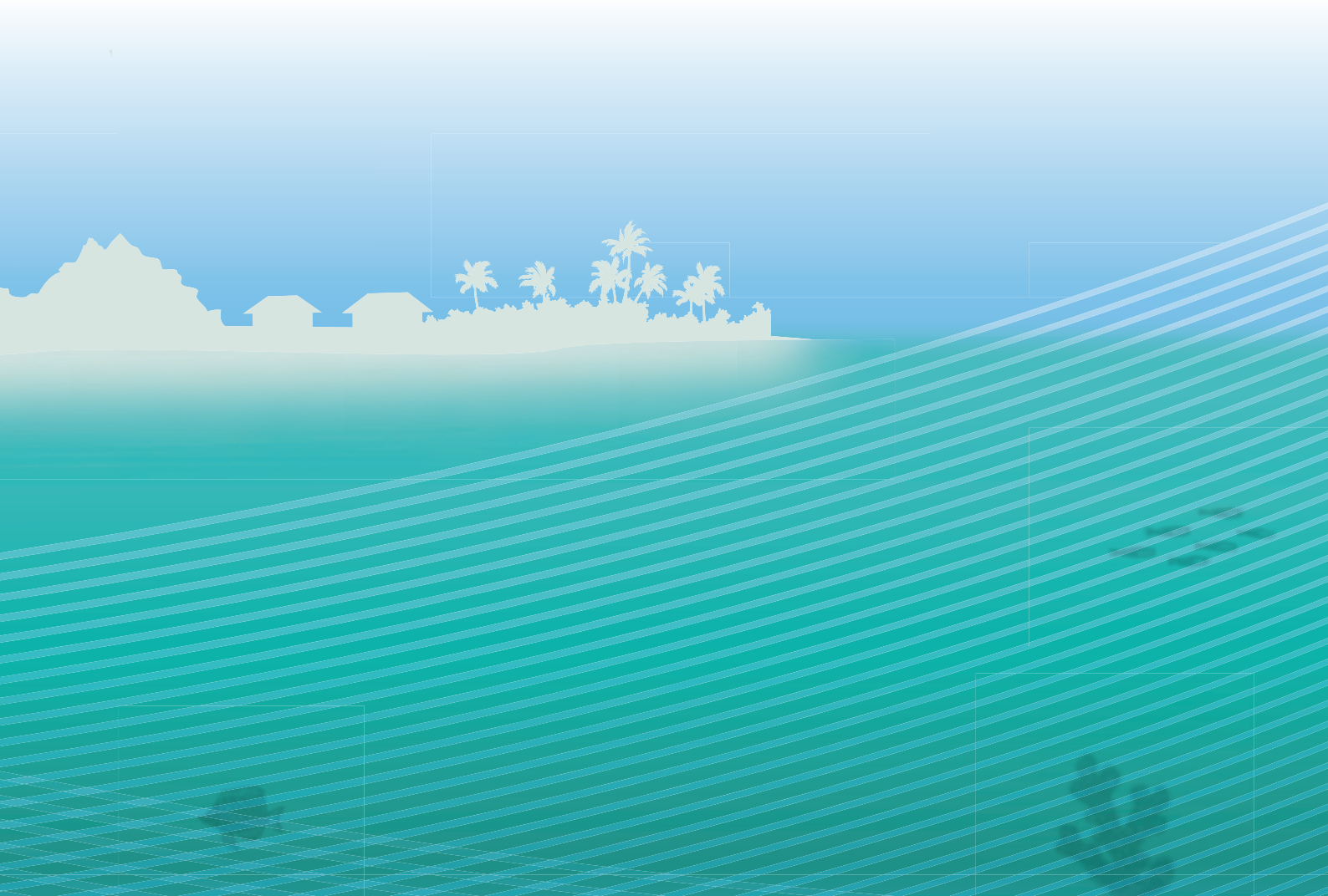
THE NIPPON FOUNDATION

THE SASAKAWA PEACE FOUNDATION

The Final Report of The Project for Exploratory Research

on Models of a Micronesian Marine Protected Area FY 2010 -2011

Palau Integrated Marine Protected Area Model



Palau
Integrated Marine Protected Area Model

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The Sasakawa Peace Foundation
The Sasakawa Pacific Island Nations Fund

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Foreword

Japan has developed profound historical and cultural relationships with its close neighbors, the Pacific Island Nations. These nations also play a major role in ensuring free and peaceful transport in the Pacific Ocean.

