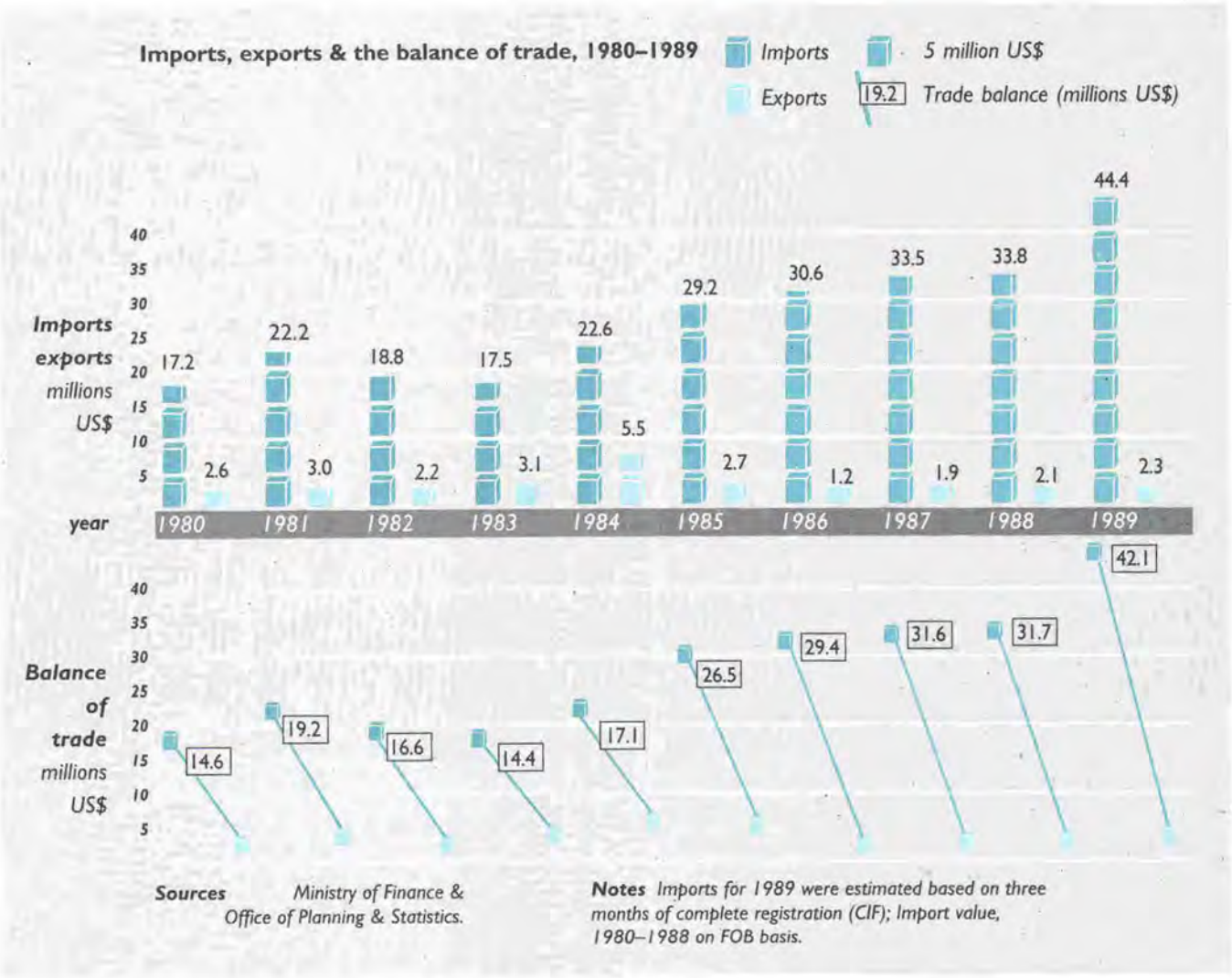


Table 2.2 *Imports, exports and the balance of trade, 1980–1989. The trade imbalance increased nearly 300 per cent over the period 1980–1989, reflecting the nation's increasing dependence on foreign goods.*

associated with the national airline and the power plant, although approximately $1 million was allocated for capital improvements. Monies from the 1989 bond offering ($20 million) were earmarked for several projects, including the purchase of a tuna purse seiner, the construction of the capitol building, the purchase of the Washington Embassy, the purchase of shares in the Bank of the Marshall Islands, and for underwriting Air Marshall Islands and the Marshalls Energy Company. The planned 1992 bond issue will be used for capital improvement projects to be identified by the Marshall Islands Development Authority (MIDA 1991).

Approved in late 1991, a $6.9 million loan from the Asian Development Bank will be used to build a fleet of long-line fishing vessels aimed at establishing a domestic pelagic fishery. Repayment is not expected to begin before 2001. In addition to these national

debts, several government-owned statutory authorities and public/private joint ventures hold loans with the Marshall Islands Development Bank, commercial financial institutions, and US federal finance programs.

2.1.4 *Increasing trade deficit*

During the period 1981–1988, the value of total imports increased two-and-a-half fold, from $17.2 million to $44.3 million. In 1988, total imports constituted 49.4 per cent of GDP, resulting in a trade imbalance of approximately $42 million (OPS 1988, 1989). A significant percentage of imported goods are foodstuffs; in 1988, food items (including beverages and cooking oils) accounted for over 33 per cent of total commodity imports. Today, the purchase of food is estimated to constitute 58 per cent of urban and 51 per cent of rural household expenditures (OPS 1990).

Agricultural production is hindered by multiple factors including scarcity of arable land, poor soil quality, and the geographic isolation of outer atolls which makes shipment of products difficult. Today, nearly 40 per cent of the fish consumed in the urban centers is imported (JICA 1991) and even though bananas are plentiful on the outer atolls, bananas from Central America are often purchased in the grocery stores. There presently are no laws specifically aimed at limiting imports or otherwise increasing the competitiveness of locally produced products.

Traditional foods produced in the Marshall Islands are breadfuit, taro, pandamus and prawns. These are being replaced by imported foodstuffs, an important factor in the growing trade imbalance. (photo: J. Connell)

2.1.5 *Reliance on natural-resource based exports*

Copra has been the primary export of the Republic since the days of the German and Japanese occupations (See Appendix 2 for details). Annual production of copra peaked at 7,000 tons in 1913, when the Jaluit Gesellschaft administered the Marshall Islands on behalf of the German government. Coconut groves, many of them planted near the turn of the century, cover 22,000 acres, or 60 per cent of the nation's land. Approximately 11,000 acres of the plantations are currently fully productive (OPS 1991c).

Total copra production & average purchase price, 1984–1988

Year	*Total production* short tons copra	*Annual average purchase price in outer atolls* US$/ton
1984	4,483	316
1985	4,301	209
1986	6,921	120
1987	5,401	202
1988	5,513	220

Sources *Tobalaar Processing Plant & Office of Planning & Statistics.*

Table 2.3 *Total copra production & average purchase price, 1984–1988.*

Having decreased by 15.1 per cent between 1979 and 1988, present annual copra production is less than 5,000 tons. Dwindling production (as shown in Table 2.3) is attributed to three causes:

1) depressed price of copra in world markets,
2) reduced productivity of aging coconut plantations, and
3) inadequate storage and shipping capabilities of outer atolls.

In early 1992, the government attempted to stimulate copra production by doubling the subsidy, making it possible to earn as much making copra on an outer island as one would working an entry-level job in the urban centers. This measure is expected to stem migration to the urban centers and result in decreased urbanization during the next several years.

As the nation's marine resources are extensive, fisheries, mariculture and deep-sea mining all hold promise for economic development. Accordingly, the Second Five Year Development Plan, 1992–1996 places a high priority on the development of renewable marine resources as an eventual replacement for copra (OPS 1991c). Planned fisheries projects target both artisanal and pelagic fisheries, while planned mariculture projects aim to cultivate giant clams, trochus, blacklip pearl oysters and seaweed for commercial markets (OPS 1991c). Although no fisheries or mariculture projects, to date, have become economically self-sustaining (Uwate et al. 1984), development of renewable marine resources is widely perceived as the "key to the future" in the Republic. As scheduled Compact funds diminish over the upcoming decade, additional dependence upon resource exploitation can be expected.

2.1.6 *Rural & urban income disparity*

There is a large disparity between rural and urban real income levels. Excluding the four atolls which receive compensation under Section 177 of the Compact, the

Copra is the primary export from the Marshall Islands. However the annual copra production is decreasing. One of the reasons is the inadequate storage and shipping capabilities of outer atolls. (photo: J. Connell)

Urban & rural estimated per capita gross domestic product, 1982–1988

GDP US$	*1982*	*1988*	*%Growth*
Urban per capita	2,184	2,012	-1.3
Rural per capita	452	718	9.8
Cash production	124	364	32.0
Subsistence production	328	354	1.3
National average	1,095	1,583	7.4

Source *Office of Planning & Statistics*

Notes *Decline in per capita urban GDP probably due to undercount of urban population in 1980 Census. Large increase in per capita rural GDP likely due to overcount of rural population in 1980 Census.*

Table 2.4 *Urban & rural estimated per capita gross domestic product, 1982–1988. In general, urban GDP is about two-and-one-half times as high as rural GDP.*

Unemployment by education level, sex & age, 1988

Grade (Gr) Level	*Males* % *unemployed by age group*				*Females* % *unemployed by age group*			
	15–19	*20–24*	*> 24*	*Ave*	*15–19*	*20–24*	*> 24*	*Ave*
None	7.7	4.8	4.8	5.6	8.8	5.1	3.1	5.8
Gr 1–5	8.7	7.3	4.3	6.5	4.8	2.2	3.8	3.6
Gr 6–7	19.5	7.0	4.6	9.5	8.8	6.6	7.6	7.7
Gr 8	25.4	21.3	25.5	24.2	32.0	18.4	21.4	24.2
Gr 9–11	28.2	31.7	28.9	29.6	34.7	39.7	27.5	34.1
Gr 12	9.4	21.6	23.3	18.9	10.2	23.5	30.5	21.0
Post-Sec	1.0	5.4	8.2	5.3	0.7	4.4	6.1	3.6
Unknown	0.1	0.9	0.4	0.4	0.0	0.1	0.0	0.0
Actual No.	**287.0**	**315.0**	**416.0**	**1018.0**	**147.0**	**136.0**	**131.0**	**414.0**
% of Total	**28.2**	**30.9**	**40.9**	**100.0**	**35.5**	**32.9**	**31.6**	**100.0**

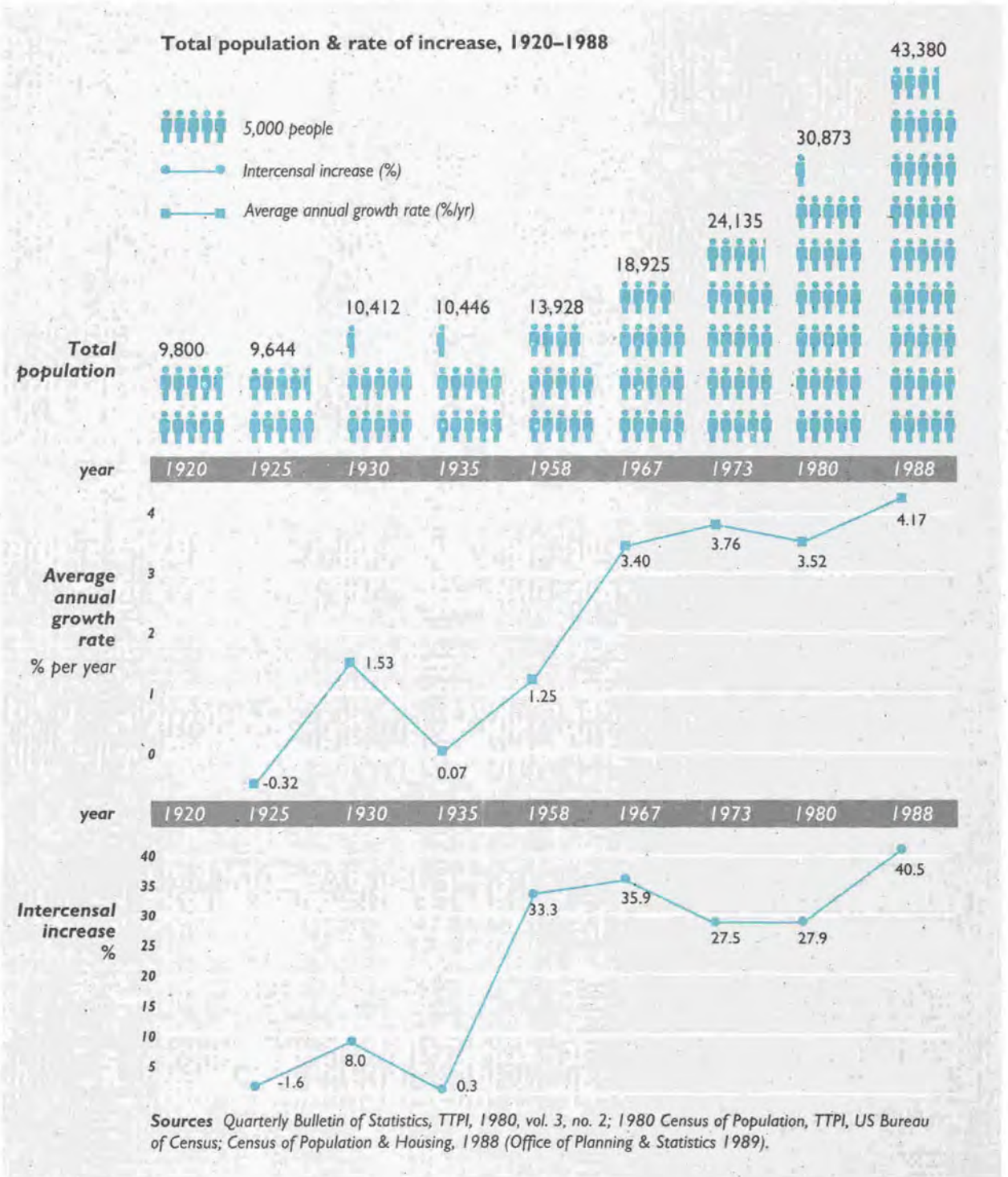
Source *Census of population & housing, 1988 (Office of Planning & Statistics 1989)*

Table 2.5 *Unemployment by education level, sex and age, 1988. A full 64 per cent of unemployment is found in the age group 15–24.*

major sources of rural local government funds are direct and indirect transfers from national government and ministerial sectors, supplemented by local taxes and levies. During fiscal year 1990–1991, estimated annual direct and indirect transfers to rural local governments were over $200 per capita, while the average per capita revenue generated in the rural communities was less than six dollars (IOIA 1991b). While reliable figures estimating urban revenue production are unavailable, the Office of Planning and Statistics has estimated that urban per capita revenue generation is roughly six times that of the rural areas (OPS 1991c).

2.1.7 *Increasing unemployment*

According to the 1988 Census, the national unemployment rate was 12.5 per cent; the rates for Majuro and Ebeye were 17.0 per cent and 13.7 per cent, respectively, while the average for all other atolls was 5.0 per cent. In urban areas, unemployment is exceptionally high among youth, averaging 57 per cent for youth aged 15–19, and accounting for 62 per cent of unemployment overall (OPS 1989). Due to rapid population growth, each year more youth compete for



Sources *Quarterly Bulletin of Statistics, TTPI, 1980, vol. 3, no. 2; 1980 Census of Population, TTPI, US Bureau of Census; Census of Population & Housing, 1988 (Office of Planning & Statistics 1989).*

Table 2.6 *Total population & rate of increase, 1920–1988. In recent years, without the influence of war and epidemics, population growth has increased to an extreme of 4.2 per cent per annum.*

already scarce entry-level positions. Despite the high unemployment rate, however, many skilled labor and professional positions are available. The lack of skilled human resources perpetuates the high unemployment rate and forces prolonged dependence upon foreign expertise.

Women are also under-represented in the work force. The 1988 Census indicated that out of the economically active population of 11,488 persons, 73 per cent were male. Women were more likely to be self-employed or members of the private sector work force than men, while men were more likely to be employed in the public sector. While the traditional matrilineal system of land inheritance accorded women significant rights and powers, the transplantation of male-dominated, western values has largely undermined these traditional values and served to exclude women from "white-collar" employment. The United Nations Development Programme (UNDP) report, *The Marshall Islands: A Statistical Profile on Men and Women,* indicated that in 1988 the average grade of educational attainment was 10.7 for males and 11.0 for females employed in the public sector. Even so, the majority of positions filled by women were clerical or janitorial in nature (Booth 1989).

2.2 Demographic trends

The predominant demographic trends in the nation today include rapid population growth and urbanization. These trends have produced significant undercurrents which profoundly impact both environmental management and economic development activities. (For a discussion of the breakdown of customary roles, see Appendix 3.)

2.2.1 *Rapid population growth*

According to the Census of Population and Housing, the national population was 43,380 in 1988 (OPS 1989). This figure represented an increase of 40 per cent since the 1980 Census, yielding an average annual rate of increase of 4.2 per cent—one of the world's highest. During the previous intercensal period (1973–1980), the annual population growth rate was 3.5 per cent. Table 2.6 presents the acceleration in population growth rate seen during the period 1920–1988. Today, approximately 20 per cent of the population is under the age of five, and fully 53 per cent is under the age of sixteen (OPS 1991b).

The high rate of growth results from the combination of a consistently high birth rate and a declining death rate. During the period 1973–1988, the crude birth rate varied minimally, from 49.5 to 49.2 per 1000, and the fertility rate declined from 7.9 to 7.2. Although the lowered fertility rate signifies that the average woman is now bearing fewer children in her lifetime, the high birth rate has been sustained, since each year the cohort of fertile women increases. The crude death rate decreased between 1973 and 1988 from 12.4 to 8.9 per 1000. Predictions based on a slowly decreasing population growth rate project an increase of 48 per cent during the next decade, from 46,200 in 1990 to 68,500 in 2000 (OPS 1991b). Table 2.7 shows population predictions for 1991 and 1996, the years defining the term for implementation of this National Environmental Management Strategy, assuming constant population growth rate (4.2 per cent/annum).

Historically, the birth rate was kept low using traditional birth control methods and the fertility rate was maintained at two to three children per woman. Presumably, this limit evolved in response to resource availability. While the westernization of lifestyle has facilitated higher birth rates, it has not included women as a major force in development. In the absence of widespread societal support for additional roles, women have been largely limited to motherhood.

The extremely high rate of population growth in the Republic has resulted in an increasingly high ratio of dependency (the ratio of dependents, ages 0–14, to working-age individuals, ages 15–64). According to

Present & projected national population by sex & age, 1991 & 1996

Age	Mid 1991			Mid 1996		
	Males	Females	Total	Males	Females	Total
0–4	5,408	4,828	**9,876**	6,061	5,826	**11,887**
5–9	4,111	3,921	**8,032**	4,896	4,730	**9,626**
10–14	3,291	3,121	**6,412**	4,061	3,890	**7,951**
15–19	2,560	2,451	**5,011**	3,253	3,095	**6,348**
20–24	1,923	1,924	**3,847**	2,519	2,422	**4,941**
25–29	1,566	1,602	**3,168**	1,886	1,896	**3,782**
30–34	1,389	1,381	**2,770**	1,530	1,575	**3,105**
35–39	1,224	1,183	**2,407**	1,352	1,354	**2,706**
40–44	972	854	**1,826**	1,186	1,106	**2,292**
45–49	683	585	**1,268**	938	828	**1,766**
50–54	460	394	**854**	653	563	**1,216**
55–59	354	318	**672**	433	372	**805**
60–64	314	307	**621**	323	292	**615**
65–69	269	277	**546**	274	268	**542**
70–74	191	207	**398**	216	224	**440**
> 74	175	201	**376**	206	227	**433**
Total	**24,530**	**23,554**	**48,084**	**71,638**	**119,722**	**191,360**

Source *Office of Planning & Statistics, 'constant hypothesis' projection*

Table 2.7 *Present and projected national population by sex and age, 1991 & 1996. An almost fourfold increase is expected during the five years of the Action Strategy (NEMS Part B) implementation.*

the National Population Policy, there are presently 114 dependents for every 100 members of the national work force (age 15–64). The needs of this extremely young population can be expected to strain progessively both private and public sector resources, particularly within the healthcare and education segments (OPS 1991b).

Table 2.8 shows OPS projections for the cost of education in the years 1995 and 2000, given population growth. Between 1990 and 2000, a fourfold increase

is expected, even as Compact funds for education sharply drop off. Resources available for environmental protection measures will also be strained by unchecked population growth, especially given that a national prioritization of needs might place health or education above environmental protection. Thus, the long term success of environmental management programs will depend to a large extent on cooperation with family planning programs.

2.2.2 *Urbanization*

Approximately two-thirds of the nation's population lives in one of the two urban centers — 45 per cent on Majuro and 21 per cent on Ebeye (OPS 1988). The combined land area of the two urban centers is 11.4 per cent of the total national land area. Together, rapid population growth and in-migration have resulted in extremely high urban population densities and overcrowding. The 1988 Census indicated that in urban Majuro and Ebeye, population densities were 28,724 and 58,456 persons per square mile, respectively. The Census also indicated that the average household size in the urban areas is 9.4 persons.

Table 2.8 *Projected number of students and cost of primary education, 1990–2000. During the years 1990–1995, the implementation period for the Action Strategy (NEMS Part B), the total cost of education is expected to increase one-and-one-half fold, from $5.20 to $8.37 million. A fourfold increase is predicted between 1990 and 2000. Needs of similar magnitude in the areas of health and social services are likely to compound, and so compromise resources available for environmental protection in the long term.*

Projected number of students & cost of primary education, 1990–2000

	1990	*1995*	*2000*
Total number of school-aged children (5-14)	**13,837**	**16,928**	**20,355**
Number enrolled			
Public	9,271	11,850	14,249
Private	2,352	3,386	4,071
Cost/student *US$m*			
Public	531	664	830
Private	119	149	186
Total cost *US$m*			
Public	*4.92*	*7.87*	*11.82*
Private subsidy	*0.28*	*0.50*	*0.76*
Total educational costs *US$m*	**5.20**	**8.37**	**12.58**

Source Office of Planning & Statistics (1991b)

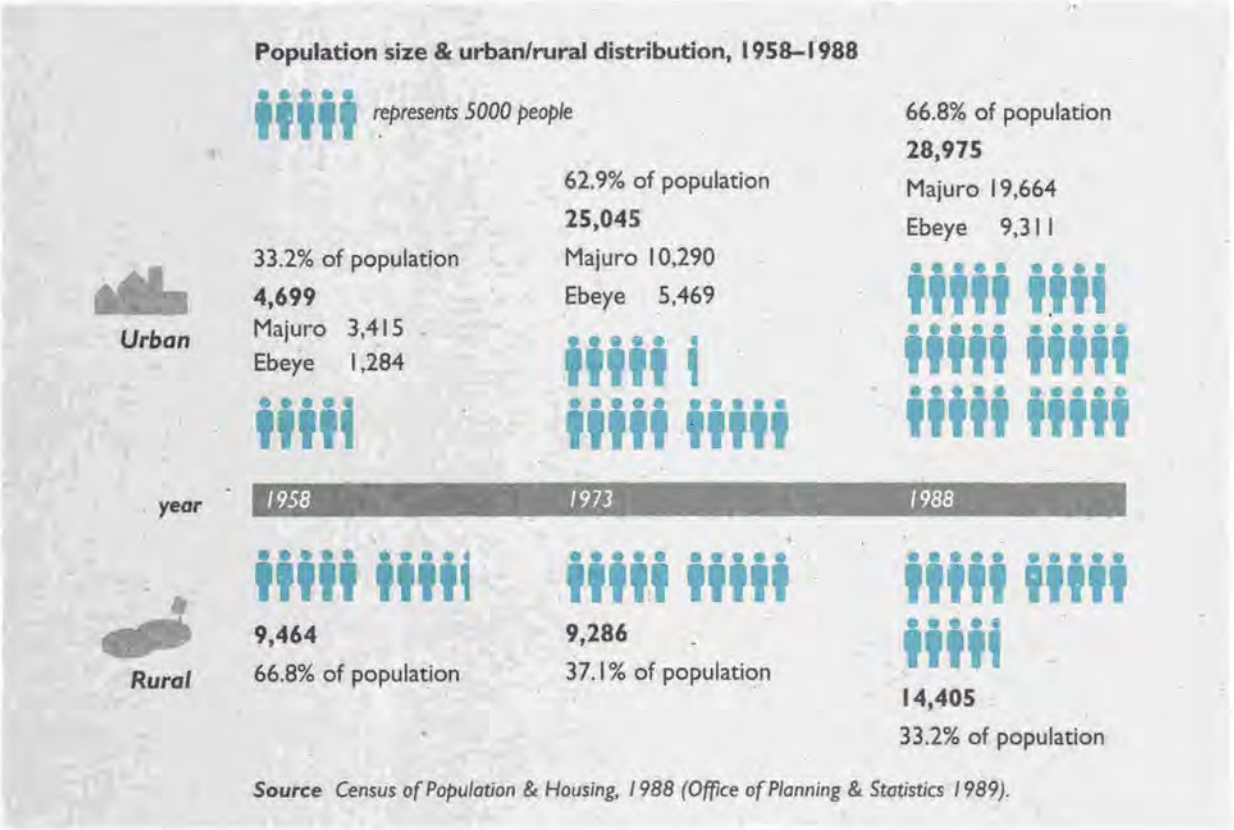


Table 2.9 *Population size and urban/rural distribution, 1958–1988. A strong trend of increasing urbanization is revealed, with the urban population accounting for 33.2 per cent of the total in 1958, and 66.8 per cent of the total in 1988.*

Past government investment, focusing on the two urban centers, has contributed to the present marked discrepancies in availability of infrastructure, services, and economic opportunity between urban and rural areas. As a result, many outer islanders are attracted to the urban centers. Between 1958 and 1988, the percentage of the population living in urban areas increased from 33 per cent to 67 per cent (see Table 2.9). Young working-age people in particular migrate to the urban centers, as evidenced by the marked difference in the ratios of dependency (see Section 2.2.1, "Rapid population growth", above for definition) of urban and rural areas—104:100 in Majuro and 180–200:100 on most outer atolls (OPS 1991b).

In many ways, the development scenario of the Marshall Islands is typical of small island nations. The Compact of Free Association with the United States distinguishes the nation, however, by significantly raising the GDP and increasing the potential for economic development. Rapid population growth should be carefully considered in all environmental management planning efforts, as it is likely to be the single most important factor in future development decisions at all levels of government. In the next chapter, environmental challenges and their root causes are discussed in the context of the above development scenario.

Environmental challenges and their root causes

Currently, the Republic of the Marshall Islands faces numerous environmental challenges, each rooted in unique combinations of inter-dependent social, cultural, and economic issues. It is the purpose of this section to identify and discuss these environmental challenges, their respective impacts, and their root causes. In general, the root causes of the environmental challenges faced by the nation stem from deficiencies in the areas of:

1) infrastructure,

2) legislation,

3) planning and coordination, and

4) education.

Several underlying issues which serve as broad causal forces are discussed in the beginning section of this chapter and discussions of specific environmental challenges and the root causes unique to each follow. (For a discussion of cultural challenges, see Appendix 3). This chapter does not attempt to suggest appropriate responses to the environmental problems discussed, but merely depicts the present situation. For a discussion of future priorities which stem from this discussion, please see Chapter 5. Specific response strategies and programs are developed in detail in NEMS Part B: Action Strategy for Strengthening Environmental Management, 1992–1996, this report's accompanying document.

The high population density of Majuro has caused major environmental problems including pollution of the lagoon by garbage and human waste. (photo: J. Connell)

3.1 Broad causal factors

Several deficiencies—in environmental impact assessment procedures, zoning and building standards, public education efforts, and planning/coordination of development and environmental management activities — undermine efforts to improve environmental quality in the Republic. In addition, rapid population growth is a general force undermining environmental management efforts, while the traditional land tenure system specifically frustrates western-style management efforts.

3.1.1 *Environmental Impact Assessment procedures*

The National Environmental Protection Act of 1984 (NEPA) contains a general requirement that all major government development projects must undergo Environmental Impact Assessment (EIA). Going one step further, the Coast Conservation Act of 1988 calls for the development of a Coastal Zone Management Plan which features specific EIA procedures. But regulations pursuant to the Coast Conservation Act have yet to be enacted and a Coastal Zone Management Plan has yet to be drafted, rendering enforcement difficult at best. In practice, then, without supporting regulations stipulating standard procedures for the EIA process, most projects under consideration do not undergo such an assessment. There is a need for EIA procedures which include a screening mechanism to separate projects likely to have major impacts, and thus necessitating comprehensive EIA, from those likely to have only minimal impacts, and thus requiring only a project review. A uniform requirement, calling for EIA in all circumstances, would be both impractical and unenforceable, given the nation's limited resources.

3.1.2 *Environmental management planning*

In general, there is a need to expand environmental planning efforts to enable the environment sector to play a more prospective, problem-solving role. As a young nation, many of the environmental problems the Republic now faces result from recently introduced processes including modern methods of transportation, construction, production and resource exploitation. Understandably, during the first five years of independence, the environment sector has taken a responsive rather than a prospective approach to the management of environmental problems, often responding on a case by case basis. Comprehensive provisions for both the management of solid and hazardous wastes and the conservation of living resources are needed. Overall, there is a need for better definition of the mission and immediate goals of environmental management programs in the Republic, and for better integration of those programs with central government planning.

3.1.3 *Coordination between development & environment sectors*

Often the absence of interagency communication in organizing development activities results in the implementation of projects which are environmentally insensitive. Coordination and communication between the environment and development sectors has historically been poor, with information regarding development projects often being withheld during the preliminary stages of a project, and environmental impact assessments rarely being performed. Often, by the time the environment sector is informed of the details, it is too late to effect useful planning changes.

Despite RMIEPA efforts toward community outreach, all too often the development sector has perceived the environment sector as antagonistic and anti-development. Requiring strong support in the form of technical expertise, testing capacities and funding, a combative approach to environmental protection would enjoy only limited effectiveness in a small nation such as the Republic, where financial and human resources are limited.

Rapid population growth and immigration from the outer atolls have resulted in overcrowding in Majuro. Poorly constructed houses are packed together without adequate sanitation and garbage disposal. (photo: J. Connell)

Instead, the RMIEPA is striving to develop an interactive, proactive and positive approach. Ideally, integration of development and environmental protection activities would occur at the planning and feasibility study levels. At present, however, the RMIEPA is not represented on national planning or development review boards, and the desired milieu of interactive cooperation is only beginning to emerge.

3.1.4 *Zoning laws & building specifications*

Inadequate zoning laws and building codes foster the substandard housing, overcrowding, and poor sanitary conditions present in today's urban communities. In 1991, the Majuro Local Government proposed zoning laws which were defeated during public hearings. No other local governments have attempted to draft zoning laws although national legislation assigns them the responsibility to do so. Likewise, building codes do not yet exist in the Republic. One result is that many houses are built without toilet facilities, or built with substandard designs and materials (for further details see Table 3.1). Moreover, septic tanks, animal pens, and graveyards are frequently located too close to ground wells and housing areas. In short, inadequate planning at the community level is a major contributor to environmental challenges relating to public health and land management. The development of zoning laws which capitalize on the strengths of the traditional land tenure system must be made a high priority.

3.1.5 *Land tenure system*

The traditional land tenure system confounds Western-style efforts both to improve the urban living environment and to conserve biological diversity. Landowners are accustomed to exercising ultimate control over land use and access, and are therefore generally unaccepting of regulations governing solid waste disposal, sewage disposal, earthmoving, or land zoning which might restrict the usage of their property. (See Appendix 3 for further details on land tenure system and traditional rights.) Generally, there is a lack of understanding among landowners regarding the benefits associated with modern concepts such as land zoning. Since all land is privately held in accordance with tradition, no public land-use scheme has been developed, and no provisions for recreational areas or nature parks have been created. There

is a need to tailor management programs to work hand in hand with traditional systems, so that environmental protection is achieved and the integrity of the land tenure system maintained simultaneously.

3.1.6 *Education*

Current shortages of trained human resources impair the environmental management capabilities of the Republic. Training in the evaluation and management of marine resources, environmental impacts, and solid/hazardous waste is sorely needed. Complicating this problem is the fact that understanding of the rudimentary scientific principles necessary for further training in environmental management is lacking, mainly due to inadequate instruction in public schools.

Recent efforts directed toward introducing environmental education into school curricula have been hampered by a lack of teacher preparation. A special, "hands-on", integrative approach to science education, known as the FAST (Foundational Approaches in Science Teaching) Program, was tested in the Republic during the early 1980s. The program required teachers to create lessons tailored to address environmental issues relevant to island living. Where properly employed, FAST met with tremendous success. But the program's overall success was limited by insufficient teacher preparation, such that it was ultimately discontinued. Current in-service teacher training conducted each summer by the College of the Marshall Islands lacks a specific "environmental education" component, and generally does not emphasize training in the sciences. Consequently, science instruction is relatively underdeveloped in both primary and secondary educational curricula.

Inadequate education at the primary and secondary school levels also results in a general lack of public awareness of environmental issues and hence a lack of support for environmental protection and management activities. Issues of eutrophication and reef destruction, over-exploitation of marine resources, contamination of fresh water supplies, and littering cannot be effectively addressed without concomitant public education. Existing public education programs are loosely organized, limited in number and scope, and often hindered by a lack of technical expertise. In summary, there is a great need to improve science education, primarily through teacher training and curriculum development. At the same time, it is critical that public education programs be further developed, and that skills development be emphasized through vocational training programs.

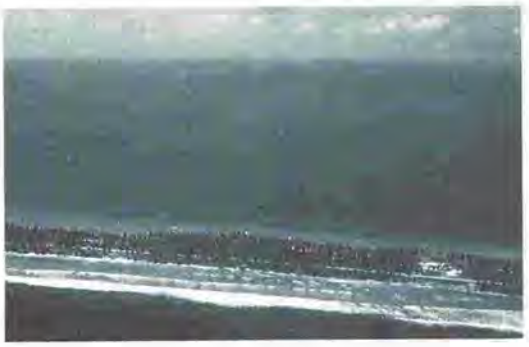
3.1.7 *Rapid population growth*

By straining existing natural resource bases, sanitation and waste disposal systems, and environmental management capabilities, the extremely high rate of population growth (4.2 per cent per annum according to the 1988 Census) contributes, either directly or indirectly, to the majority of the environmental challenges described. As discussed in Chapter 2, rapid population growth and the resultant high ratio of dependency also strains existing education, health, and social service systems, serving to divert funds needed for economic development and environmental protection activities. It is important to note that environmental management and planning efforts must cooperate with population programs to be successful in the longterm.

3.2 Challenges to the natural environment

3.2.1 *Climate change & sea level rise*

By far the most threatening long-term environmental issue facing the Republic of the Marshall Islands is global climate change and the accompanying potential for a devastating rise in the average sea level. Greenhouse gases including carbon dioxide, nitrous oxide, methane and low-level ozone are emitted into



A Marshall Islands road clearly demonstrates how vunerable Majuro is to sea level rise. (photo: J. Connell)

the atmosphere worldwide as the byproducts of biological and industrial processes. Levels of these gases in the atmosphere have steadily increased in recent years, causing scientific concern that they might trap radiant energy, ultimately causing global warming and a consequent rise in average sea level (Bruce 1990; IPCC 1990a; Leggett 1990).

Based on data available in 1991, the Intergovernmental Panel on Climate Change (IPCC) predicted a sea level rise of between 10 and 30 centimeters by the year 2030, and a 30 to 100 centimeter rise by the end of the 21st century (IPCC 1990a). Although the extent of global warming and resultant sea level rise is a much debated topic among scientists, the threat of any appreciable degree of sea level rise represents a very real danger to the Republic, a nation of low-elevation land masses. As shown in a recent case study of the Marshall Islands vulnerability to sea level rise, the destruction of precious arable land, fresh water lenses, and coastal property would profoundly impact the nation (Crawford et al. 1992). In the worst case scenario, the nation's atolls and islands could be rendered uninhabitable (Roy & Connell 1989; Wyrtki 1990; Pernetta & Hughes 1990; Leggett 1990; Miller & MacKenzie 1988).

3.2.2 *Solid waste accumulation*

Traditionally, disposing of solid waste involved simply discarding it on the ground to decompose, or into the intertidal zone to be carried out to sea. Before the introduction of non-biodegradable materials and the formation of densely populated human communities, these methods presented few ecological problems. Today, however, with the typical household generating significant quantities of nonbiodegradable solid waste, such materials are accumulating on land and in marine waters at ecologically damaging levels. Particularly in the two urban areas, where population densities are among the world's highest (30,000 people per square mile in urban Majuro and 60,000 people per square mile in Ebeye), waste disposal has become a critical challenge. The buildup of terrestrial and marine solid waste has a multitude of negative environmental impacts, including the destruction of marine organisms, the spread of vector-borne disease, and the contamination of fresh water sources.