In 1988, the Sasakawa Peace Foundation (SPF) hosted the Pacific Island Nations Conference with the aim of boosting cooperation among the Pacific Island Nations and strengthening the region's ties with Japan. This international conference prompted SPF to establish the Sasakawa Pacific Island Nations Fund (SPINF) in 1989 (capitalized at three billion yen). Since its establishment, SPINF has viewed the Pacific Island Nations as important partners of Japan, and has thus conducted with the islands a wide variety of exchanges and human resource development programs.

The guidelines for the third period come into effect in 2009 and focus principally on programs to promote maritime security and management in the seas around the Republic of the Marshall Islands, the Federated States of Micronesia, and the Republic of Palau, for which countries evenly paced activities are expected. Besides, SPINF will strive to provide resource management training for sustainable development and capacity building programs that continue to the islands efforts to develop and become self-supporting.

This report summarizes findings from the Project for Exploratory Research on Models of a Micronesian Marine Protected Area, a study conducted between 2010 and 2011 with a grant from the Nippon Foundation for the support of Island states. It is anticipated that results from this study will not only benefit the Micronesia region but also marine conservation efforts in the larger Pacific Ocean region, which includes Melanesia and Polynesia.

In closing, we would like to express our deepest gratitude to members of the Micronesia Marine Environment Committee, relevant authorities of the Republic of Palau who have extended their cooperation to this project, as well as many others who have lent their kind support to the compilation of this report.

November 2012

The Sasakawa Pacific Island Nations Fund, The Sasakawa Peace Foundation

The Micronesia Marine Environment Committee Members

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Glossary

ADB	: Asian Development Bank
AusAID	: The Australian Agency for International Development
BMR	: Bureau of Marine Resource
BNM	: Belau National Museum
BWA	: Belau Watershed Alliance
CBD-COP	: Convention on Biological Diversity - the Conference of the Parties
CDM	: Clean Development Mechanism
CI	: Conservation International
CNN	: Cable News Network
CPI	: Consumer Price Index
CPUE	: Catch Per Unit Effort
CTI	: Coral Triangle Initiative
DEM	: Digital Elevation Model
DFWP	: Division of Fish and Wildlife Protection
DMLE	: Division of Marine Law Enforcement
DMS	: Dimethyl Sulfide
EEZ	: Exclusive Economic Zone
EQPB	: Environment Quality Protection Board
EU	: European Union
FADs	: Fish Aggregating Devices
FAO	: Food and Agriculture Organization of the United Nations
FFA	: Forum Fisheries Agency
GDP	: Gross Domestic Product
GEF	: Global Environment Facility
GIS	: Geographic Information System
GNI	: Gross National Income
GPS	: Global Positioning System
HIES	: Household Income and Expenditure Survey
IBA	: Important Bird Areas
ICRI	: International Coral Reef Initiative
ICM	: Integrated Coastal Management
ICZM	: Integrated Coastal Zone Management
IPCC	: Intergovernmental Panel on Climate Change
IUCN	: International Union for Conservation of Nature
IWRM	: Integrated Water Resource Management
JICA	: Japan International Cooperation Agency
LMMA	: Locally Managed Marine Area
LCC	: Low-Cost Carrier
MC	: Micronesia Challenge
MCT	: Micronesia Conservation Trust
MEAT	: Management Effectiveness Assessment Tool