Insufficient infrastructure is the primary cause of the waste accumulation problem, although lack of public awareness of proper disposal techniques is a major contributor. In recent years, rapidly expanding urban populations have become heavily dependent on imported packaged goods (as discussed in Chapter 2). A discussion of how the overload of solid waste has strained the newly established collection and disposal systems of Majuro, Ebeye, and the larger rural communities follows.

At best, the collection of solid waste in Majuro is erratic, contributing to public health and pollution problems. Piles of trash often remain near residences for days, attracting flies and inviting animals to rummage through and disperse the waste on the ground. In frustration, some residents revert to the traditional practice of throwing household waste into the ocean or lagoon. If it is collected by the municipal authority, the trash is taken to the public landfill located on the

In urban centers especially, solid waste accumulation is a chronic problem. As shown here, waste commonly piles up near residences. (photo: J. Connell)

oceanside reef of the atoll. Plastic-coated wire cages, called "gabions", are filled with coral rubble and used to build a partial sea wall before waste is dumped. Although permit restrictions stipulate that the landfill is to be compacted and covered with several inches of fill material daily (RMIEPA 1990), this is inconsistently done, due to frequent equipment failures and insufficient quantities of fill material. At high tide, ocean water inundates the landfill, and although the gabions generally prohibit the egress of solid waste, leachate freely seeps onto the adjacent reef flats. The surrounding ocean waters consistently fail to meet EPA water quality standards (RMIEPA 1991). Despite regulations against the dumping of hazardous waste, no guard is present to prevent its entry into the public landfill, where children openly play and scavenge and domestic pigs routinely feed. In late 1990 one boy died when materials which he had obtained from the dump exploded.

On Ebeye, the trash collection system has greatly improved over the past several years, and is now quite reliable. As in Majuro, however, inadequate disposal methods are impacting both public and reef health. The dump site does not feature a gabion sea wall, or any other containment structure, and the trash is neither regularly compacted nor covered with sand. At high tide, the trash is carried freely into the lagoon. Children play in the piles of rubbish, lighting fires and sometimes eating discarded food. One women's group on Ebeye complains that the efforts of the Sanitation Inspector are futile; when the Inspector forces a business to dispose of outdated food, it is dumped in the public landfill, where children consume it and become ill (James 1991). According to the Kwajalein Development Authority, funds to improve the dump site are not presently available.

Solid waste-related problems are not unique to urban centers. Seepage from garbage pits, the most common mode of disposal in rural areas, often pollutes nearby wells. An initial investigation of nitrate-contaminated wells in Jabor, Jaluit implicated seepage from nearby waste disposal pits as the likely source of the contamination (Barber 1991). Open garbage pits also provide ideal breeding grounds for flies and other pests which commonly function as disease vectors. Just as in urban areas, growing populations and resultant magnification of the waste stream have rendered the traditional disposal method of throwing trash into the intertidal zone environmentally and economically detrimental in rural areas, particularly in light of the heightened emphasis on rural artisanal fisheries development (OPS 1991c) and the associated importance of maintaining healthy, clean reefs.

3.2.3 *Hazardous waste accumulation*

The hazardous materials accumulating in the Republic generally originate either as materials left in the Republic by various foreign agencies or as byproducts of modern life. Hazardous materials left behind by foreign agencies include approximately a hundred electrical transformers containing poly-chlorinated biphenyl (PCB)-contaminated oil which date back to the US Trust Territory Administration. The transformers are stockpiled out of doors on Majuro, many of them leaking. Additional expended transformers await disposal on Ebeye, Jaluit, and Enewetak. Approximately fifty corroding, 55-gallon drums containing cyclogen emulsifier, a substance with known carcinogenic potential, are stored unsheltered at the Public Works yard in Majuro. The drums were donated to the Republic in 1986 by a foreign contractor, but use of the emulsifier for road repair only began in late 1991, after receiving assurances from the American Embassy that no health hazards are posed to road workers who wash their hands after working with the substance (Bodde 1991). Additional unsheltered, rusty and leaky drums of cyclogen are located on Guegeegue Island, Kwajalein.

Hazardous waste is generated each day by the college, the two hospitals, a few industries, and by cars and boats. The College of the Marshall Islands operates two scientific laboratories for instruction in chemistry and biology which produce small amounts of chemical hazardous wastes. Hospital wastes, including "sharps" (needles, scalpel blades, etc.), laboratory reagents, and various materials contaminated with infectious bodily fluids, are generated daily. In addition, used oil and expended batteries from airplanes, industrial machinery and personal vehicles routinely require disposal, particularly in the urban centers. It bears mention that on multiple occasions foreign interests have solicited the government to allow the dumping of various types of solid wastes; to date, these offers have been considered but not accepted. Upon assuming control of the Laura agricultural demonstration

Technicians test soil near stockpile of electrical transformers containing PCB-contaminated oil, confirming contamination. (photo: RMIEPA)

farm in 1991, the Ministry of Resources and Development discovered a small warehouse full of pesticides left behind by the Taiwanese technical mission. Labeled in Taiwanese, the specific chemical contents of the containers remains unknown. The pesticides will require safe disposal in the future, as the Ministry does not have plans to use them.

In summary, disposal of hazardous waste is an unmet challenge in the Republic. While present regulations prohibit the dumping of hazardous materials, no alternative, legal method for their disposal has yet been defined. Not surprisingly, illicit dumping occurs. One industry was discovered discharging PCB-contaminated oil into the Majuro lagoon in 1989, and was duly prosecuted by the Environmental Protection Authority (RMIEPA 1989). As there is presently no formal procedure for the disposal of used oil and expended batteries, much of this material commonly finds its way onto reefs. Currently, a portion of the hazardous medical waste is burned, but the incinerators used at both health centers suffer from faulty design and construction and consequently expose humans to noxious fumes (Andrike et al. 1991).

Storage facilities for existing hazardous substances are insufficient. In general, they neither adequately contain hazardous substances nor prevent their leakage into the environment. To date, a twenty-foot reinforced shipping container used by the RMIEPA to store small quantities of hazardous materials is the

only sheltered storage available. Unfortunately, arrangements for the disposal of the contained materials have been unsuccessful and the container is currently full. Given the high surface salinities present, the average useful life of a shipping container in Majuro is only five years, so the present container can only be expected to last until 1994. As development proceeds in the Republic a higher priority must be assigned to the development of a comprehensive hazardous waste management system facilitating safe and efficient routine disposal mechanisms.

3.2.4 *Contamination of fresh water supply*

In rural and urban areas alike, limitations of water collection, storage and pumping facilities contribute to the problems of water quality. The primary deficiencies are capacity-related in urban areas, and design-related in rural areas. In general, the present inadequacies of urban public water storage and pumping capacities lead to the use of alternative water sources, including private catchments and wells, which are easily contaminated in high population density areas. For those people who are unable to access an alternate source of water during hours when public water is not available (see below) personal hygiene may suffer, exacerbating public health problems.

Numerous water-borne diseases occur in the Marshall Islands, including typhoid, cholera, and an array of debilitating bacterial and protozoan-caused diarrheal disorders. Since the public water supply on Majuro and Ebeye is monitored daily and normally meets or exceeds the US Environmental Protection Agency's standards for drinking water (RMIEPA 1991), these diseases are primarily spread by water from unmonitored private catchments and wells. Poorly designed/located pit latrines and septic tanks may also directly contaminate nearby groundwater wells. Presently, neither urban center possesses the equipment with which to empty septic tanks. Noninfectious disorders may result from drinking polluted water as well. Consumption of high nitrate content water has been shown to lead to severe health risks for infants, resulting in methemoglobinaemia, or "blue baby" syndrome (WHO 1984). Testing by the RMIEPA in 1991 confirmed that several wells on Jaluit atoll contain exceptionally high levels of nitrates, probably as the result of microbial contamination from nearby garbage pits (Barber 1991). Also, water may be contaminated by lead from catchment surfaces painted with lead-based paints or constructed with lead-content nails.

Doubling as a water catchment surface, the airport runway in Majuro currently supplies roughly 75 per cent of the public water. Rain falling on the runway surface is collected, stored in reservoirs, and filtered and treated prior to entering the public water system which comprises about 11 miles of water mains. Current reservoir storage capacity on Majuro is 27 million gallons. Daily water usage varies between 750,000 and 1,200,000 gallons, depending on water availability. Since present storage capacity is insufficient to meet the needs of the community, officially designated "water hours" are strictly enforced, with public water generally only available for three to six water hours per day.

Furthermore, insufficient water pressure during water hours has prompted some residents located at the end of the main line to install pumps independently in an effort to enhance water pressures to their homes. Operation of these pumps during non-water-hours creates a vacuum in the water mains, facilitating seepage of contaminated water from the surrounding soil into the public water system.

On Ebeye, the public water system is entirely supplied by a desalination plant fueled by waste heat from the island's power plant. With a total capacity of 300,000 gallons, the plant produces approximately 200,000 gallons of water per day. Cistern capacity, totaling about one million gallons, is inadequate to meet current community needs. Consequently, public water is only available to individual households for approximately forty-five minutes each day. Despite

the use of private water catchments to enhance this supply, a chronic water shortage persists, augmenting community hygiene problems.

In rural areas, the majority of fresh water is supplied by water catchments and, where feasible, groundwater wells. Catchments often become contaminated with coliforms and other pathogens, particularly on the northern semi-arid atolls where people are reluctant to drain and clean them. Lacking pumps, groundwater wells in most rural areas require the lowering of a bucket to collect water, increasing the likelihood introducing contaminants into the water supply. In addition, many rural wells lack adequate coverage and thus allow entry to small animals and organic debris. Finally, as mentioned, the inappropriate placement of septic tanks, animal pens and disposal pits near wells is another common source of contamination of groundwater in rural areas. The RMIEPA Water Quality Monitoring Laboratory estimates that over 75 per cent of the rural wells tested are contaminated with coliforms and other bacteria.

3.2.5 *Eutrophication & pollution of coastal waters*

Signs of eutrophication and pollution are readily evident on reefs adjacent to settlements, particularly in urban areas. Algal blooms occur along the coastline in Majuro and Ebeye, and are especially apparent on the lagoon side adjacent to households lacking toilet facilities. Whether from household or industrial waste, high nutrient loads — in combination with favorable light, temperature, and carbon dioxide conditions — stimulate rapid algal growth. In this setting, algae proliferate and quickly outcompete the slower-growing corals, covering all available space; reef death follows (Leventin 1982; Wood & Johannes 1975; SPC/SPEC/ESCAP/UNEP 1985).

In Majuro, lagoonal waters adjacent to urban areas are plagued with "red tide", a proliferation of dinoflagellates often associated with ecosystem disturbance. Red tide may threaten marine life by lowering dissolved oxygen levels in the water, and may also render some types of seafood toxic to humans (Levinton 1982; Yasumoto et al 1977). Enclosing over 65 per cent of the circumference of Majuro lagoon, a system of land-filled causeways which accommodates the main road enhances eutrophication by preventing the natural flushing of lagoonal waters. Data recorded by the RMIEPA from 1988 to 1991 shows that water quality in the enclosed area has steadily declined (RMIEPA 1991). Stagnation of lagoonal waters, and the resultant decrease in dissolved oxygen levels is known to lead to fish death and reef deterioration (Dahl 1981; Dawson 1959; Jones & Endean 1973b).

Today, most eutrophication results from inadequate disposal of sewage and household waste, industrial waste being only a minor contributor. In the two urban centers, the sewage which enters the public systems is expelled untreated via outfalls which are located in 25–45 feet of water. Although a cursory investigation (Maragos 1990) did not reveal significant damage to the surrounding ecosystem the outfalls may require extension if the volume of waste disposed is significantly increased, whether through rapid population growth, industrialization, or both. Neither the Majuro nor the Ebeye docks feature sewerage hookups for ships, and neither urban center has the equipment with which to empty septic tanks or ship holds. When a ship is in port, there is no option but to expel sewage into lagoonal waters.

Sewerage facilities are also inadequate in households and schools. The 1988 Census of Population and Housing indicated that, of households with toilet facilities, the majority in urban areas feature flush toilets, while the majority in rural areas feature pit latrines. As shown in Table 3.1, however, roughly 10 per cent of all urban households, and over 60 per cent of rural households have no toilet facilities (OPS 1989). In addition, many schools do not have functional toilets, and some have none at all. In the absence

Household access to drinking water & toilet facilities, 1988

Facilities	*Number of households*				*Per cent of total*
	Majuro	*Ebeye*	*Outer islands*	*Total*	
Source of water					
Piped	1,602	820	31	2,453	50
Catchment	536	116	1,449	2,101	43
Well	36	5	226	267	5
Other	54	9	39	102	2
Total	**2,228**	**950**	**1,745**	**4,923**	**100**
Toilet Facilities					
Flush toilet	1,227	785	138	2,150	42
Water seal	469	43	370	882	20
Pit latrine	216	30	355	601	12
None/other	316	92	882	1,290	26
Total	**2,228**	**950**	**1,745**	**4,923**	**100**

Source *Census of Population & Housing 1988 (Office of Planning & Statistics 1989)*

Table 3.1 *Household access to drinking water and toilet facilities, 1988. Roughly 10 per cent of all urban households and over 60 per cent of rural households lack toilet facilities altogether. Water catchments are major water sources in urban and rural areas alike.*

of toilet facilities, the traditional practice of defecating in the intertidal zone is usually followed, contributing to the eutrophication problem and to the spread of various diseases. Since urban Majuro's recently installed saltwater flush toilet system is actually operational only during high tide due to design limitations, even households with toilets often utilize the intertidal zone for at least part of the day. Moreover, having never become accustomed to using toilet facilities, many children view toilets as strange and uncomfortable anomalies, and prefer to use the intertidal zone, even when toilets are available. As mentioned above, point-source discharges from industries are limited at present, but the nutrient-rich waste water from planned fish processing units could significantly increase eutrophication on Majuro, Ebeye and Jaluit.

3.2.6 *Destruction of coral reefs*

As an atoll nation, the ongoing destruction of coral reefs represents a serious environmental challenge to the Republic. In addition to their crucial supportive role in the maintenance of healthy reef fisheries and uniquely biodiverse ecosystems, living reefs are essential wave-breakers which help to avert coastal erosion and storm flooding, and are suppliers of organic matter which builds up the atolls. Although a plethora of activities contribute to coral reef destruction, three particularly destructive activities are dredging, channel blasting, and boat anchoring.

Primarily on Majuro and Kwajalein, sand and gravel for construction is extracted from the lagoonal intertidal and nearshore zones by suction and bucket dredging. Both types of dredging destroy coral reefs at the dredging site, but suction dredging heavily impacts adjacent reefs as well. The large volume of sand displaced during suction dredging is carried down- current where it is deposited on reefs, leading to gradual reef death (Hodgson 1989; Maragos 1989; Schlapak & Herbich 1978). The suction dredger in use on Majuro utilizes a siltation skirt rather than settling ponds to trap sediment, providing only limited protection to down-current reefs. In addition, the removal of intertidal materials by dredging may change sand deposition patterns and enhance coastal erosion (Bjorken 1990; Rosti 1989; Maragos 1979). On Majuro, such changes have already been noted. Mieco Beach, once a highly popular sandy area on Delap island, disappeared in just a few years after two dredging operations were located up-current.

Channel passages into the lagoons of many atolls have been widened and deepened to accommodate the four government field trip ships servicing the outer atolls. Shallow passes have also been created to allow passage of small motor boats. By definition, the dynamite blasting and dredging performed to create these channels and passages must destroy reef systems. But some methods are more destructive than others. The technique presently used by the Office of Programs and Projects (Ministry of Resources and Development) involves simply placing the dynamite in a natural recess of the reef and detonating the charge. No charge drill holes are used, nor is charge placement planned in such a way as to minimize incidental damage to the adjacent reef. As a result, the majority of the marine organisms in the vicinity of the blast are killed, and adjacent coral reefs may take several years to recover. Moreover, in certain instances, tidal flats which were naturally submerged during low tide are exposed after the reef blasting, leading to loss of inner lagoon habitats important to bait fish and many other organisms. The use of drill holes and packing could greatly diminish the destruction of adjacent marine life, including corals (Maragos 1989; Yelverton et al 1973).

Boat anchorages often damage coral reefs, leaving scars which can be readily seen on the reefs of Majuro and Kwajalein. The sections of reef torn away by anchors commonly take several years to rejuvenate. Although the increasing popularity of Majuro lagoon as a yacht anchorage has made this an issue of increasing concern in recent years, no formal studies

quantifying the aggregate damage have yet been performed. Presently, there are no marina or permanent mooring facilities for pleasure craft, even though there are typically fifteen to twenty yachts anchored in the Majuro lagoon at any one time. The need for permanent moorings should be evaluated and addressed as soon as possible.

Uncontrolled earthmoving activities such as this contribute to ongoing problems of coral reef destruction and coastal erosion. (photo: RMIEPA)

3.2.7 *Coastal erosion*

Coastal erosion is an issue which understandably alarms many landowners. Although no accurate measure of the natural rate of coastal erosion is available, many landowners believe that erosion has significantly increased in recent years, especially in urban areas where there has been concentrated construction activity. Dredging, sandmining, development of the coastal zone, and the construction of inter-island causeways all contribute to coastal erosion (Maragos 1979 & 1989; Rosti 1989; Odum 1976). The effects of dredging on coral reef systems have been touched on above. Illicit removal of sand from beaches by professional contractors and private parties alike is commonplace. Although this technically requires an earthmoving permit from the RMIEPA, rarely is one obtained. Indeed, with the alternative being to purchase sand from an authorized dredging operation, many landowners see it as their right to remove sand from their beaches. Such uncontrolled sandmining enhances coastal erosion (Levin 1970).

Development of the coastal zone is also largely uncontrolled. Enforcement of existing Environmental Impact Assessment requirements and earthmoving permit procedures has been poor, attributable to inadequate human resources, resistance from landowners, and underdeveloped EIA requirements. The extremely high population densities of Majuro and Ebeye, and the rapid rate of growth of both the population and the Gross Domestic Product, has resulted in a proliferation of unmonitored coastal zone construction over the past five years. Efforts to control these activities have been further hampered by the absence of a comprehensive coastal zone management plan (see Coast Conservation Act, Chapter 4), with defined Environmental Impact Assessment procedures.

A cursory study undertaken in 1990 (Pilkey 1990) suggested that on Majuro, coastal erosion is enhanced by the presence of the numerous landfilled causeways which link a dozen islands by paved road, encircling nearly two-thirds of the lagoon. Dawson (1959) noted a profound increase in coastal erosion and a virtual collapse of lagoonal ecosystems in the years after Palmyra atoll was completely enclosed by similar landfilled causeways. After several of the causeways had partially eroded, and water flow was restored, Maragos (1979) noted improvement in ecosystem health. By preventing the natural dispersion of storm surges, the existing causeways augment stillwater rise on the ocean side, magnifying storm flooding of urban Majuro (Crawford et al.1992). And by diverting coastal currents from their natural paths, the causeways may be contributing to the erosion of coastal areas. Although culverts or bridges require a higher initial investment, they may prove to be "cheaper" in the long run, taking into account environmental costs.

In response to the extremely high population density on Ebeye Island, the Kwajalein Development Authority plans to develop several adjacent islands to provide additional living space. Houses built on nearby Guegeegue Island in 1989 have remained vacant for

nearly two years, awaiting a transportation link to Ebeye. Plans to link Ebeye to Guegeegue via six landfilled causeways will be implemented in late 1991. While the need for transportation linkages between the islands is obvious, it is likely that problems similar to those noted in Majuro would result in Ebeye. The situation is further complicated by the fact that Ebeye's sewage outfall is on the lagoon side. The newly constructed landfilled causeways might prevent the exit of the sewage, compromising the already diminished lagoonal water quality and coral reef health. No formal study investigating the sewerage outfall and its effects on the surrounding reef system has been undertaken.

3.2.8 *Over-exploitation of renewable resources*

The potential for over-exploitation of renewable marine resources is a serious threat to both economic development and the maintenance of biodiversity. Under the Second Five Year Development Plan, 1992–1996, the marine resource sector is expected to take the lead in revenue production, helping to reduce the trade imbalance and to increase national self-sufficiency (OPS 1991c). It is expected that pelagic fisheries will contribute most to national revenue production, while artisanal fisheries and mariculture programs will help to mitigate current urbanization trends and enhance individual self-sufficiency (OPS 1991b).

To date, the only existing regulations pursuant to the Marshall Islands Marine Resources Authority Act of 1988 are "Rules and Regulations on Foreign Fishing Agreements and Fish Processing Establishments". At this time, MIMRA lacks regulations with regard to conservation. In this setting, where rapid population growth and diminishing Compact funds are encouraging the rapid development of marine resources, the absence of regulations directed at conserving marine resources is an "open door" to over-exploitation. Also, as there is presently no legal framework for the establishment of nature parks or reserves, areas of special natural value cannot be protected. Several sites on the northern atolls of Bikar and Taongi have been identified as extremely important hatcheries for marine turtles and sea birds (Thomas 1989), but have not yet been afforded legal protection. The RMIEPA has made the development of the legal framework for protection of such special areas a high priority during fiscal year 1992.

The four primary targets of current marine resource exploitation efforts are pelagic fisheries, artisanal fisheries, aquarium fish and cultivated invertebrates (OPS 1991c). The pelagic fishery in Marshallese waters is mainly exploited by foreign interests using long-line and pole and line techniques. Pelagic drift-net fishing is prohibited by national legislation. Registry of foreign vessels and the granting of permission to fish under bilateral and multilateral agreements is a significant source of revenue, totaling $1.3 million in 1989 (MIDA 1991) (The RMI shares in the revenues generated through the Multilateral Tuna Treaty with the United States). Even so, it is suspected that poaching is widespread. Surveillance of the Exclusive Economic Zone has improved greatly during 1991–1992, and has resulted in the apprehension of several poachers.

Although present artisanal fisheries are primarily subsistence based, their future development is considered a central component of the nation's plan for "spatially integrated development" (see "National Population Policy, 1990", Chapter 4, Section 4.4.1). Specifically, reef fisheries are expected to help meet the domestic demand for fish to help stem urbanization by stimulating economic development on the outer atolls. Artisanal fisheries development projects for Likiep, Namu and Ailinglaplap atolls will be implemented with assistance from the Overseas Fishery Cooperative Foundation (OFCF) of Japan. Certain aspects of the projects have been modified to minimize their environmental impacts, but as with the pilot project carried out on Arno atoll (JICA 1989), records are only being kept for the catch of commercially

valuable species. MIMRA has not yet implemented a comprehensive conservation system.

Aquarium fish have been commercially harvested from reefs in Majuro for over ten years by one company. Capturing fish with slurp guns, the collectors follow a well defined reef rotation scheme, harvesting fish from different areas each day, and giving exploited reefs time to recuperate. It is estimated that at least 3,000 fish per month are presently exported from Majuro for sale in Hawaii, California and Japan (OPS 1991c). The export of live aquarium fish is expected to grow during the next several years. Two new aquarium fish export companies were formed in 1991. The MIMRA has not yet developed regulations to monitor and protect this resource, although the experience of the company which established reef rotation schemes may prove helpful in doing so.

Other renewable resources including giant clams, coconut crabs, and marine turtles are already threatened by over-exploitation. The five species of marine turtles which are believed to occur in the Marshall Islands are considered endangered, due to over-exploitation worldwide. A turtle tagging effort, as a component of the SPREP Turtle Conservation Program, is planned for Bokaak atoll during 1992. Anecdotal evidence provided by members of various outer-atoll communities suggests that sizes of coconut crabs and giant clams collected for food have noticeably decreased over the past five years. Lacking formal stock assessment studies, however, it is difficult to quantify current depletion rates and patterns. The MIMRA is involved in several mariculture projects aimed at increasing stocks of threatened invertebrates, including giant clams.

3.2.9 ***Potential environmental emergencies***

Importation of oil has grown steadily over the past several years, increasing from a total of 6.5 million gallons in 1986 to 9.7 million gallons in 1989. Sub-

Subsistence fishermen are encouraged to increase their yields. As commercialization of artisanal and pelagic fisheries proceeds, conservation of renewable resources will become of increasing concern. (photo: Ministry of R&D)

tracting the oil sold to foreign vessels, domestic consumption increased from 4.7 million gallons in 1986 to 7–8 million gallons in 1989. Nearly half of this oil is used by the power plants of Majuro, Ebeye and Jaluit, the remainder being divided between the government ships, industries, and public and private vehicles. Tankers carrying petroleum products supply Majuro and Ebeye at least once per month. In addition, many large ships and barges enter Majuro lagoon to take on fuel and offload cargo. Land-based commercial oil and gasoline supply tanks belonging to Shell and Mobil Oil Companies are present in Majuro, Ebeye and Jaluit. Small oil spills (< 1000 gallons) occur frequently and are generally allowed to dissipate with little intervention. However, the potential exists for a major accidental marine spill, conceivably resulting in the widespread devastation of coral reefs. Training and infrastructure to develop greater response capabilities for such an emergency are needed.

A toppled oil truck at the Majuro dock. Emergencies such as this one require immediate, well coordinated responses. (photo: RMIEPA)

Current responses to environmental challenges

The biggest environmental challenges faced in the Marshall Islands are solid waste accumulation and sanitation issues.

Initiated by both the public and private sectors, responses to the environmental challenges examined in Chapter 3 have met with varying degrees of success. In general, the public sector's response has been two-tiered. Efforts at the policy-maker level have been directed towards strengthening environmental legislation and management capabilities, while those at the program officer level have focused on raising public awareness of environmental issues and responding to environmental crises. Limited private sector responses have originated from church and women's groups, generally focusing on solid waste and sanitation issues. Responses to rapid population growth and the underdevelopment of human resources are examined at the end of the chapter, as these two factors profoundly impact environmental management capabilities. During discussion of the present responses, certain needs are touched on, and these needs and associated priorities are discussed in detail in Chapter 5.

4.1 Institutional responses

4.1.1 Environmental protection authority

The Republic of the Marshall Islands Environmental Protection Authority (RMIEPA) was created in 1984, with the mandate to preserve and improve the quality

of the environment. Until 1987 the Authority was combined with the National Environmental Sanitation office. Thereafter, RMIEPA was established as a government-funded statutory authority with ties to the Ministry of Health Services. Serving today as the nation's primary agency for environmental protection, the RMIEPA regularly interacts with various international organizations, including the United Nations Development Programme, World Health Organization, South Pacific Regional Environment Programme, United States Environmental Protection Agency, and the United States Department of the Interior.

The RMIEPA is overseen by a Chairman and four members of the Authority who function as a Board. Presently, four members are from Majuro and one from Ebeye. One member from Majuro represents the private sector, and all others represent government agencies. Meeting regularly with RMIEPA management staff, the Board plans and reviews program activities, informing the Minister of Health Services of all major policy and planning decisions under consideration. Daily activities of the RMIEPA are managed by a General Manager.

During the first five years of independence, the RMIEPA has grown to a twelve-member staff with an annual budget of approximately $200,000 per annum. Significant progress has been made in establishing regulatory programs, and several successful enforcement efforts have raised public awareness of the RMIEPA presence and function. In 1991, legal action against a foreign fishing company resulted in an out-of-court settlement of $250,000 for environmental damages caused to pristine Bokaak atoll by an accidental grounding. Another grounding in early 1992 resulted in a settlement of $214,000. The primary constraints faced by the RMIEPA today are:

1) lack of public awareness of environmental issues,
2) landowner resistance to environmental regulation,
3) underdeveloped staff skills in environmental management, and
4) an organizational structure which does not adequately delegate responsibilities.

With past planning and coordination efforts undermined by frequent staff turnover, activities of the young RMIEPA have tended to be responsive rather than prospective. Planning and coordination efforts have been further frustrated by the fact that the RMIEPA is rarely represented on national planning and project review committees (such as the National Planning and Coordination Committee). Presently, there is an immediate need to create a hazardous waste management program, a toilet facilities permitting unit, a nature parks unit, and an Environmental Impact Assessment Unit within the RMIEPA. Several existing RMIEPA programs designed to respond to the previously described environmental challenges are examined below.

Water quality monitoring program

Regulating the quality of fresh and coastal waters, the RMIEPA Water Quality Monitoring Program operates two testing laboratories, one on Majuro and one on Ebeye. The laboratories monitor the quality of:

1) the public water of Majuro and Ebeye on a daily basis,
2) the coastal waters of Majuro and Ebeye (including sewerage outfall areas) on a monthly basis, and,
3) the water of private catchment systems and wells on any atoll, upon request.

The program also tests catchment water at schools and restaurants as part of the Environmental Sanitation Program's inspection routine. (See "Environmental sanitation program", overpage.)

Tests for pathogenic bacteria, dissolved oxygen, turbidity, chloride, pH, calcium, conductivity, nitrates, HPC, TDS, and residual chlorine, are performed employing water quality standards adopted from the US

Environmental Protection Agency. In the event that the water does not meet the minimum standards, the populace is notified via broadcasted and printed public service announcements. Owners of private catchments found to be contaminated are sent a personalized letter suggesting methods for quality improvement. Fees for business and private catchment evaluations, which are only performed on request, are US$20 and $3, respectively.

Overall, the Water Quality Monitoring Program has been successful in both improving the quality of public drinking water in the two urban areas and raising public awareness of water quality issues during the period 1986–1991. Public waters now consistently meet USEPA standards. Contamination of private catchments and wells is still prevalent, however (RMIEPA 1991). Presently, nearly two-thirds of the program's operating costs are defrayed by payment from the Majuro Water and Sewer Company for daily monitoring of the public water system. There is also a perceived need to expand the capabilities of the two laboratories to include testing of soils and marine organisms for contamination by various toxins. As laboratory equipment is expensive, the program's major constraint is funding.

Environmental sanitation program

Administered by the RMIEPA, the Environmental Sanitation Program focuses on eradicating disease vectors and performing inspections of restaurants, ships, school cafeterias, hospitals, public areas, and waste disposal facilities. Past community outreach efforts have included conducting food-handlers workshops for restaurant personnel, visiting outer atolls for sanitary inspections and pest control activities, and participating in various World Health Organization studies. The program presently employs four people on Majuro and one on Ebeye. Managed by the RMIEPA (under a Memorandum of Agreement with the Ministry of Health Services), but funded by the Ministry of Health Services, the program is presently suspended in "administrative limbo". Instead of being employees of the RMIEPA, the staff are employees of the Public Service Commission. Charged with the responsibility to manage the program, but lacking the power to hire, fire, promote, or make funding decisions, the RMIEPA management has, understandably, had a difficult time setting goals for the program and overseeing its daily activities.

Solid waste disposal monitoring program

Under the RMIEPA Solid Waste Disposal Monitoring Program, public and private landfills are issued permits, often subject to special restrictions, and monitored for compliance. Presently, the program is restricted to Majuro atoll, where the RMIEPA works closely with the Ministry of Public Works and the Majuro Atoll Local Government in the management of the public landfill at Rubar Weto. Plans to expand the program to Ebeye, where the landfill is in great need of design improvement (see Chapter 3, Section 3.2.2, "Solid waste accumulation"), have been hampered by staff shortages and financial limitations. Currently, only one staff member at RMIEPA is responsible for the Solid Waste Disposal Monitoring Program. This staff member also bears responsibility for hazardous waste management issues, which have increased in magnitude in recent years. The RMIEPA management has therefore made plans to create an additional position for better distribution of these responsibilities, pending available funds.

During the program's first five years of existence, landfill management has greatly improved on Majuro atoll. Whereas the landfill in operation in the early 1980s was completely open to the lagoon, the Rubar Weto landfill, which has been in operation since 1989, features a containment seawall made of gabions to contain the trash. Also, although frequent equipment failures and scarcity of fill material prevent coverage of the dumping zone each night, compaction is performed on a fairly regular basis. The Environmental Sanitation Program operates permanent fly traps at

the dump site which, although not effective in eradicating the pest problem, do help to reduce it. Design changes made pursuant to the RMIEPA permit help to drain the leachate which used to pool during low tide and emit foul odors. Although the RMIEPA has recommended aeration of the leachate as a possible alternative to drainage, this has been impossible without the necessary equipment. Despite these shortcomings, it should be noted that in 1991 a visiting World Health Organization consultant on solid waste management stated that the Majuro landfill is one of the best managed in the Pacific region.

Even so, solid waste management remains one of the primary environmental issues in the nation, ground litter and marine debris being virtually ubiquitous. The public landfill on Ebeye is not presently regulated, nor are garbage disposal facilities located on outer atolls. There is a need to expand the activities of the program in the area of public education, and to develop a formal program of hazardous waste management. Further staff training in both solid and hazardous waste management will be essential for program expansion and improvement.

Earthmoving monitoring program

Under the RMIEPA Earthmoving Monitoring Program, proposed earthmoving projects are evaluated and issued with permits which feature special restrictions when appropriate. Permit fees both for commercial and private earthmoving activities are $100. One component of the RMIEPA Earthmoving Regulations requires that any person engaged in earthmoving activities takes responsible measures to protect and preserve all historical and cultural resources that may be affected by the activity. During 1991, the Historic Preservation Office established separate permitting procedures to ensure that such conservation measures are carried out. A person or agency wishing to engage in earthmoving activities is now required to acquire permits from both agencies, completing two separate application processes.

During recent years, the effectiveness of the RMIEPA Earthmoving Monitoring Program has been hampered by frequent staff turnover, and a general lack of community acceptance of the relevant regulations. Enforcement of regulations remains a difficult problem. Landowners and developers often fail to see the merit in securing the required permits, choosing instead to move earth illicitly (see Chapter 3, Section 3.2.7, "Coastal erosion", for complete discussion). The RMIEPA staff member responsible for the earthmoving program requires advanced training in Environmental Impact Assessment to review permit applications adequately, create special restrictions and suggest project design modifications. For the past two years, the earthmoving specialist position has been frequently vacant. When it is filled, the specialist should work closely with the education program to increase public support for the program.

Public education program

The RMIEPA Public Education Program works to raise public awareness of national and local environmental issues, and frequently solicits public involvement in community cleanup efforts. Formerly executed by just one staff member, the program was expanded in late 1991 with the hiring of a second. During 1991, an environmental primer was developed for first through third graders, drawing on traditional stories to illustrate the importance of maintaining a healthy environment. Environmental videos developed by the program are occasionally aired on the public television station, addressing topics ranging from water catchment maintenance to abatement of coastal erosion. Stickers and posters with environmental messages have been distributed and are extremely popular. Also, the Public Education Officers regularly participate in a half-hour radio program, discussing current environmental concerns.

Considered by RMIEPA management to be of prime importance, the education program has been targeted for expansion during the next several years. Although

past efforts have met with marked success, certain areas require improvement. RMIEPA-sponsored clean-up days have been reasonably effective in reducing ground litter and raising community awareness of solid waste management issues, and the weekly radio broadcast has been effective in providing rudimentary environmental education. However, better coordination with other education-oriented agencies could improve the program's outreach and make more efficient use of available resources. Overall, a lack of direction plagues the program, with efforts often initiated in response to the availability of external funding rather than identified needs. Further training in the use of sophisticated media (such as video, television, and desktop publishing) in public opinion assessment methods and in the design of campaigns targeting specific groups of the population, would greatly enhance the program's effectiveness.

Toilet facilities permitting program

The Toilet Facilities Permitting Program, although legally established, is not presently operational. Within the RMIEPA, no enforcement unit specifically regulates toilet facilities or processes permits, although when toilet facilities permits are occasionally requested, they are processed by the Solid Waste Management Specialist, and inspections of toilet facilities are sometimes carried out by the Environmental Sanitation Officers. A well-designed education campaign is required to gain public support for this program once a staff member is designated to enforce the regulations.

Inadequate sewerage facilities in the urban areas are contributing to eutrophication problem and the spread of disease. The need for toilet facilities must be addressed. (photo: J.Connell)

4.1.2 *Marine resources authority*

Established as an independent statutory authority in 1988 with the passage of the MIMRA Act, the Marshall Islands Marine Resources Authority (MIMRA) is overseen by a five-member Board of Directors composed of three ex-officio members and two members appointed by the President. The Minister of Resources and Development serves as the Chairman of the Board. Daily activities of the MIMRA are managed and administered by a Director.

The overall mission of MIMRA is to develop, maintain, and protect the biological and physical marine resources of the Republic. Specific responsibilities assigned by the MIMRA Act include establishing and maintaining a fishing licensure system and a program for the surveillance of the Exclusive Economic Zone, establishing and enforcing marine resource conservation regulations and, with Cabinet approval, negotiating foreign fishing agreements on behalf of the Republic. Focusing its efforts in the areas of fisheries and mariculture development, MIMRA in late 1991 transferred the responsibility for surveillance of the Exclusive Economic Zone to the Office of the Attorney General, and the task of coordinating deep-sea mineral exploration to the Office of Planning and Statistics. The two responsi- bilities retained are to develop and conserve marine resources.