MPA : Marine Protected Area
NECO : Ngiratkel Etpison Company
NGO : Non-governmental Organization
NOAA : National Oceanic and Atmospheric Administration
NPO : Nonprofit Organization
OTV : Oceania Television
ODA : Official Development Assistance
OFCF : Overseas Fishery Cooperation Foundation
PAN : Protected Areas Network
PANF : Protected Areas Network Fund
PALARIS : Palau Automated Land and Resource Information System
PCC : The Palau Community College
PCS : Palau Conservation Society
PICRC : Palau International Coral Reef Center
PMDC : Palau Mariculture Demonstration Center
PNA : Parties to the Nauru Agreement
PNCA : Palau National Code Annotated
PPP : Polluter Pay's Principle
PVA : Palau Visitors Authority
REA : Rapid Ecological Assessment
REDD+ : Reducing Emissions from Deforestation and Degradation in Developing countries
RISL : Rock Islands Southern Lagoon
SCRFA : Society for the Conservation of Reef Fish Aggregation
SEC : Scientific Ecological Knowledge
SOPAC : Applied Geoscience and Technology Division of Secretariat of the Pacific Community
SPC : Secretariat of the Pacific Community
SPREP : Secretariat of the Pacific Regional Environment Programme
SPSS : (Content of) Suspended Particles in Sea Sediment
TEC : Traditional Ecological Knowledge
TNC : The Nature Conservancy
TTPI : The Trust Territory of the Pacific Islands
UH : University of Hawaii
UNDP : United Nations Development Programme
UNEP : United Nations Environment Programme
UNEP-WCMC : United Nations Environmental Programme-World Conservation Monitoring Centre
USP : The University of the South Pacific
VDS : Vessel Day Scheme
WASC : Western Association of Schools and Colleges

Chapter 1 Project Overview

1.1 Background and Objectives

While environmental conservation initiatives began to take place in various parts of the world from the beginning of the 20th century, it was the phenomenon of coral bleaching, which occurred in the 1980s and was thought to be due primarily to changes in the earth's environment, that set in motion policy initiatives geared towards global marine environmental efforts that were significant throughout the 1990s. Some of these policy moves include the adoption of "Agenda 21" in the United Nations Conference on Environment and Development (UNCED), i.e. the Earth Summit (1992), the holding of the first-ever meeting of the Conference of the Parties (COP 1) and the inauguration of the International Coral Reef Initiative (ICRI) (1994).

At the 10th meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD-COP 10) held in October 2010 in Nagoya, the "Aichi Target" was adopted. The motion set in place strategic plans to be adopted beyond 2011 for the achievement of coexistence of humans with nature by the year 2050. In particular, Target 11 of Strategic Goal C in the Aichi Target specifies an objective that directly concerns Marine Protected Areas (MPAs) – "By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes" (The Ministry of the Environment, 2010).

In accordance with such global policy initiatives, the establishment of MPAs and the expansion of its mutual network, which are geared towards the conservation of coral ecosystems rich in biodiversity and the sustainable use of resources, have been promoted in various locations across the globe. While marine environment conservation efforts have been implemented by the respective governments of Pacific island nations with assistance from donor countries and NGOs, many challenges still remain for the utilization of protected areas, such as processes for their establishment and maintenance management that includes finance control.

In light of such circumstances, this present project was implemented over a span of two years by the Sasakawa Peace Foundation with the aim of ensuring sustainability that will help to link societies of the past with those of the future within the Micronesia region.

The Micronesia Marine Environment Committee, a body composed of experts specializing in the environment and social sciences concerning island communities, functions as the parent organization of this project. Based on diverse perspectives gleaned from committee meetings and field studies, current assessments have been conducted to devise an Integrated Marine Protected Area model that is aimed towards sustainable use of resources and conservation of biodiversity and takes into account the continuum from watersheds to coral reefs.

In this project report, the model above has been presented as the Palau Integrated Marine Protected Area Model with the goal of contributing positively to the construction of sustainable island societies in the Pacific region.

1.2 Scope and Content of Project Implementation

1.2.1 Establishment of the Micronesia Marine Environment Committee

In line with the objectives outlined above, the Micronesia Marine Environment Committee was established in September 2010 with the following key members:

Prof. Makoto Tsuchiya, University of the Ryukyus, President of the Japanese Coral Reef Society, Specialized Field: Ecosystem Dynamics, Coral Reef Ecosystem Services

Dr. Shinichiro Kakuma, Vice Director of the Okinawa Prefectural Fisheries Extension Center, Specialized Field: MPAs for Sustainable Use of Resources

Prof. Shunsuke Nagashima, Research center for the Pacific Islands, Kagoshima University, Vice President of the Japan Society for Island Studies, Specialized Field: Small Island Societies and human life

Dr. Houbun Ikeya, President of the Ecosystem Conservation Society-Japan, President of the Association of National Trusts in Japan, Specialized Field: Conservation of Terrestrial Ecosystem, Land Trusts

Mr. Yasushi Hibi, Vice President of the Conservation International, Managing Director of the CI-Japan, Specialized Field: Conservation of Biodiversity and Sustainable Development in Developing Countries, Participation of Community Residents for Sustainable Development

1.2.2 The Micronesia Marine Environment Committee Meetings

The Micronesia Marine Environment Committee held the following six committee meetings between September 2010 and February 2012.

1) The 1st Micronesia Marine Environment Committee Meeting

Date: September 16, 2010

Venue: The SPF Meeting Room , 4F, The Nippon Foundation Building, Akasaka, Tokyo, Japan

Participants: Prof. Tsuchiya, Dr. Kakuma, Prof. Nagashima, Dr. Ikeya, Mr. Hibi, Mr. Fukai, Mr. Shiozawa

Outcomes: Determining member roles and implementation of the 1st Field Study in Palau

2) The 2nd Micronesia Marine Environment Committee Meeting

Date: March 11, 2011

Venue: The SPF Meeting Room , 4F, The Nippon Foundation Building, Akasaka, Tokyo, Japan

Participants: Prof. Tsuchiya, Dr. Kakuma, Prof. Nagashima, Dr. Ikeya, Mr. Hibi, Mr. Fukai, Mr. Shiozawa

Outcomes: Construction of final Integrated MPA Model with inclusion of watersheds

3) The 3rd Micronesia Marine Environment Committee Meeting

Date: June 2, 2011

Venue: Meeting Room No.8, 2F, The Nippon Foundation Building, Akasaka, Tokyo, Japan

Participants: Prof. Tsuchiya, Dr. Kakuma, Prof. Nagashima, Dr. Ikeya, Mr. Hibi, Mr. Fukai, Mr. Shiozawa
Mr. Ritsu Endo (the Ecosystem Conservation Society-Japan)

Outcomes: Confirmation of contents of the interim report and narrowing down of possible survey sites to Palau

4) The 4th Micronesia Marine Environment Committee Meeting

Date: August 4, 2011

Venue: Meeting Room No.1, 2F, The Nippon Foundation Building, Akasaka, Tokyo, Japan

Participants: Prof. Tsuchiya, Dr. Kakuma, Prof. Nagashima, Dr. Ikeya, Mr. Hibi, Mr. Fukai, Mr. Shiozawa Mr. Endo, Mr. Kiyotaka Asami, Dr. Rintaro Suzuki (the Ecosystem Conservation Society-Japan)

Invitees: Prof. Robert H. Richmond (University of Hawaii, President of the Internatiojal Society for Reef Studies), Mr. Joseph Aitaro (Director, Bureau of PAN, Ministry of Natural Resource, Environment and Tourism)

Outcomes: Establishment of Ngiwal, Ngerikiil and Ngermeduu Bay as specific field research sites in Palau

5) The 5th Micronesia Marine Environment Committee Meeting

Date: December 12, 2011

Venue: ROCORE Naha Hotel, Naha, Okinawa

Participants: Prof. Tsuchiya, Dr. Kakuma, Prof. Nagashima, Dr. Ikeya, Mr. Hibi, Mr. Fukai, Mr. Shiozawa

Outcomes: Formulation of contents of field study report, additional research and final report

6) The 6th Micronesia Marine Environment Committee Meeting

Date: February 16, 2012

Venue: The SPF Meeting Room , 4F, The Nippon Foundation Building, Akasaka, Tokyo, Japan

Participants: Prof. Tsuchiya, Dr. Kakuma, Prof. Nagashima, Dr. Ikeya, Mr. Hibi, Mr. Fukai, Mr. Shiozawa, Mr. Endo, Dr. Suzuki

Outcomes: Determination of schedule for the compilation of field study report and final report

1.2.3 Field Studies

Based upon the decision made by the Micronesia Marine Environment Committee, committee members conducted the following five field study trips to Palau from January 2011 to January 2012.

1) The 1st Field Study Trip to Palau

Date: January 6 – 18, 2011

Participants: Prof. Tsuchiya, Dr. Kakuma, Prof. Nagashima, Dr. Ikeya, Mr. Shiozawa,

Objective: Current assessment survey of initiatives concerning MPAs in Palau

Subjects of Investigation: PCS, PAN Office, PICRC, Micronesia Challenge Office, BMR, etc.