Although legally established in 1988, MIMRA is not yet fully operational; its Board does not regularly meet

and its programs are in infancy. Struggling to establish programs in artisanal fisheries and mariculture, the young agency has not yet fully assumed its resource management responsibilities. Conservation regulations pursuant to the MIMRA Act have yet to be drafted or enacted. Likewise, no provisions have been made for the establishment of marine parks, nor have provisions for resource monitoring and conservation been included in planned or ongoing artisanal fisheries development projects (see Chapter 3, Section 3.2.8, "Over-exploitation of renewable resources" for complete discussion). The export of aquarium fish, a rapidly expanding industry, also continues unregulated. However, vessels licensed to fish in the EEZ are required to transmit catch data by radio on a regular basis, which is submitted to the South Pacific Commission's fisheries monitoring program. Also, the recently transferred Surveillance Program is working to stop poachers and improve data on pelagic catches. Finally, certain activities of ongoing mariculture projects are aimed, at least in part, at compensating for past over-exploitation and at diminishing harvesting pressure by instituting the exploitation of cultivated stock.

EEZ surveillance program

Until the EEZ Surveillance Program's transfer to the Office of the Attorney General in late 1991, MIMRA operated three patrol boats. One of the boats was purchased in 1986, with funds from Section 216 (b) of the Compact Agreement and the second was supplied by the US Coast Guard in 1988. These two original vessels are no longer in commission. The Australian government delivered a third patrol boat in 1991, and technical advisors are currently training a totally Marshallese crew. As the program has been plagued by a lack of trained personnel in the past, this long-term training is expected to enhance greatly the future effectiveness of the program. Supplementary surveillance information is occasionally provided by the New Zealand Navy from P-3 Orion over-flights which detect surface vessels via radar and aerial sighting. The transfer of the program to the Office of the Attorney General is expected to strengthen the Surveillance Program's ability to prosecute violators. Indeed, apprehension of poachers has already shown a marked increase during the short time since the program's transfer.

Mariculture program

Thus far, the culturing of giant clams, considered to be endangered, has been the primary focus of mariculture efforts in the Marshall Islands. Presently, Marshall Islands Aquaculture (MIA) Company operates a giant clam farm at Mili atoll under contract to MIMRA. The farm has been successfully spawning and raising giant clams in a protected bay since 1988, using original methods and solar-powered equipment developed to accommodate outer atoll settings. MIA also manages a landbased mariculture farm on Likiep atoll, under contract to MIMRA. During the Second Five Year Development Plan period, 1992–1996, juvenile clams from these farms will be provided to private farmers to raise on the reefs adjacent to their homes. This "sea ranching" concept is expected to diminish harvesting pressures on natural populations by providing fishermen with an alternate source of income, and by creating an economic incentive for resource conservation. A farmers cooperative will ensure that the participating clam farmers have access to markets once the clams are ready for harvest (ARP 1991; CTSA 1990).

The MIMRA mariculture farm at Likiep atoll also operates a trochus hatchery with the aim of restoring trade in trochus shells. Originally brought to the Marshall Islands during the Japanese occupation, trochus were heavily exploited for export and stocks were virtually obliterated by the mid-twentieth century. During the Second Five Year Development Plan period, 1992–1996, trochus spat from the farm will be made available to reseed suitable atolls. As with the "sea ranching" of giant clams, the seeding of reefs

with trochus is expected to help re-establish wild populations, reduce harvesting pressure on remaining natural populations, and create economic opportunity for outer atolls. During 1989 trochus shell exports from Enewetak, the only atoll where substantial populations of trochus still exist, totaled approximately 155 metric tons, generating $520,000 in revenue (OPS 1991c). Operating budgets of most local governments are about one-tenth of this amount. This valuable marine resource is seen as a potential replacement for copra as the economic mainstay of the outer atolls.

MIMRA is also engaged in developing technology for the cultivation of black-lip pearl oysters. In 1984, a black-lip pearl oyster mariculture project was initiated on Arno atoll, with disappointing results. Subsequent evaluation of reef and current conditions indicated that Namdrik atoll might be more suitable for black-lip pearl oyster cultivation. In 1990, a pilot project on Namdrik atoll, executed by MIMRA with United Nations assistance, established facilities to rear 10,000 oyster spat (Dashwood 1991). Although the Namdrik lagoon proved too deep to support extensive cultivation, the oysters which have already been strung to the cultivation stands appear to be thriving. The first harvest is expected in 1994. If the project is successful, MIMRA plans to provide seedlings from the Namdrik farm to other suitable atolls during the Second Five Year Development Plan Period, 1992–1996.

To supplement and enhance the activities of the existing giant clam and trochus farms, MIMRA is in the process of establishing a Mariculture Demonstration Center on Likiep atoll. Other species of potential research and development interest include oysters, sea cucumbers, seaweed, sponges and algae. The center will demonstrate current commercial mariculture technology and provide facilities for research and development. Training seminars for mariculture farmers are planned as well (OPS 1991c).

4.2 Other programs & projects

4.2.1 *Rural sanitation project*

The goal of the Rural Sanitation Project (RSP) is to raise rural sanitation standards by providing outer atoll households with water-seal toilets and water catchments. Funded by the United States Environmental Protection Agency and administered by the Marshall Islands Development Authority, the project began in 1988 on Arno atoll. Following completion of Arno atoll in 1991, the project moved to Ailinglaplap atoll, where over a hundred households have already been serviced (Laupepa 1991).

The Rural Sanitation Project has improved sanitary conditions on Arno atoll. Community involvement has been a key aspect of the program's success. Living on Arno during construction, the Project Director taught several local people how to build toilets and catchments, eventually appointing them supervisors of construction. On Arno atoll 256 toilets and 252 water catchments were completed with construction overseen by four local supervisors (Laupepa 1990). Similar arrangements have been made on Ailinglaplap, where the project is now underway (Laupepa 1991).

4.2.2 *Sea level rise vulnerability case study*

A case study designed to evaluate the vulnerability of Majuro atoll to potential sea level rise is presently being jointly conducted by the RMIEPA and the Office of Planning and Statistics, in accordance with the common methodology for vulnerability assessment developed by the Intergovernmental Panel on Climate Change (IPCC). The study seeks to determine the physical, ecological and socioeconomic impacts of sea level rise as projected by the IPCC (30–100 cm during the next 100 years). Computer models taking into account such factors as wave run-up, still-water rise, and bathymetry are being used to quantitatively predict physical impacts. Funding for the study has been provided by the National Oceanic and Atmo-

Sea level rise studies are being conducted to investigate the physical, ecological, and socio-economic impacts on Majuro atoll. (photo: J. Connell)

spheric Administration (NOAA) and SPREP has assisted with coordination of the study. Response strategies will be developed as the culmination of the study, and the final report has been prepared (Crawford et al.1992).

4.2.3 *Laura Water Lens Project*

Funded by the US Environmental Protection Agency and implemented by the Capital Improvements Project, the aim of the Laura Water Lens Project is to increase access to the water lens and improve sanitation in Laura, a settlement at the western-most tip of Majuro atoll. Ultimately, the Laura lens is expected to deliver approximately 400,000 gallons of fresh water per day although present yield is just over 200,000 gallons per day. The project is also engaged in building water-seal toilets for each household in Laura.

Lack of oversight and poor engineering design have plagued the Laura Water Lens Project. As a result, there is currently a risk of water lens contamination. Although the toilet facilities under construction utilize septic tanks, the preliminary surveys failed to take note of elevations. In some cases, the septic tanks have been placed at a lower elevation than the septic fields, preventing gravity flow and threatening lens contamination (Barber 1991, personal communication). In late 1991, the United States Environmental Protection Agency sent a specialist to evaluate the problems and develop a plan of action.

4.3 Private sector responses

4.3.1 *Women United Together in the Marshall Islands (WUTMI)*

Women's groups, active in virtually every community, have been instrumental in promoting conservation of the Marshallese culture and in finding solutions to the public health and social problems affecting their communities. For example, women's groups were integral to the marked improvement in solid waste collection which has been achieved on Ebeye over the past several years.

Women United Together in the Marshall Islands (WUTMI), a private sector coalition of numerous women's groups operating in the Marshall Islands, plays a critical organizational role in these efforts, and in efforts directed toward increasing involvement of women in development activities and national decision making. WUTMI has played a crucial role in the development of the draft National Women's Policy, addressing issues as wide-ranging as access to loans and expansion of women's opportunities in the Marshall Islands. The major constraints of WUTMI, and the women's groups which it represents, are inadequate funding and organization (WUTMI 1991).

4.3.2 *Cans for Kids Program*

The Cans for Kids Program, begun in 1988, is administered by Majuro's Cooperative Elementary School, and five other private schools participate in the program. With diminishing Compact funds for education, recycling the 7 million aluminum cans imported to the Republic each year was seen as a potential source of funds for needed school supplies and textbooks. During its three years of existence, however, the Cans For Kids Program has met with only limited success. The program's primary limitation has been its lack of financial incentive. Cans were not purchased by the program until late 1991, and community support for the project has been limited as a

result. Another limitation of the program has been the inability to crush the cans to a density which makes shipping costs affordable. A small can-crusher donated by the Steinlager Brewery in late 1991 is expected to remedy this problem. With both of its major constraints recently overcome, the effectiveness of the program is expected to increase dramatically over the next several years.

4.4 Legislative responses

4.4.1 *Protecting the natural environment*

Within the context of the Pacific region, legislation regulating environmental quality and resource utilization is well developed in the Marshall Islands. Although certain provisions for the conservation of renewable resources have been made, one major deficiency in the current environmental legislation is the absence of provisions for establishing a national nature park system. On the whole, however, it is the coordination, implementation and enforcement of existing legislation that is critically important to environmental management efforts today. Existing legislation relating to the environmental issues discussed in Chapter 3 is briefly discussed below.

National Environmental Protection Act, 1984

The 1984 National Environment Protection Act (NEPA) established the Republic of the Marshall Islands Environmental Protection Authority (RMIEPA) as an independent statutory authority. The defined objectives of the RMIEPA include:

1) regulating individual and communal activities to ensure the maintenance of safe, healthful, and aesthetically pleasing surroundings,
2) preventing environmental degradation,
3) monitoring the impact of human activities on natural resources, and
4) preserving important historical, cultural and natural aspects of the nation's heritage.

Under NEPA, all major government projects are required to include an Environmental Impact Statement in their feasibility studies; in practice these assessments rarely occur. The RMIEPA is granted the power to create and enforce regulations in order to achieve the stated objectives. NEPA retains all Trust Territory environmental regulations until such time as they are revoked, modified, or superseded.

Pursuant to NEPA, regulations governing solid waste management, toilet facilities, sewage disposal and

The Pandanus is one of the Marshall Islands principal crops and also characteristic of the natural beauty of the atolls.
(photo: J. Connell)

earthmoving have been enacted by the RMIEPA. Modified Trust Territory regulations covering pesticide usage, air pollution, and marine water quality are presently in draft form, and are expected to be enacted in 1992. A permitting system has been established for each of the three sets of regulations—monitoring solid waste disposal facilities, toilet facilities, and earthmoving. These permitting systems are administered by the RMIEPA. (See Section 4.1.1, above for further details.)

Effectiveness of enforcement notwithstanding, the regulations which have been enacted pursuant to the NEPA have, in general, provided appropriate regulatory authority. One exception to this involves the current earthmoving regulations which have been widely criticized by the agricultural community and private landowners as being too rigid and unrealistic. These regulations may require review in light of the traditional land tenure system. Also, a public education campaign should be launched to raise public understanding of the regulations. For instance, although agricultural activities are largely exempt from permit requirements, farmers offer some of the staunchest resistance to the regulations, possibly reflecting simple misunderstanding.

Coast Conservation Act, 1988

The 1988 Coast Conservation Act (CCA) calls for planning, monitoring, and controlling the development of the coastal zone. The Act directs the RMIEPA to:

1) survey the resources and uses of the coastal zone,
2) prepare a coastal zone management plan to regulate and control development activities within the zone, and
3) develop and implement plans for coastal resource conservation.

The Act also provides for the establishment of an Environmental Impact Assessment program at the RMIEPA. Within three years of the Act's passage (the deadline was the end of 1991), the Director of Coast Conservation (the General Manager of the RMIEPA) is required to submit a comprehensive coastal zone management (CZM) plan. Although the deadline is past, development of the plan has yet to begin, and subsidiary regulations delineating requirements for Environmental Impact Assessment have yet to be enacted. Nonetheless, development of a CZM Plan has been established as a high priority in the RMIEPA Five Year Development Plan (OPS 1991c), and subsidiary regulations to the CCA delineating requirements for EIA are currently in draft form.

Draft Alternate Environmental Standards for United States Army Facility, Kwajalein Atoll (USAKA), 1992

Under Title One, Article VI of the Compact of Free Association, the United States is obligated to apply environmental standards to its activities in the Marshall Islands (USPL 99-239). These standards must be substantively similar to a number of pertinent US statutes. Section 161(a)(4) of the Compact specifically requires the United States, in cooperation with the Marshall Islands, to develop alternate, judicially-reviewable standards and procedures to regulate its activities in the Marshall Islands. A first draft of the alternate standards were negotiated during fiscal year 1990 by representatives from the RMIEPA and several US agencies. Expected to be finalized in 1992, the regulations feature a streamlined approach to permitting procedures, which grants the RMIEPA certain project review rights.

Marshall Islands Marine Resources Authority Act (MIMRA Act), 1988

The MIMRA Act of 1988 established the Marshall Islands Marine Resources Authority to coordinate and regulate the exploration, exploitation, and management of biological and physical resources. Prohibiting the use of fishing techniques which significantly

damage reef ecosystems, such as the use of dynamite or chemicals, the Act defines standards for fishing equipment and prohibits foreign fishing vessels from fishing within the EEZ without appropriate licensure. Marine resource conservation regulations pursuant to the Act have not yet been drafted. (See Section 4.1.2, above, for related details.)

Marine Resources (Trochus) Act, 1983

The Trochus Act of 1983 regulates the harvesting of trochus, establishing a licensing and permitting system and defining a harvest season.

Marine Resources Act, TTPI Code

The Marine Resources Act originates from preceding Trust Territory Code. The Act prohibits both the killing of turtles on land and the collection of their eggs, sets minimum ocean-capture size limits, and establishes seasonal capture quotas. Limits for the harvesting of cultivated sponges and black-lip pearl oysters are also defined.

Endangered Species Act, TTPI Code

The Endangered Species Act of 1975 protects certain species of plants and animals deemed to be endangered. The Act prohibits harvesting, possessing, selling or exporting any threatened or endangered plant or animal species. The endangered species list of the Trust Territory (1976) was adopted for this purpose and has not yet been updated. The importation of exotic fauna and flora is regulated by a permitting system and punishments for violation of the Act are defined. The Marshall Islands is not a signatory to the Convention on the International Trade in Endangered Species.

4.4.2 *Reducing population growth rate*

National Population Policy, 1990

The National Population Policy of 1991 examines the potential economic, social, and environmental ramifications of continued rapid population growth and urbanization (OPS 1991b). Projections are made for three scenarios:

1) a continuation of the present growth rate (4.2 per cent per annum),
2) a moderate decrease in growth rate (to 3.6 per cent per annum), and
3) a marked decrease in growth rate (to 3.4 per cent per annum).

It is concluded that the moderate-rate scenario would most effectively facilitate long-term sustainable economic development in the Marshall Islands, resulting in both a lower ratio of dependency (ratio of dependents, age 0–14, to members of the work force, age 15–64), and a reasonable labor force growth rate. The policy targets the increased usage of birth control and the achievement of "spatially integrated development" at the national level.

As set forth in the Policy, "spatially integrated development" aims to mitigate urbanization by increasing economic opportunity and access to educational and social amenities on outer atolls. In accordance with the National Population Policy, the Second Five Year Development Plan, 1992–1996, emphasizes the development of the outer atolls, programming a total of $55 million for outer atoll development projects (an increase of nearly eightfold since the First Five Year Development Plan). The establishment of an efficient transportation and communication infrastructure linking local, regional and national markets is the key objective of the "spatially integrated development" strategy.

The proposed transportation and communication network classifies the atolls of the Republic into "urban centers", "regional centers", and "local areas". The urban centers, Majuro and Ebeye, are designated as the links to world markets and the suppliers of tertiary health and social services. Jaluit and Wedge, the designated regional centers, are to be the centers of regional marketing networks and the suppliers of

secondary health and social services. The remaining outer atolls, designated as "local areas", are targeted for agriculture, fisheries and mariculture development, and for the provision of primary healthcare and social services. This "spatially integrated development" is expected to foster a "more desirable population distribution", as well as a more complete utilization of outer atoll resources to support and sustain national development.

Implementation of the National Population Policy, which establishes the national "age of consent" at 16 and the "minimum legal age of marriage" at 18, will be overseen by a special Population and Development Unit established in late 1991 within the Office of Planning and Statistics (with support from the United Nations Fund for Population Activities and the Asian Development Bank). The unit will monitor the implementation of the National Population Policy during the Second Five Year Development Plan period, 1992–1996, working closely with existing agencies including the Family Planning Program within the Ministry of Health Services. Currently developing a comprehensive family planning education strategy targeting youth, the Family Planning Program hopes to ensure that, by 1995, at least 60 per cent of sexually active men and women will be using some form of birth control (Andrike et al. 1991).

With the passage of the National Population Policy in late 1990, the national government formally recognized the importance of population-related problems. As the Policy has only recently been enacted, it is impossible to evaluate its effectiveness yet. However, two possible constraints to its implementation can be anticipated. First, a lack of awareness of population issues at the community level must be overcome. As mentioned above, the Family Planning Program has targeted public education programs specifically directed towards increasing contraceptive use. The implantation of the long-term Norplant contraceptive device to delay first pregnancy past the teen years is being emphasized, and the results thus far are encouraging. Ultimately, however, the enlistment of support from churches and women's groups will be essential. Second, inadequacies in interagency coordination must be overcome. The policy of "spatially integrated development" requires the cooperation of the transportation, communication, fisheries and agriculture sectors in supporting the development of regional centers. At present, however, the precepts of the Population Policy are not well understood within these sectors.

Draft National Children's Plan of Action, 1991

The Draft National Children's Plan of Action addresses social, educational, environmental and health issues relating to children, within the context of rapid population growth. The plan calls for the Ministry of Health to promote family planning in the Republic by providing education and making contraceptives readily available to community members. Specifically, the Ministry of Education is called upon to emphasize primary education, and to introduce a cultural education program at all grade levels. In addition, the government is expected to enhance the environment of the child by:

1) endeavoring to provide safe drinking water to all,
2) establishing consumer protection measures,
3) improving sanitation standards by providing intensive community education and ensuring proper waste disposal, and
4) providing safe and adequate recreational facilities (RMI 1991f).