Research Sites: Rock Islands, Peleliu Island, Babeldaob Island

Protected Areas Surveyed: Teluleu, Ngermedelim, Ngatpang, Ileyakl Beluu, Ngermasech, Ngermeduu Bay, Ngermeskang Bird Sanctuary

2) The 2nd Field Study Trip to Palau

Date: September 14 – 25, 2011

Participants: Prof. Tsuchiya, Prof. Nagashima, Mr. Asami, Dr. Suzuki, Ms. Yuuka Yano, Ms. Izumi Mimura, Ms. Dativa J. Shilla (University of the Ryukyus), Mr. Shiozawa

Objectives: GIS data collection and survey of mangroves, rivers, local communities and land management conditions of the three research sites

Subjects of Investigation: Bureau of PAN, EQPB, BNM, BMR, Bureau of Agriculture, PALARIS Office, PCC, JICA Expert Office, Airai State Government, Ngiwal State Government, PCS, PICRC, OTV, Ministry of Community and Cultural Affairs, etc.

Research Sites: Ngiwal, Ngermeduu Bay, Ngerikiil

3) The 3rd Field Study Trip to Palau

Date: November 17 – 24, 2011

Participants: Dr. Ikeya, Mr. Endo, Mr. Shiozawa

Objective: Terrestrial environment study (including environment index study)

Subjects of Investigation: Bureau of PAN, BNM, EQPB, etc.

Research Sites: Ngiwal, Ngermeduu Bay, Ngerikiil, Rock Islands

4) The 4th Field Study Trip to Palau

Date: December 12 – 18, 2011

Participants: Prof. Tsuchiya, Ms. Yano, Ms. Mimura, Ms. Noelle W. Oldiais (University of the Ryukyus), Mr. Shiozawa

Objectives: Collection of sediment from rivers, river mouths and waterfront coral reefs of the three research sites and survey of local communities

Subjects of Investigation: Bureau of PAN, PICRC, BMR, EQPB, PCC, etc.

Research Sites: Ngiwal, Ngermeduu Bay, Ngerikiil, Rock Islands

5) The 5th Field Trip Study to Palau

Date: January 1 – 13, 2012

Participants: Dr. Kakuma, Prof. Nagashima, Mr. Shiozawa

Objectives: Current assessment survey of coastal fishing in Palau and survey of local communities

Subjects of Investigation: Bureau of PAN, BMR, JICA Expert Office, Airal State Government, Ngiwal State Government, Koror State Government, OTV, Airal local community, Ngiwal local community, etc.

Research Sites: Ngiwal, Ngermeduu Bay, Ngerikiil, Rock Islands, Ebiil conservation area

1.3 The Report's Structure

This report discusses and studies the research sites of the project, explains the reasons for narrowing down the

Palau research sites, provides basic information on Palau, environmental conservation initiatives in Palau, coastal fishing in Palau, information on relevant institutions gained through the field study trips, as well as information on the surveyed conservation areas and the survey report on the model research site, conservation area facilities in Palau and the current status of establishment and maintenance management of protected areas.

As for the Japanese transcription of state- and area names, a lot of Japanese sources use spelling given before the War, which attempted to make it easier for the Japanese to pronounce these names. However, in this report, we have tried to use transcription as close to the original pronunciation as possible. In particular, “Nga” and “Ngi” in names beginning with “Ng,” are pronounced as nasal “ga” and “gi”, whereas “Nge” and “Ngeche” as “ne.” Therefore, such names are transcribed with the *katakana* characters for “ga”, “gi” and “ne,” respectively, together with their local names written in the English alphabet (for example, names formerly transcribed as “Arumonogui” have been changed to “Ngaremlengui”).

Further, transcription of names spelled with double “i” such as Aimeliik has been changed to long vowels as in “Aimerīku.”

Chapter 2 Targeted Regions of Study

2.1 Micronesia Region Overview

The Micronesia region (see Fig. 2.1) is composed of ROP (Republic of Palau), FSM (Federated States of Micronesia), RMI (Republic of the Marshall Islands), CNMI (Commonwealth of the Northern Mariana Islands), Guam, the Republic of Kiribati and the Republic of Nauru. The process of gaining autonomous rule and attaining present conditions in the countries and territories of the Micronesia Region took place over the span of some 50 years after the end of World War II.