4.4.3 Developing human resources

Scholarship Assistance Act, 1986

The Scholarship Assistance Act assigns to the Marshall Islands Scholarship, Grant, and Loan Board the responsibility for appropriating scholarship funds (RMI 1986). Since the majority of these funds are provided under the Compact, they must be used at institutions

within the United States or Micronesia. Periodically publishing a list of priority areas for funding, the Board reviews applications and awards scholarships in accordance with stated national educational goals, policies, and affirmative action initiatives. Several areas related to environmental management were added to the list in 1991 at the suggestion of the RMIEPA.

Upon graduating, recipients are obligated to return and work in the Marshall Islands for a minimum of two years. Many Marshallese students have been sent to the United States to attend college via this scholarship program. Unfortunately, a significant number of these students have failed to complete college degrees. And, although the Act stipulates that all recipients of educational aid must return to the Republic to work, many students have chosen to remain in the United States after graduation. At present, no penalties for failing to return are delineated. On the other hand, no specific incentives such as guaranteed jobs or low-interest loans for first homes or offices are offered to encourage a graduate's return. High unemployment among urban youth may also be a factor which discourages return.

National Manpower Training Council Act, 1991

The 1991 National Manpower Training Council Act establishes a National Manpower Training Council, with representatives from the Office of Planning and Statistics, and the Ministries of Health Services and Social Services, and Education (RMI 1991e). The purpose of the Council is to coordinate the development of human resource training programs with the needs of the private and public sectors. Training needs have already been identified by the Committee on Vocational Training and Manpower—a special committee created in 1990 by Cabinet and since dissolved by the National Manpower Training Act. The Council will be responsible for establishing national trade testing and certification programs as well as education programs.

Industries Development Act, 1981

The Industries Development Act of 1981 establishes a Manpower Training Program administered by a Board of Supervisors comprising high-level representatives from the Ministries of Resources and Development, Public Works, and Education (RMI 1981). Using monies provided by the Nitijela, the primary legislative house of the Republic, the Manpower Training Program aims to increase the pool of skilled human resources by developing short-term training programs for youth in targeted vocational areas. During the past several years, the program has operated only sporadically. Youth training programs available under the Compact of Free Association have largely filled the gap.

Draft National Women's Policy, 1991

The Women United Together in the Marshall Islands (WUTMI) coalition, and the Women's Interest Office of the Ministry of Social Services are in the process of developing a National Women's Policy (RMI 1991d). The draft policy establishes the goal of increased involvement of women in development, emphasizing the role of the private sector women's groups in meeting training and public education needs, and in lobbying for women's issues. Targeting increased educational and professional opportunities for women, the draft Policy outlines several implementation steps. The policy will be finalized and submitted to the national government for consideration in early 1992.

Future priorities for strengthening environmental management capabilities

Future priorities for strengthening environmental management capabilities are discussed in this chapter, under the headings of five Program areas. These priorities took form from informal and formal discussions and debates held by the Task Force on Environmental Management and Sustainable Development over the period 1990–1992. An overview of the five Program areas is presented in the beginning portion of this chapter and a more detailed discussion of the future priorities follows.The priorities described herein served as the basis for the discussion at the National Seminar on Environmental Management and Sustainable Development (held in Majuro, October 9–11, 1991), and for the formulation of the strategies and programs contained in NEMS Part B: Action Strategy for Strengthening Environmental Management, 1992–1996. (See NEMS Part B for detailed descriptions, including cost estimates for numerous programs and of activities planned for the period 1992–1996.)

5.1 Overview of program areas & priorities

5.1.1 *Program area I* Maintaining clean water, land & air

Priorities

- Protecting fresh and marine water quality and promoting the wise management of water resources.
- Improving solid and hazardous waste management systems at the community level.
- Maintaining clean air.

5.1.2 *Program area II* Conserving renewable resources

Priorities

- Managing renewable resources for sustainability.
- Enabling informed decision making by providing timely, accurate and accessible information regarding status and abundance of natural resources.

5.1.3 *Program area III* Ensuring environmentally sensitive decision making

Priorities

- Fostering a partnership between development and environment sectors.
- Developing environmental management capabilities.
- Increasing community awareness of environmental issues.

5.1.4 *Program area IV* Protecting special spaces & species

Priorities

- Establishing a national nature park system.
- Conserving the nation's biodiversity.
- Preserving the nation's cultural identity.

5.1.5 *Program area V* Minimizing the impact of environmental emergencies

Priorities

- Supporting regional and global initiatives to stabilize, and ultimately reduce, greenhouse gas emissions.
- Ensuring that environmental emergencies are met with well coordinated and prepared responses.

5.2 Discussion of priorities by program area

Specific priorities for strengthening environmental management capabilities are briefly described below, within the framework of the five Program areas just outlined.

5.2.1 *Program area 1* Maintaining clean water, land & air

Improving water quality

Coastal Water

Pursuant to the Coast Conservation Act 1988, the RMIEPA should develop a coastal zone management plan, with attendant regulations prescribing categories of development activities within coastal zones, and restricting certain coastal zone activities. The RMIEPA should work closely with other relevant agencies to ensure that the final product is both practical and enforceable. These regulations should facilitate the establishment of Environmental Impact Assessment procedures which minimize "red tape" through the use of an initial screening mechanism to separate projects likely to have major environmental impacts, and thus necessitating comprehensive EIA, and those projected to have only minor impacts, and thus necessitating only a simple project review. Specific EIA procedures should be developed as an interagency process which emphasizes a consistent, thorough review process.

The coastal zone management (CZM) plan must encompass a number of sensitive areas. Master plans for the extraction of construction materials in urban and regional areas should be incorporated into the plan, delineating appropriate locating of dredging and sandmining operations. Well defined requirements for reef blasting and stipulations for charge placement techniques to contain blasts and minimize damage to surrounding reef ecosystems should also be defined. The CZM Plan should capitalize on the strengths of the land tenure system wherever possible.

A feasibility study should be undertaken immediately to determine possible design improvements for Majuro's system of landfilled causeways. This study should evaluate the potential for restoring the natural current patterns and nutrient flows by various

means including the construction of bridges and culverts. In addition, sewerage hookups should be installed at the docks on Majuro and Ebeye, allowing ships to access the public sewer systems. A fee charged for this service could be used to defray costs associated with the monitoring of coastal waters.

In both urban centers, the adequacy of current sewerage outfalls requires re-evaluation in light of recent population growth and the planned expansion of the manufacturing sector. Two particular factors which could affect the future efficiency of the present systems are:

1) a planned fish cannery and transhipment facility which could greatly increase the quantity of waste-water effluent being discharged by the Majuro sewerage outfall, and
2) a planned causeway between Ebeye and Guegeegue islands which could compromise lagoonal flushing of the Ebeye outfall (located on the lagoon side of the island).

Following assessment of the potential effects of these developments, necessary outfall design changes should be made accordingly. An RMIEPA proposal made to the Asian Development Bank in 1991 already calls for short-term technical assistance to conduct such a study.

Fresh water

Increasing the present water collection and storage capacities of both rural and urban areas is required. The expansion of water storage capacities in the two urban areas represents the most pressing need. A twenty-four hour water supply would help alleviate many of the public health problems associated with the use of private pumps during off hours, and with alternative water sources including private catchments and wells. A feasibility study to evaluate the construction of an alternate water source such as a desalination plant, an Ocean-Thermal Energy Conversion (OTEC) unit, or a system of floating water

In rural and urban areas alike, rainwater is a major source of water. Here, a modern catchment is outfitted for proper cleaning, so that water quality can be maintained. (photo: RMIEPA)

catchments, should be undertaken immediately. Provisions should also be made for minimizing the effects of accidental contamination of the existing water catchment by aviation fuel and oil spills.

In rural areas, there is a critical need to install hand pumps for accessing ground wells, and to construct adequate covers for well openings. Support for projects such as the Rural Sanitation Project, which use local labor to build catchments and toilet facilities, should be increased. Finally, the present $25 toilet permit fee should be re-evaluated, as it may be discouraging homeowners from permit acquisition and toilet construction. Toilets should be built and maintained in all schools, and equipment to empty septic tanks should be purchased.

The passage of local building codes to define minimum standards for plumbing would help alleviate the problems associated with inadequate toilet and water facilities in urban areas. Construction of water catchments utilizing hazardous materials such as lead-based paints should be disallowed. Zoning ordinances which define minimum distances between septic tanks, animal pens, and ground wells should be established for Majuro, Ebeye, Jaluit, and Wedge immediately.

Improving solid & hazardous waste management

Solid waste management plans should be formulated at the community level for Majuro, Ebeye, Jaluit, and Wedge. The efficiency of the current collection system in Majuro must be improved. First, suitable trucks and collection containers are needed. Recycling, wherever feasible, should be seriously pursued. The present Majuro landfill is adequate but requires two minor revisions. First, the timely provision of needed fill materials must be assured to allow prompt coverage and compaction of deposited wastes. Second, adequate equipment backup must be available to compensate for equipment breakdowns which frequently obstruct the compaction and coverage processes. The Ebeye dump site requires a containment system such as the gabions used on Majuro to prevent the egress of deposited solid wastes into the ocean. At both disposal sites, personnel should be assigned to prevent children from playing and scavenging in dumping areas.

The landfill permitting and monitoring activities of the RMIEPA's solid waste management program should be expanded to include Ebeye, Jaluit, and Wedge. Expansion to Ebeye is required immediately. As development continues and the population grows, it will also become of pressing importance to monitor landfills of regional centers such as Jaluit and Wedge. Local assembly of gabions, the plastic-coated wire-cages used to reinforce landfills, should be pursued as a method of reducing solid waste management costs while creating jobs.

In order to reduce the waste stream, the RMIEPA should work closely with community leaders and the existing Cans For Kids Program (see Chapter 4, Section 4.3.2, "Cans for Kids Program") to establish strong aluminum recycling programs for both urban centers. Over seven million aluminum cans are imported into the Republic each year. Recycling these cans would significantly reduce ground litter and marine debris. The passage of local ordinances requiring a mandatory deposit to be included in the sale price of all beverages packaged in aluminum cans would provide needed financial incentive for recycling. With a designated redemption value, fewer cans would be found littering the ground and cluttering coral reefs. In 1991 the RMIEPA requested funding from the South Pacific Regional Environment Programme (SPREP) to help purchase an aluminum can crusher and establish a large-scale recycling program. Local ordinances restricting the use of plastic grocery bags should also be considered as so many of them find their way into the lagoon and ocean. The feasibility of developing recycling programs for oil and automobile batteries also requires investigation.

Since an estimated 40–50 per cent of urban solid waste entering our limited landfills is biodegradable, a community composting facility would be an effective means of reducing the waste stream. A proposal to the Majuro Local Government for the development of a central composting facility was made by RMIEPA in 1991 but no program has yet begun. The benefits of such a composting program would be wide ranging. First, a reduction in solid waste requiring disposal by the over-burdened conventional system would help improve the efficiency of collecting and disposing of the remaining non-biodegradable wastes. Second, less organic matter would find its way into coastal waters, and thus problems associated with eutrophication would be reduced. Finally, a readily available source of nutrient-rich soil would encourage development of subsistence farming activities, indirectly reducing foodstuff importation and improving household nutrition. Beyond subsistence usage, the produce grown could readily be sold to urban markets, augmenting household incomes.

A formal study to define hazardous waste disposal technologies appropriate to the Marshall Islands setting is needed, followed by procurement of equipment and construction of facilities as deemed necessary. Specially designated storage containers should be placed at appropriate sites where such materials as used oil, expended batteries, infectious hospital

wastes, and other hazardous lab/industrial byproducts are generated. Procedures for the handling, transporting, and disposing of these hazardous wastes require development and personnel training. Opportunities for regional sharing of information and resources should be investigated. Pooling of resources for the acquisition of facilities, equipment, and training would be cost-efficient, and would have the additional benefit of fostering cooperation and interdependence within the Pacific region.

Improving air quality

The incinerators used at both urban health centers require renovations to reduce the volume of noxious fumes which are emitted.

5.2.2 *Program area II* ***Conserving renewable resources***

Marine resources

Regulations defining procedures for marine resource conservation including aquarium fish harvesting techniques, reef rotation schedules, and organism quotas are needed. The principles of resource conservation should be incorporated into all MIMRA artisanal fisheries development projects including those funded by foreign donors. A baseline marine stock assessment should be undertaken for those atolls targeted for reef fisheries development. The surveys should not stop with a one-off inventory of resources, but should be incorporated into the project as ongoing, low-technology, monitoring activities. Information from this continuous evaluation of resource condition and abundance should be stored and regularly updated in a computerized database, which can be quickly accessed by a management information system. Such a database would facilitate insightful management and conservation of marine resources.

A reorganization of MIMRA is planned during 1992. Technical assistance and funding from the Asian Development Bank has been secured to install a "Project Management Unit" orientation within the agency. Proposed staff will include a Director, a Finance Officer, and a Fisheries Officer. The Director will oversee all ADB-funded projects and evaluate all proposed commercial and industrial fishing projects including foreign, domestic and joint ventures. The Finance Officer will be responsible for maintaining all financial records of the unit. The Fisheries Officer will be responsible for regulating fisheries activities and collecting relevant statistics. In cooperation with RMIEPA, the Project Management Unit should emphasize Environmental Impact Assessment as a primary factor in considering proposed projects.

With increasing emphasis placed on rural renewable marine resource development, a system for providing

trained fisheries extension agents to atolls with mariculture and fishery projects will be needed. These extension agents should assist the various local communities in the management of artisanal fisheries, as well as giant clam, trochus, and oyster mariculture projects. Effective yet low-technology stock inventory methodologies should be taught to local mariculture farmers. Training of fisheries extension agents and community members alike could be enhanced by coordinating with the Mariculture Demonstration Center on Likiep atoll, the College of the Marshall Islands, the vocational training program of the Office of Planning & Statistics, the University of the South Pacific and the University of Guam.

Efforts aimed at enhancing efficiencies of intermodal transportation of mariculture and fishery products, and expanding local and international markets for these products, must be intensified to meet increasing production capacities. The Asian Development Bank has agreed to fund a study designed to help identify problems associated with the current inter-island transportation system, and to suggest ways of improving this system. This study is tentatively planned for late 1992.

Land resources

To conserve valuable soil, current rural agricultural extension agents (primarily trained in agroforestry) of the Ministry of Resources and Development will require additional training in the areas of composting, soil conservation, hydroponics, and small-scale gardening techniques. Excess produce from community agricultural programs could be transported to urban centers for sale, thereby helping to compensate for dwindling copra incomes. However, enforcement of quarantine regulations must be improved if commercial produce enterprises are to be developed.

5.2.3 *Program area III* ***Ensuring environmentally responsible decision making***

Improving interagency coordination

Environmentally responsible decision making will grow from a strong partnership between the development and environment sectors. As discussed previously, the RMIEPA should work to establish a strong, interactive, problem-solving role with respect to development. A representative from the environment sector should be included on major development and planning boards, and the details of projects under consideration should be freely shared.

It is essential that the RMIEPA seek long-term technical assistance in the area of Environmental Impact Assessment (EIA). An environmental engineering consultant should be based at the RMIEPA for at least one year to evaluate and upgrade the earthmoving, solid waste management, and toilet facilities enforcement programs. Staff require training in EIA processes and in methods of mitigating environmental impacts. In addition, the earthmoving regulations presently in effect should be evaluated in the interest of better alignment with the land tenure system.

Strengthening public education programs

Strengthening of the RMIEPA public education program is necessary to meet present environmental challenges. Efforts directed towards reducing littering and illegal dumping should be stepped up. An aggressive campaign to encourage recycling and to reduce the use of plastics and disposable diapers should be launched. The creation of a campaign mascot and slogan (similar in concept to the US "Woodsy the Owl" motto —"Give a hoot, don't pollute"), would help to promote environmental education programs oriented toward school children.

Education programs aimed at improving sanitation

through the control of disease vectors and the maintenance of water catchments should be increased, utilizing a wider range of communication media. Along these lines, the South Pacific Regional Environment Programme (SPREP) has agreed to publish a pamphlet currently being written by RMIEPA staff on the subject of water catchment maintenance. The pamphlet will be published in Marshallese and widely distributed to rural and urban communities. On outer atolls, workshops concerning the proper construction of septic tanks should be held periodically. The program should coordinate its community outreach programs with the activities of community action groups to make more efficient use of resources.

Present RMIEPA facilities for public education are inadequate; a well-equipped media center is a critical need. Where necessary, technical assistance should also be sought to train RMIEPA staff in such activities as desktop publishing, camera-ready layout, video editing and dubbing, underwater photography, and public speaking. Necessary equipment including video and underwater cameras should be purchased. The RMIEPA submitted a request to the Asian Development Bank in 1991 for short-term provision of a public education consultant to evaluate and upgrade the existing RMIEPA public education program during fiscal year 1992–1993.

Developing human resources

Efforts at human resource development should be aimed at encouraging the return of recently graduated Marshallese. An incentive program including low-interest loans or grants for returning graduates to establish residences and/or offices within the Marshall Islands should be considered. In addition, cooperative interaction between regional educational institutions such as the University of the South Pacific and University of Guam where the Pacific culture is pervasive, would provide alternative collegiate educational opportunities to prospective students and possibly lead to a higher rate of graduate return. At the same time, methods of enforcing the mandatory return-work agreements with students must be investigated.

Environmental education should be incorporated into school curricula. Educational materials including lesson plans and primers should be developed jointly by the RMIEPA and the Ministry of Education. Lessons which teach Marshallese language and cultural heritage should be developed in consultation with the Alele Inc. and the Historic Preservation Office. The in-service teacher training program operated by the College of the Marshall Islands should be expanded to include essential training in environmental education utilizing the environmental lesson plans. In general, more emphasis is needed on teaching basic science principles beginning with primary education curricula. With SPREP assistance, the RMIEPA has scheduled an environmental education curriculum workshop for elementary and high school teachers for mid 1992.

5.2.4 *Program area IV*
Protecting special spaces & species

Conserving biodiversity

National legislation establishing programs of protected areas management and species conservation is needed. Such legislation should be developed as the joint action of RMIEPA and MIMRA. Important turtle and seabird refuges on Bokaak, Bikar, and Taka should be protected. On a regional scale, the Republic should work closely with other Pacific Island nations to conserve valuable regional marine resources, including pelagic fisheries, sea mammals and sea turtles.

Conserving cultural identity

The Historic Preservation Office has already prioritized the development of both national and local Cultural Resource Management Plans, to be carried out during the Second Five Year Development Plan period, 1992–1996. These plans will identify issues relevant to the management of proposed development projects, including those related to tourism, mariculture and agriculture. Regulatory procedures for identifying, ranking, and protecting cultural and historic resources will also be established. Permitting procedures will monitor access to submerged historical resources, export of cultural/historical resources, and access to archeological sites.

Loss of traditional skills is an increasing concern as urbanization proceeds. (photo: Ministry of R&D)

5.2.5 *Program area V*
Minimizing impacts of environmental emergencies

Anticipating sea level rise

As a member of the United Nations and the Alliance of Small Island States (AOSIS), the Republic should be outspoken in the international arena on issues relating to sea level rise. Towards this end, active preparation for and follow up to the United Nations Conference on Environment and Development (held in June 1992 in Brazil), and in the Intergovernmental Negotiation Committee meetings, should be maintained. The Republic should also work to develop response strategies to projected sea level rise, in conformance with the Intergovernmental Panel on Climate Change (IPCC) common methodology for vulnerability assessment. Data pertinent to sea level rise should be freely shared with Pacific neighbors.

Anticipating catastrophe

As oil traffic has increased significantly in recent years, a contingency plan for a marine oil spill crisis is needed. This plan should define the cooperative interactions of ministerial sectors during a crisis. Cooperation with regional oilspill response arrangements should be emphasized. Oilspill response team members will require further training in the use and maintenance of modern cleanup equipment; training from the US Coast Guard should be pursued.

Specific Strategies and Programs which spring from the above Program Areas and Priorities are contained in NEMS Part B: Action Strategy for Strengthening Environmental Management, 1992–1996, the accompanying document. With oversight from the National Task Force on Environmental Management and Sustainable Development, the programs will be implemented during the time period of the Second Five Year Development Plan, 1992–1996.

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Additional environmental description

1 Climate

The only atoll for which complete weather data exists is Majuro, the nation's capital, where a US National Oceanic and Atmospheric Administration Weather Station is located. At 171°12 E and 7°09 N, Majuro is representative of the southern atolls, which feature two distinct seasons demarcated by changes in wind speeds and precipitation levels. During the "dry season", December through April, wind speeds average 12.7 miles per hour and average monthly rainfall is 7.6 inches. During the "wet season", May through November, average wind speed is 8.0 miles per hour, and average monthly rainfall is 12.1 inches (NOAA 1989b).

Daily temperatures recorded for both northern and southern atolls fluctuate between the high seventies and mid eighties with no seasonal variation. On Majuro atoll, the average temperature is 81°F, with a difference of approximately one degree between the coldest and hottest months. Ranging from a high of 83 per cent at night to a low of 76 per cent at noon, average relative humidity is high throughout the year for both northern and southern atolls. Although hot and moist, the climate is also sunny, since rain storms seldom last longer than a few hours. During 1989, Majuro received an average of 63 per cent of total possible sunshine (NOAA 1989b).

Major storms do not often impact the Marshall Islands, but typhoons and hurricanes frequently originate in the area, gathering strength as they move away from the equator. Prior to typhoons Zelda and Axel in 1992, the most recent typhoons to affect the Marshall Islands occurred in 1905 and 1918, and the nation has never experienced a tsunami. However, high wave action and ocean swells following hurricanes in other parts of the Pacific do occasionally impact the Marshall Islands, with devastating results. In December 1979, high ocean swells inundated urban Majuro for several hours, washing away land, homes and commercial buildings.

2 Soils

Four distinct soil types were described by Fosberg in his "Review of the Natural History of the Marshall Islands" (1990).[1] Fosberg's discussion of these four soil types is summarized below.

The soil most commonly found on the islets of the Marshall Islands lacks a series name. Consisting of almost pure white or pink coral sand, with no darkened A horizon nor any trace of a B deposition-horizon, it is found on beach ridges and dunes throughout the Republic. The youngest of all the soil types, it lacks most nutrient elements except calcium.

The **Shioya Series** is composed of slightly modified coral sand and small gravel, with a slightly darkened thin A horizon, and a circum-neutral reaction. The most common and least differentiated soil series in the Marshall Islands, this soil is light brown to grey in color, with sandy texture, and lacking any coherence or structure.

The **Arno Atoll Series** is the best developed common soil found in the Marshall Islands; the type location is Arno atoll. It features a friable, usually fine textured, A horizon, with a circum-neutral reaction. It is light brownish grey to buff in color, and is found in the interior of large, moist to wet islets.

The **Jemo Series** is a localized soil found under *Pisonia grandis* forests, where acidic humus accumulates faster than it decomposes. Characterized by a conspicuous A-O horizon of mor-like humus with an acidic reaction, the series features a notable but fragmented B horizon which is either a crumbly, phosphatic mixture of humus and coral sand or a hardpan of phosphatic rock, usually 2–8 inches thick. When present, the hardpan layer generally indicates that birds nest in the forest, depositing guano. Underlying the B horizon is a C horizon in transition to the parent material of sand or gravel. This relatively rich soil is found in various thicknesses of up to 12 inches.

[1] *For a more technical analysis of soil types found on Airik, Arno, Majuro, Mili and Taroa atolls, see Laird 1989.*

3 Terrestrial resources

3.1 Vegetation

3.1.1 *Mixed broadleaf forest*

Areas which have not been greatly disturbed by humans are most commonly characterized by mixed broadleaf forest of low to medium stature with a closed canopy. This forest is usually composed of a small number of tree species (*Tournefortia argentea, Guettarda speciosa, Pisonia grandis, Pandanus tectorius, Allophylus timoriensis, Cordia subcordata, Hernandia sonora*), a few shrubs (*Scaevola sericea, Suriana maritama, Pemphis acidula, Tournefortia*) and a layer of ground cover consisting of several species (*Lepturus repens, Thuarea involuta, Fimbristylis cymosa, Polypodium scoloprendria*). A few epiphytes are also present in the southernmost atolls (Taylor 1950; Hargreaves 1970).

3.1.2 *Monospecific forest*

Forests dominated by one species are extremely rare in the tropics. In the Marshall Islands where heat, surface salinity, and solar radiation are high and soil nutrients are low, such forests probably exist in response to the stressful conditions. But, in the case of *Neisosperma oppositifolia*, the mono-specific stands may actually be a final stage of succession. The ability of *Neisosperma* seedlings to survive in the dense shade of the mature trees may indicate that it succeeds the mixed broadleaf forest in some habitats. Several mono-specific forests occur in the Marshall Islands (Fosberg 1990; Thomas 1989):

- *Neisosperma* forests occur in the moist interiors of islets. The trunks of the trees are 4–12 inches in diameter. The crowns are dense and symmetrical, with large, dark green leaves. Thick stands of seedlings cover the ground under the forest. In spots where the canopy is chlorotic, a few shrubs such as *Allophyllus timoriensis* may grow.
- *Pisonia grandis* forests were probably once very common throughout the Marshall Islands, as suggested by the soil record. Semi-decomposed acidic leaf litter comprises a spongy layer of humus covering the ground under the forest. *Pisonia* wood is soft and brittle. Branches which fall to the ground during storms may take root if ground moisture is sufficient. Although *Pisonia* may reproduce by seed,

vegetative propagation seems to be more common. Probably once common in the Marshall Islands and throughout the Indo-Pacific region, *Pisonia* forest is now rare. Easy to clear, it provided fertile soils for coconut plantations.

- *Tournefortia argentea* forests occur in relatively dry habitats on narrow islets. In addition to being mono-specific, stands of *Tournefortia* are usually of a single generation. A pioneer of sand bars, denuded islets, and abandoned clearings, *Tournefortia* is usually replaced after one generation by mixed broadleaf forest.

3.1.3 *Shrubs & herbaceous plants*

Several species of shrubs typically grow along shorelines. *Pemphis acidula* often inhabits rocky shorelines near high energy wave environments. *Suriana maritama* and *Scaevola sericea* are located along sandy shores, and *Scaevola* dominates areas where storm action has recently destroyed previous vegetation (Bryan 1972; Fosberg 1952).

Herbaceous plants occur mainly under forests. On the dry northern atolls, however, stands of *Lepturus repens*, a bunch grass, cover large areas. An early pioneer of sand and gravel, its seeds are carried by water, wind or birds. *Boerhavia* is common on both shaded and exposed ground. *Tribulus terrestris*, sporting long runners and bright yellow flowers, is often associated with bird colonies. Other herbs common in open areas are *Tacca leontopetaloides* ("arrowroot") and *Portulaca*.

3.1.4 *Mangroves*

Limited stands of mangroves (*Bruguiera*) are found in swampy areas containing brackish water on several of the larger islands of the wet southern atolls (Stemmerman 1981). These stands were probably transplanted and cultivated by humans from other high islands in the Pacific. The plants had many traditional uses; the bark was used for dyes and the branches for eel traps (Spennemann & Lajuan 1990). *Rhizophora* also occurs in the Marshall Islands, but is usually found along shorelines.

3.2 Birds

According to Berger (1987a), the northern atolls provide nesting sites for many birds including the wedge-tailed, sooty and slender-billed shearwaters (*Puffinus pacificus, P. griseus, P. tenuirostris*), red-tailed and

white-tailed tropic birds (*Phaethon rubricauds* and *P. leturus*), red-footed and brown-footed boobies (*Sula sula rubripes, S. leucogaster*), great frigate bird (*Fregata minor*), gray-backed tern (*Sterna lunata*), sooty tern (*S. fuscata*), brown, black, and blue-gray noddies (*Anous stolidus, A. tenuirostris, Procelsterna cerulea*), and the white, black-naped, and crested terns (*Gygis alba, Sterna sumatrana, Thalassepus bergii*). In addition, several species of pelagic sea birds and waders migrate through the Marshall Islands, including numerous species of shorebirds which nest in the Arctic.

Thirty-nine species of land and freshwater birds inhabit the Marshall Islands for at least part of the year. Many land and freshwater birds can be seen migrating through the Marshall Islands including the long-tailed cuckoo (*Eudynamis taitensis*), a nesting bird from New Zealand. No endemic species and no passerine species are known for the Marshall Islands. Two native forest birds are extremely rare. In fact, the crimson-crowned fruit dove (*Ptilinopus porphyraceus*) is believed to be extinct, and the Micronesian pigeon (*Ducula oceania*) is classified as endangered. Also, the Wake rail (*Rallus wakensis*) which once occurred in the Marshall Islands is now believed extinct. Birds which have been introduced to the Marshall Islands include chickens, ducks, turkeys, quails and parrots.

3.3 Mammals

The twenty species of whales identified by Reese (1984) as present in the Marshall Islands include the blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), sei whale (*B. borealis*), minke whale (*B. acutorostrata*), killer whale (*Orcinus orca*), and short-finned pilot whale (*Globicephala macrorhynchus*). Berger also lists a number of dolphins including the bottlenose dolphin (*Tursiops truncatus*), the common dolphin (*Delphinus delphis*), and the spotted dolphin (*S. attenuata*). Other marine mammals such as seals and sea lions are not known to occur in the Marshall Islands.

Numerous mammals have been introduced to the Marshall Islands, and some have become feral. Domestic dogs (*Canis familiaris*), cats (*Felix catus*), goats (*Capra hircus*) and pigs (*Sus scrofa*) were first introduced to the Marshall Islands in the 19th century. The house mouse (*Mus musculus*), the Norway rat (*Rattus norvegicus*) and the roof rat (*Rattus rattus*) were introduced in the 20th century, when foreign contacts became more frequent. Pigs, dogs, cats and goats have become feral on some islets where human habitations have been abandoned. Feral dogs and cats have become common in urban areas as well.

3.4 Reptiles

The reptiles recorded on Enewetak (Lamberson 1984) were primarily geckos from the genera *Hemidactylus, Lepidodactylus*, and *Hemiphyllodactylus typus*, and *Gehyra*, and skinks from the genera *Emoia* and *Lipinia*. The Brahminy blind snake (*Remphotyphlops bramina*), a nocturnal, secretive burrower from Southeast Asia and the Philippines, was collected twice on Enewetak, but it is questionable whether a viable population exists there. According to Fisher (1948) and Marshall (1975), the monitor lizard (*Varanus indicus*) was introduced to the Marshall Islands by the Japanese as a rat catcher and possibly a food source. The monitor lizards feed on rats, land crabs and various marine life; specimens collected at Enewetak reached one meter in length. It is not known whether viable populations are still present. There is no recorded occurrence of amphibians or sea snakes in the Marshall Islands, although all five of the world's species of sea turtles are believed to occur in Marshallese waters. The northern atolls of Taongi (Bokaak) and Bikar have been identified as important breeding sites for turtles (Thomas 1989).

History & government structure

Environmental management issues are best understood and most appropriately addressed in the context of their historical, political and economic frameworks. A short review of the nation's history and governmental structure is presented below, as an adjunct to the discussion on economic trends contained in Chapter 2. It is hoped that this material will aid readers unfamiliar with the Marshall Islands in assimilating the remainder of the report, which focuses on current issues related to the management of natural and cultural resources.

1 History of the nation

Evidence suggests that the Marshall Islands were first inhabited by humans nearly 3,000 years ago (Craib 1983). Although little is known about these early settlers, it is believed that they subsisted as horticulturalists, with a heavy reliance on marine-resource exploitation (Spennemann, D.H.R.1991, pers. comm.). The first outsiders to visit the Marshall Islands, Spanish explorers of the Loaisa Expedition, landed on one of the northern atolls in 1526 AD. However, deeming the omnipresent coral reefs treacherous and the Marshallese people fierce, the Spanish, who regularly sailed galleons between Spain and the Philippines, steered clear of the archipelago for decades after this initial visit.

In 1767, Captain Wallis visited the northern atolls of Rongerik and Rongelap, and in 1788, British captains Thomas Gilbert and William Marshall explored the southern and central atolls of Mili, Arno, Majuro, Maleolap, Aur, Wedge and Erikub. Later, the Russian cartographer A. J. Krusenstern named the archipelago after Captain William Marshall. Russian Captain Otto von Kotzebue, exploring the northern Marshall Islands in 1816–1817 and again in 1824, wrote an extensive account of his discoveries, recording for the first time the Marshallese names for the two chains of the archipelago, "Ralik," and "Ratak", meaning "sunset" and "sunrise", respectively (Kotzebue 1930).

Only after whalers began visiting the atolls frequently in the early 19th century did a few traders slowly gain a foothold. By the late 1860s, several German companies including J. C. Godeffroy and Sons and A. Capelle and Co. had established regular trading stations on the southern atolls. After purchasing the archipelago from Spain and establishing a protectorate in 1885, the German government contracted the Jaluit Gesellschaft (Jaluit Company) — actually a syndicate of German trading companies which virtually monopolized trade in the region thereafter — to administer the Marshall Islands. Setting quotas which required each adult Marshallese to plant a certain number of coconut palms per month, the Gesellschaft established many of the coconut groves still present today. Copra quickly became the tax base and the main export of the Marshall Islands, with production reaching about 7,000 tons per annum by 1913.

While the Germans introduced economics, the Americans introduced Christianity. Many customs and traditions faded under the pressure of strict Protestant dogma of American missionaries arriving to establish churches in the mid to late 1800s. In particular, clothing was introduced, dancing abolished, and the use of local medicines discouraged (Hezel & Berg 1979).

With the start of World War I in 1914, Japan assumed control of Micronesia and the Marshall Islands. And when the League of Nations formally granted Japan control over the region at war's end, the Japanese proceeded to establish a large presence in the territory. By 1938, over 50 per cent of the population of Micronesia and nearly 15 per cent of that of the Marshall Islands constituted Japanese settlers. Administering the Marshall Islands as a district of Micronesia, Japan enforced a strict colonial policy stressing economic development, acculturation of the Marshallese to the Japanese way of life, and fortification of the atolls for military defense. By emphasizing the development of trade in copra, marine resources and handicrafts, the Japanese administration successfully fostered economic growth. An extensive, and relatively advanced, educational system was also established, and basic health standards were raised (Purcell 1967).

Japan began fortifying the Marshall Islands in the late 1930s. With the onset of World War II in 1941, Japan utilized several of the atolls as military bases, conscripting the Marshallese as farmers and laborers to support their military activities. Conditions worsened as the war continued and in 1943, when many Marshallese were being forced to work and food was scarce, the people of Mili atoll staged an uprising against the Japanese which was brutally suppressed. As forced labor continued, American forces attacked Japanese installations on several of the southern atolls. Finally, after a prolonged artillery barrage of Kwajalein atoll on February 4, 1944, American forces captured the Japanese headquarters, effectively ending the war in the Marshall Islands. By this time, however, living conditions in the Marshall Islands had deteriorated critically and economic activity come to a standstill.

The United Nations Strategic Trust of 1947 officially granted control of the Marshall Islands to the United States. Majuro was established as the new capital, and the US Navy continued to administer the islands until 1952, when responsibility was transferred to the Department of the Interior. Between 1946 and 1958, the United States government carried out 66 tests of nuclear devices on the northern atolls of Bikini and Enewetak. In 1954 the Bravo hydrogen bomb, over 1,000 times the magnitude of the bomb dropped on Hiroshima, was detonated on Bikini atoll. While the people of Bikini and nearby Enewetak had been evacuated, the people of downwind Rongelap and Utirik had not, and were thus exposed to large quantities of fallout. While the extent of contamination

in the years immediately following the nuclear tests varied among the four affected atolls, groundwater and soils were generally rendered too radioactive to support human life for some time.

Together with Palau, the Caroline and Marianas Islands, the Marshall Islands were administered by the United States as part of the Trust Territory of the Pacific Islands (TTPI). In October, 1986, the Compact of Free Association between the Republic of the Marshall Islands and the United States of America was signed and the Republic became a Freely Associated State. Specifically, the Compact recognizes the Republic of the Marshall Islands as a sovereign nation with its own constitution, and defines political, military and economic relationships between the two nations. The United States agrees to provide funds designated for development of the Marshall Islands until the year 2001. Also, residents of the four atolls — Bikini, Enewetak, Utirik and Enewetak — most heavily affected by the American testing of nuclear devices receive special compensation including land payments, free health care and USDA food, under Section 177 of the Compact.

With the implementation of the Compact in 1986, for the first time in over a century the Marshall Islands acquired political independence (the United Nations Security Council actually terminated the trusteeship status of the Republic in December, 1990). To date, the young Republic has exchanged notes of recognition with seventeen countries including the United States of America, the Federated States of Micronesia, Australia, Israel, Fiji, Kiribati, New Zealand, Philippines, Papua New Guinea, Japan, Chile, Solomon Islands, Vanuatu, Tuvalu, Western Samoa, China and Nauru. Two embassies, one in Washington, D.C. and one in Suva, Fiji, and one Consulate-General in Honolulu, are presently operated. Embassies to Japan and China, and a Permanent Mission to the United Nations in New York, will be opened in the future.