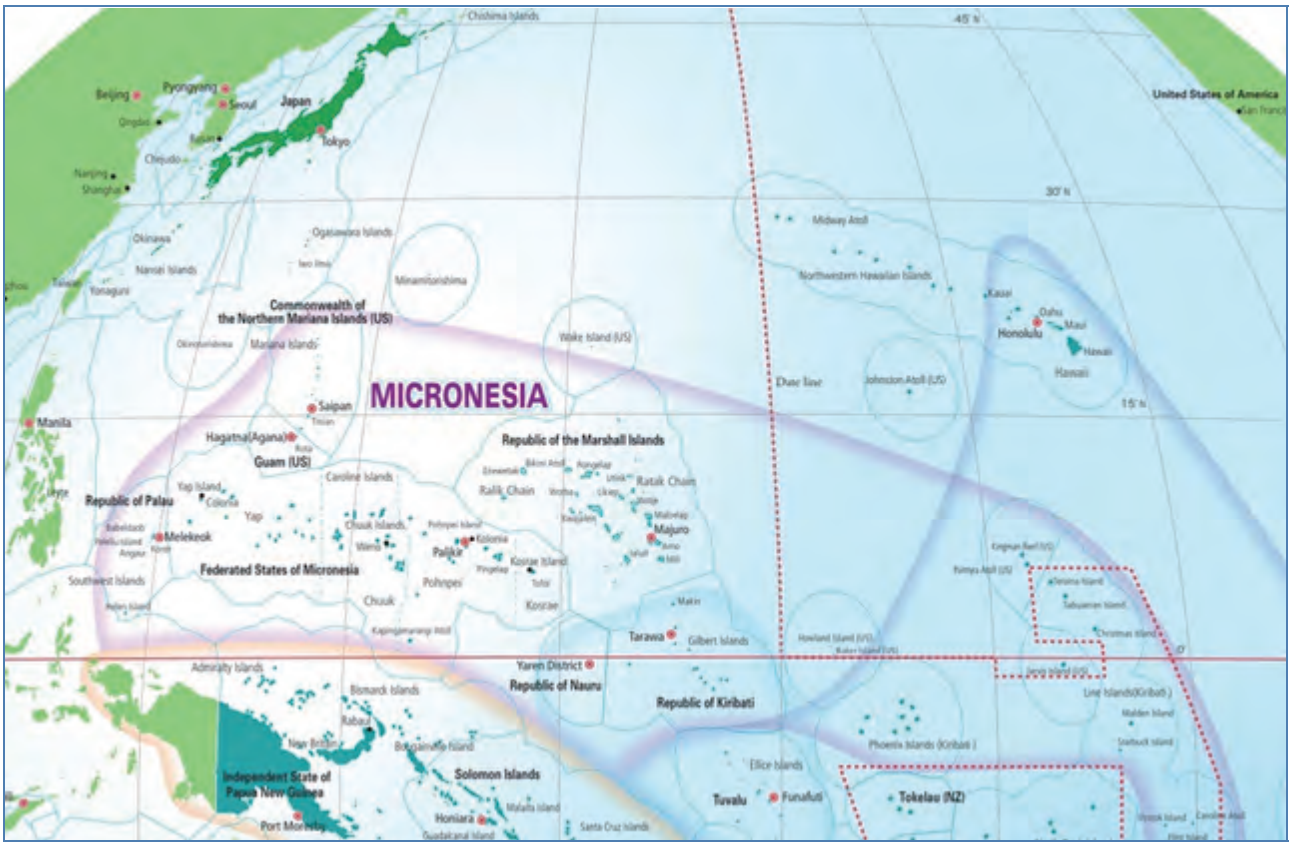


Figure.2.1. Map of the Micronesia region. (2012, SPINF, SPF)

2.1.1 From WWI to the End of WWII

Following the outbreak of WWI in 1914, Germany faced a declaration of war from Allied nations that included Japan and Australia. This move led to the Japanese occupation of the German-held territories of present-day ROP, FSM, RMI and CNMI, as well as the ceding of present-day Republic of Nauru to Australia.

With the conclusion of the Treaty of Versailles in 1919, the League of Nations decreed that Japan would gain control of German territories north of the equator, while those located south of the equator were placed under mandatory rule under Australia, New Zealand and United Kingdom. As a consequence, present-day ROP, FSM,

RMI, and CNMI came under the Japanese League of Nations mandate while present-day Republic of Nauru, which was rich in mineral phosphate deposits at that time, assumed joint mandatory rule by United Kingdom, Australia and New Zealand.

On the other hand, Guam became an U.S.-controlled territory in 1899 after the Spanish-American War while the Republic of Kiribati was ceded to United Kingdom in 1892.

2.1.2 From the End of WWII to the Foundation and Independence of Autonomous Government

After the end of WWII in 1945, Japanese-controlled territories of present-day ROP, FSM, RMI and CNMI that belonged to the Japanese League of Nations mandate became UN trust territories under the administrative right of the United States in 1947. The move to create trust territories was made with the aim of restoring stability and independence to the Pacific region, which had seen some of the hardest fought battles during the war.

From 1947 to 1986, the six territories of Northern Mariana Islands, Palau, Yap, Chuuk, Pohnpei and the Marshall Islands were regarded to be part of the Trust Territory of the Pacific Islands (TTPI). The trust territory was represented by a flag bearing six stars, which was similar to the national flag of present-day FSM (Kosrae was part of Pohnpei at that time). While the United States were keen to combine these six territories to form an independent FSM, in 1978 the Northern Mariana Islands, Palau and the Marshall Islands voted in their respective regional assemblies to leave the federation.

The Northern Mariana Islands first established its autonomous government as a Commonwealth nation. In 1986, CNMI (the Commonwealth of the Northern Mariana Islands) was incorporated into the United States. The Marshall Islands enacted its first constitution and set up an independent government as RMI (the Republic of the Marshall Islands) in 1979 before eventually gaining formal independence in 1986 upon the conclusion of the Compact of Free Association agreement with the United States. Similarly, the territories of Yap, Chuuk, Pohnpei and Kosrae established their inaugural constitution and set up an autonomous government in 1979 as FSM (the Federated States of Micronesia) before attaining independence in 1986 after signing the Compact of Free Association agreement with the United States. Palau established its first independent government as the Republic of Palau with the completion of a draft constitution in 1979 and the enactment of an official constitution in 1981. However, the problematic relationship between Palau's non-nuclear constitutional clause and the draft agreement of the Compact of Free Association with United States became a source of domestic controversy. As a result, Palau only gained formal independence after the Compact of Free Association with the United States was signed in 1994 at the end of a total of eight referendums that were held to gain citizens' approval for the passage of the alliance agreement.

After the departure of the Northern Mariana Islands from the federation, the following reasons provided a background against which the formal separation of ROP, FSM and RMI took place. In addition to the different languages spoken in Palau, Yap, Chuuk, Pohnpei, Kosrae and the Marshall Islands, the Marshall Islands was also experiencing problems concerning monetary compensation from the United States with regards to nuclear tests. Moreover, Palau exhibited much possibility for growth through the maximization of its geographical characteristics as well as a strong indication for independence. At present, these three countries share close mutual relations that resemble those of fraternal countries and engage in mutual cooperation on foreign-related issues as a joint region. Despite this, ROP, FSM and RMI are strongly adverse to having their respective national characteristics overlooked and being regarded as a collective region. For example, it is essential to dismiss the inclination to assume that

outcomes of the case study of ROP in this particular project would necessarily apply to both FSM and RMI.

At present, the Compact of Free Association with the United States agreements have become the “Compact of Free Association with the United States, as Amended” in all three countries. While the contents of the agreements differ according to local situations in each country, common characteristics include receipt of fiscal aid and guarantee of security from the United States while preserving autonomous diplomacy, as well as a waiver of travel visas to the United States and the right to semi-U.S. citizen privileges due to the countries’ mutual status as U.S. territory. The sense of distance and the extent of the relationship with the United States may be expressed in the following order, beginning with the closest - state (e.g. Hawaii), territory (e.g. Guam), self-governing dominion (e.g. CNMI), free associated state (e.g. FSM).

After WWII, present-day Republic of Nauru was placed under joint administrative rule of Australia, New Zealand and United Kingdom in 1947 before assuming autonomy as part of the British Commonwealth of Nations in 1968. Although the Republic of Nauru was the wealthiest nation in the Pacific region until the 1980s because of its rich mineral phosphate deposits, it is now one of the poorest nations within the region.