The Republic is a member nation of numerous regional and international organizations including the United Nations (UN), the Asian Development Bank (ADB), the South Pacific Forum (SPF), the South Pacific Commission (SPC), the South Pacific Regional Environment Programme (SPREP), the Alliance of Small Island Nations (AOSIS), the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO), the Forum Fisheries Agency (FFA), the International Criminal Police Organization (INTERPOL), the South Pacific Applied Geosciences Commission

(SOPAC), the World Health Organization (WHO), the University of the South Pacific (USP) and the Tourism Council of the South Pacific (TCSP). The Republic is an associate member of the Economic and Social Commission for Asia and the Pacific (ESCAP).

2 Government structure

Containing elements of the American and British systems, the Constitution of the Republic of the Marshall Islands establishes a parliamentary system with legislative, executive, and judiciary branches. With 33 members elected to serve four-year terms, the "Nitijela" is the primary legislative house. Its counterpart, the Council of Irooj (Council of Chiefs), functions as a consultative legislative body, with the power to revoke any bill deemed contrary to customary law, the land tenure system, or any traditional practice.

The President and his or her ten-member Cabinet comprise the executive branch which is selected from the legislative branch in the following way: after 33 Senators are directly elected to Nitijela, the Senators elect one of their rank to become President. In turn, the President appoints ten of the remaining Senators to be Cabinet Ministers, endowing each with a ministerial portfolio. As for all members of Nitijela, the term of office for the President and Ministers is four years.

The judiciary branch is composed of Supreme and High Courts, District and Community Courts, and a Traditional Rights Court, as well as a Judicial Services Commission. Minor disputes are settled in district and community courts, and the Traditional Rights Court reviews titles and disputes over land tenure, settling all matters pertaining to customary law and traditional practices. Major judicial issues are decided in the High and Supreme courts, which have review and appellate jurisdiction as well. The Judicial Services Commission makes recommendations on judicial appointments to the Supreme and High Courts, which require Nitijela confirmation. This commission also makes the actual decisions on lower court appointments. In 1990, a Constitutional Amendment strengthening the role of the Traditional Rights Court was approved by referendum.

The government administration consists of the Office of the Chief Secretary, the Public Service Commission, the Electoral Office, the Auditor General's Office, the Clerk of the Cabinet, the National Police, the Postal Service, and ten Ministries including Education, Finance, Foreign Affairs, Health Services, Interior and Outer Islands Affairs, Justice, Public Works, Resources and Development, Social Services, and Transportation and Communication. In early 1992, the Ministry of Health Services was renamed the Ministry of Health and Environment.

A number of statutory authorities, agencies, and public/private joint ventures exist under the umbrella of the national administration. These include: The Marshall Islands Development Authority, Kwajalein Atoll Development Authority, Marshall Islands Development Bank, Capital Improvements Project, Tobolaar Copra Processing Plant, Marshall Islands Marine Resources Authority, Republic of the Marshall Islands Environmental Protection Authority, Majuro Water and Sewer Company, Marshalls Energy Company, National Telecommunications Authority, Air Marshall Islands, Alele Inc., and two commercial fishing ventures, M & F Fishing, and M & D Fishing.

Each of the twenty-four local governments is led by a mayor elected for a four-year term, a local council of traditional leaders, and a local police force. Largely funded by the national government, the local governments development activities are coordinated by the Ministry of Interior and Outer Islands Affairs.

In summary, the Marshall Islands history is marked by colonialism. Nuclear testing has also profoundly impacted the history of the nation. The government structure is closely patterned after a Western-style democracy, although traditional law and the land tenure system is preserved by the Constitution.

State of the cultural environment

Although the main body of this report is concerned with the state of the natural environment, the state of the cultural environment is also extremely important. Rapid economic development and a marked westernization of lifestyle has taken place in recent years. Although foreign influences have long been present in the Marshall Islands, never before has the culture been so profoundly impacted. Traditional skills, oral traditions and cultural sites are all at risk in the face of newly adopted values which increasingly lead young people to undervalue traditional ways, speaking the Marshallese language, and maintaining special sites. This appendix briefly describes the nation's cultural resources, identifies threats to the cultural environment, and then outlines present conservation efforts and needs. Designed as a supplement to the main body of the State of the Environment Report, this summary is by no means an exhaustive examination of cultural issues.

1 Cultural resources

1.1 Material culture

Traditional skills associated with navigation and fishing, canoe building, handicraft production, and subsistence gardening are important components of the material culture of the Marshall Islands. For millennia these skills enabled the Marshallese to endure the challenges of the atoll environment and enjoy self-sufficiency. While the importance of these skills has diminished in modern society, they remain important symbols of the uniqueness of Marshallese culture, providing insights into a more environmentally sensitive way of life.

1.1.1 *Traditional navigation & fishing skills*

Traditional Marshallese navigational skills have been widely recognized as unique. Navigation was based not only on celestial position, but also on the behavior of ocean swells reflecting prevailing currents and bottom topography. To learn these skills, youngsters sometimes were blindfolded and made to lie in the bottom of the canoe where they were expected to concentrate and "learn" the swells. A stick chart, or *medo*, was also used for instruction. The shells of the stick chart represented islands or atolls, and the sticks represented currents.

Accomplished navigators knew the currents by name, and were knowledgeable in identifying certain sea markers such as bird species, which were known to inhabit specific islands and could thereby help "direct" them to their destinations.

Within this tradition, knowledge of the relationships between seasons, cycles, conditions and fish behavior was extensive. A wide variety of fishing methods — including line, spear and net fishing — were employed. Fishing lines were made from *armwe*, a tree (*Pipturus argenteus*), and lures were made from feathers, sennit, coconut fronds, and turtle shell fragments . Fishing experts were highly regarded in the community, passing their knowledge selectively to only a few youth of the upcoming generation.

1.1.2 *Canoe building skills*

Even today Marshallese outrigger canoes represent the subsistence way of life, being the provider of transportation and food. The hull of a Marshallese outrigger canoe is asymmetrical; the outside, or leeward side is flat, and the outrigger, or windward side, is rounded. This asymmetry obviates the need for a centerboard or a deep hull, restricting lateral drift and keeping the canoe on a straight course. Traditionally, large canoes

were made for voyaging, and were crafted out of large breadfruit trees, coconut sennit rope and breadfruit glue being used for binding. Today, few canoes exceed 20 feet in length, and most are used for intra-atoll transportation and fishing. A few canoes are still crafted from breadfruit trees, but it is now common to build the main hull from modern materials such as plywood and lumber, and the remaining parts from traditional materials found locally (Alessio 1991).

1.1.3 Weaving skills

Marshallese handicrafts are noted throughout the Pacific for their high quality of workmanship and originality in the use of natural materials. Most of the handicrafts are made by women in their homes during free time. Materials used in the production of crafts are prepared entirely by hand, and all weaving is done manually. Most handicrafts are woven products made from pandanus leaves *(maan)*, the treated outer skin of the coconut frond *(kimej)*, twine from the midsection of the coconut leaves *(malwe)*, and shells of various sorts. The finest weaving done is in making the *neided* traditional dress of the women. Today, many items are woven and used for sleeping, sitting, or floor mats, and as containers (Curtis, 1991). Typical items crafted for sale include baskets, fans, wall hangings, shell jewelry, purses, and model outrigger canoes.

1.2 **Oral traditions**

Prior to the introduction of a written language, the Marshallese cultural heritage was largely maintained via oral traditions. Elder generations passed down beliefs, values and philosophies by telling stories and anecdotes to the younger generations. Many places in the Marshall Islands which have special cultural significance offer a wealth of folklore associated with their pasts.

A member of the Malayo-Polynesian (Austronesian) family of languages, the Marshallese language is closely related to the languages spoken by the people of the Gilbert and Caroline Islands. Associated with each of the two archipelagos (Ralik and Ratak) is a recognized dialect of the Marshallese language. The Marshallese language has been heavily influenced by the languages of the colonial powers, with words from the Japanese, German and English languages modified and integrated into the Marshallese language. There is a growing awareness among the Marshallese people of the important roles their language and oral

traditions play in preserving Marshallese cultural identity (Capelle, A. 1991, pers. comm.).

1.3 Cultural sites

Sites of archeological, historical, and traditional importance are plentiful in the Marshall Islands. Archeological sites contain evidence indicating that although early settlers cultivated plants they also relied heavily upon the exploitation of marine resources including fish, shellfish, turtles and marine mammals. Historical sites, many dating from the German and Japanese occupations and World War II, document the role that foreign powers have played in the Marshall Islands. Sites of special cultural and spiritual significance, as recorded in oral traditions, are also known.

1.3.1 *Archeological sites*

Archeological evidence indicates that the Marshall Islands were settled by Austronesian speaking people during the first millennium BC. Cultural sites encountered are predominately coral gravel scatters, shell middens and gardening sites (taro patches). Subsurface features such as earth-ovens *(um)* and gardening horizons buried by typhoon deposits are occasionally encountered during earthmoving activities. Burial sites are rare given that most Marshallese were buried at sea and only high-ranking chiefs buried on land. Known archeological sites are mainly located on the relatively developed atolls such as Majuro, Arno and Kwajalein (Spennemann, D.H.R. 1991, pers. comm.).

1.3.2 *Historical sites*

Many historical sites exist in the Marshall Islands, most dating from the World War II era but some also dating back to the days of the German occupation. Remnants of war and occupation including bunkers, coastal guns, tanks, airplanes, ships and gravestones can be found on land or in lagoons. Many of these sites have special significance to Japanese and American visitors who sometimes travel to the Republic to visit the site where an ancestor fought and died during the war.

1.3.3 *Traditional sites*

Marshallese oral traditions are often associated with natural features (*ekjabs*) in the landscape believed to possess special powers (Curtis, 1991). These features which may be stretches of land, natural depressions, patch reefs, large coral boulders, etc. are afforded the same importance as archeological or historical sites (Spennemann, D.H.R. 1991,

pers. comm.). Even in cases where the entire story or significance associated with the site is no longer completely known, young people often show respect or fear for the sites.

1.4 **Land tenure system**

In general, land is the most highly prized possession in the Marshall Islands. With slightly less than 70 square miles of land in the entire archipelago and prime settlement areas being extremely limited, land has long been highly valued.

Composed of sections of varying width which run from ocean to lagoon, ownership parcels called *wetos* are usually two to five acres in area. The *wetos* are held communally by lineage *(bwij)* members who traditionally cleared and tended the land for subsistence agriculture. Even today social position is derived according to both present and future land ownership rights, and on most outer atolls (those exclusive of Majuro and Kwajalein) a subsistence lifestyle prevails. According to the *Second Five Year Development Plan, 1992–1996*, 53 people per square mile subsist on agricultural and fisheries activities (OPS 1991c).

Typically, each member of the *bwij* holds one of four recognized social positions with respect to the *weto*, being either the *irooj-laplap* (paramount chief of certain lands), the *irooj-edrik* (lesser chief of certain lands), the *alap* (person with immediate management responsibility for the land), or *dri jerbal* (worker on land). The majority of land is matrilineally inherited, *bwij* members tracing descent from a common *Alap* ancestress (Tobin 1958). Traditional rights of land tenure are unequivocally preserved in the Constitution, and the traditional requirement of consensus decision making, in which all persons with land rights to a certain *weto* must agree on questions of land transfer, is retained.

2 Challenges to the cultural environment

2.1 Neglect of the Marshallese language

The neglect of the Marshallese language represents the most significant current challenge to the cultural environment. The language binds the Marshallese people together and imparts a unique cultural identity. Increasingly, the Marshallese language is disregarded at public ceremonies in favor of English. Furthermore, many public schools do not provide instruction in the Marshallese language. The frequent viewing of commercial videos from the United States, very popular among urban children and adults alike, is believed to contribute to the progressive dominance of English in today's society.

2.2 Breakdown of customary roles

Rapid urbanization has been accompanied by a profound westernization of lifestyle. Traditional values which emphasize sharing and cooperation are in direct conflict with introduced values which glorify wealth and personal success. The extended family is yielding to the nuclear family, communal goals are being overshadowed by independent goals, and subsistence activities are being replaced by cash-generating activities. Although the effects of the cash economy on Marshallese culture and tradition are most noticeable in the urban centers, they are increasingly evident in the outer atolls as well. The breakdown of customary roles is occurring within both the extended family and the community.

2.2.1 *The extended family*

Traditionally, the Marshallese lived a subsistence lifestyle centered around reef gleaning, horticulture and fishing. Children and the elderly were cared for by members of the extended family who lived in the family compound. Boys were trained in fishing, sailing and navigating by older male family members. Girls were trained in food preparation, weaving, and child rearing by older female family members. Adoption of children by relatives was commonplace, and sisters participated in the rearing of each other's children without distinction (OPS 1990).

The emergence of the cash economy has complicated all traditional family relationships. Today, an outer atoll woman sending her children to Majuro to live with her sister while they attend school may be surprised when her urban sister requests monetary assistance, saying that she cannot afford to support them. Urban wage earners are often frustrated when unemployed members of their extended family turn to them for

support. In some cases, a wage earner may have as many as thirty financial dependents.

2.2.2 *The community*

The emphasis in traditional society was on sharing — of food, tools, expertise, even children. The *irooj*, as high chief, had responsibility for the *dri jerbals*, or commoners whom he ruled. If a *dri jerbal* needed food, housing or other assistance, the *irooj* was often called upon for help. In turn, the *dri jerbals* paid tribute to their *irooj* with gifts of food and crafted items. The *alap*, as leader of a *dri jerbal* clan, served as mediator between his people and the *irooj*, and made routine decisions concerning land management.

The cash economy has complicated the customary relationships between the *irooj*, *alap* and *dri jerbal*. In urban centers, the value of customary status is being challenged by the modern emphasis on financial status, confusing all customary protocols. Instead of asking the *irooj* for a few breadfruit to tide his family over during lean times, for example, a *dri jerbal* may now request that the *irooj* pay his mother's hospital bill. Although the deterioration of traditional roles is most pronounced in the urban centers, it is occurring in the rural areas as well.

2.3 Destruction of cultural & historical sites

The scarcity of land suitable for settlement and building in the Republic results in the inadvertent construction of modern structures overtop archeological and historical sites. Earthmoving activities regularly expose archeological sites. Likewise, historic sites dating to the German and Japanese periods, including many relics from World War II, are threatened by decay and vandalism.

2.4 Loss of traditional skills

The rapid westernization of lifestyle witnessed in the Republic during the past decade has resulted in a devaluation of traditional skills among the young. While the skills necessary for self-sufficiency on an atoll are still retained by the elder generations, the younger generation typically shows little interest in learning traditional methods of boat building, navigation, weaving and fishing. Increasingly, youth value what is new and modern over what is old and traditional.

3. *Responses to cultural challenges*

3.1 Alele Inc.

Alele Inc. was established in 1984 as a quasi-governmental nonprofit corporation with ties to the Ministry of Interior and Outer Islands Affairs. The overall mission of Alele is to conserve and promote Marshallese language and culture. It currently operates a public library and anthropological museum, and houses the national archives which are actively being expanded to document oral traditions and material culture.

Administered by Alele, the Waan Aelon Kein Canoe Project records traditional canoe building skills using narrative videos, line drawings, and still photographs. Alele also conducts Marshallese language courses, and operates a public television station, broadcasting public interest programs and educational documentaries which address issues relating to nutrition, health, youth, population growth and the environment.

Overall, Alele has been highly effective in raising public awareness of cultural issues and in recording Marshallese history and language. The public education television station operated by Alele has helped convey information about cultural and environmental issues. The major constraint faced by Alele has been inadequate funding.

3.2 Historic preservation office

In accordance with the Historic Preservation Act 1991, the Historic Preservation Office (HPO) was transferred from Alele Inc. to the Ministry of Interior and Outer Islands Affairs during fiscal year 1991–1992. The mission of the HPO is to preserve and revitalize Marshallese culture and tradition. While past efforts have focused on documenting historical resources, future efforts will emphasize the protection of historical sites.

Towards this end, the HPO is currently engaged in creating a national register of historic and cultural sites which will guide the creation of protected areas. During the period 1992–1996, the HPO plans to establish a network of Atoll Cultural Preservation Officers (ACPOs) at the community level. These officers will work with the *irooj* (chiefs) and *alaps* (land managers) to identify and protect historical and cultural resources on all atolls. Past efforts have been focused on Majuro atoll, but future plans include outer atolls. The major constraints faced by the HPO include staff shortages and inadequate funding.

3.3 Legal instruments

3.3.1 *Historic Preservation Act 1991*

The Historic Preservation Act 1991 established the Historic Preservation Office (HPO) within the Ministry of Interior and Outer Islands Affairs, charging the office with the responsibility for preserving and protecting the cultural and historical resources of the Republic. The office is granted the authority to establish regulations and permitting systems governing the classification of, and access to, cultural/historical resources and future national heritage sites.

3.3.2 *National Archives Act 1988*

The National Archives Act of 1988 makes provisions for the custody and preservation of public records, designating Alele Inc. as the keeper of the National Archives. Its functions include:

1) preserving existing and future archival resources, including cultural resources of the Republic,
2) collecting and housing archival resources not currently preserved, and
3) promoting the efficient maintenance of public records by providing technical assistance to other governmental sectors as needed.

3.3.3 *Republic of the Marshall Islands Language Commission (Jarloklak) Act 1983*

The Republic of the Marshall Islands Language Commission Act of 1983 establishes the Marshallese Language Commission (Jarloklak). The responsibilities of the commission include preserving, developing and promoting the use of the Marshallese language by creating a spelling system and a dictionary. In 1991 a lexicon of the Marshallese language published by the University of Hawaii (PALI) in 1976 was submitted to the Nitijela for review. If accepted, it will become the standard by which all students are taught to spell Marshallese words. The commission will continue to function in an advisory capacity to the Cabinet and Nitijela on all issues relating to the perpetuation of the Marshallese language.

Priorities for cultural conservation are addressed in Chapter 5 of this document. Strategies and specific programs for cultural conservation are presented in NEMS: Part B. Strategy 9, "Protecting cultural values and practices", features seven programs to be implemented during 1992–1996. It should be noted that some of these programs, including the creation of a historic sites register and a network of atoll preservation officers, have already begun under the auspices of the Historic Preservation Office.

About National Environmental Management Strategies — NEMS

Recent times have witnessed increasing threats to Pacific environments, coupled with an increasing awareness of the need for action. National Environmental Management Strategies (NEMS) are a measure of this awareness and a positive response to these threats.

NEMS, being developed in a number of Pacific countries, outline the major environmental issues faced by each country and identify the steps required to address them. There has been a strong emphasis on the identification of clear, fully costed programmes in each of these steps.

These NEMS have been developed in each country through a process of extensive in-country consultation and gathering of relevant background information. The end result is a document which "belongs" to the government and people of each country. The effective implementation of NEMS will be essential for sustainable development of the region and will involve all relevant organisations.

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national environmental management strategy