Present-day Republic of Kiribati is composed of the Gilbert Islands, Phoenix Islands and a portion of the Line Islands, although the majority of the population lives in Gilbert Islands. Gilbert Islands was made a colony of United Kingdom along with Ellice Islands (present-day Tuvalu) in 1916. When Ellice Islands separated from the colony to assume independence as Tuvalu, Gilbert Islands was merged with Phoenix Islands and a part of Line Islands, both of which were under the rule of United Kingdom and United States, to form the Republic of Kiribati in 1976. Both Tuvalu and Kiribati are currently under the jurisprudence of United Kingdom.

2.1.3 The Current Situation in the Micronesia Region

Against such a historical backdrop, the American system of education and way of life have become firmly established in present-day ROP, FSM, RMI, CNMI and Guam. It is common for residents in these countries to receive higher education beyond university-level in Guam, Hawaii and the mainland of the United States. On the other hand, the establishment of the British school system in the Republic of Nauru, the Republic of Kiribati and Tuvalu has led many of their citizens to pursue tertiary education at the University of the South Pacific (USP), Australia and New Zealand.

Simply put, the Micronesian region north of the equator may be regarded to be American while the Micronesian region south of the equator may be thought of as being British (although Kiribati is located slightly north of the equator).

On the other hand, geographical conditions have led to mutual interaction between the peoples of the Republic of Kiribati and Tuvalu within RMI. As a result, communities of Kiribatese and Tuvaluans can be found in RMI.

For reasons of expediency, the Free Associated States with US of ROP, FSM and RM will be referred to as Micronesia and/or the Micronesian region in this report.

2.2 Marine Conservation Efforts in the Micronesia Region

During the 1980s and 1990s after countries in the Micronesia region gained independence, environmental problems grew increasingly prominent worldwide. This was also a period of time when international efforts towards marine environmental conservation at the policy level became more active. Until today, initiatives in the Micronesia region have been carried out by many international NGOs that include local governments, NGOs, Japan, Taiwan, United States, Australia, JICA, the US National Oceanic and Atmospheric Administration (NOAA), UN bodies (UNEP, GEF etc.) and the Nature Conservancy (TNC).

The Micronesia region was not spared from the effects of coral bleaching, a large-scale natural phenomenon that took place worldwide in 1998. Particularly in Palau, soil runoff from road construction works on Babeldaob Island (1997 to 2007) further exacerbated the damage, severely threatening the survival of coral reef ecosystems. As a consequence, resource levels of fish species such as the grouper fell from the end of the 1990s. As a means of recovering from such damage, establishment of MPAs was carried out at the local community and state government levels.

In 2001, the Palau International Coral Reef Center (PICRC) was established with grant assistance from the Japanese government. In 2006, the “Micronesia Challenge Initiative” spearheaded by the national government of Palau achieved consensus from ROP, FSM, RMI, Guam, as well as 3 countries and 2 jurisdictions in CNMI. This initiative called for participating countries and territories to “effectively conserve at least 30% of the near-shore marine resources and 20% of the terrestrial resources across Micronesia by 2020”. As part of the same initiative, endowment funds for ROP, FSM and RMI were set up within the Micronesia Conservation Trust (MCT) to ensure sustainable financial resources. Fund balances have been maintained and bolstered through contributions by each respective government, the Global Environment Facility (GEF), TNC and the Conservation International (CI). In addition, a Green Fee was introduced in Palau in 2009 to provide an alternative sustainable financial resource for the endowment fund.

In September 2009, President Toribiong of Palau presented the “Declaration of Shark Sanctuary” at the UN General Assembly and moved to prohibit the capturing of sharks within Palau’s Exclusive Economic Zone (EEZ). A ban on the capturing of sharks was enacted in RMI in 2011, which forbade the import of sharks captured both in and outside of RMI’s EEZ. Such efforts not only prevented the over-fishing of sharks for shark’s fin, but also contributed to the management of tuna resources in the region.

For instance, in February 2012 Japanese fishing vessels ran afoul of the aforesaid ban and was made to pay US$125,000 in fines to the Marshall Islands Marine Resource Authority (MIMRA). According to a member of a particular Japanese purse seine fishing vessels union, purse seine fishing vessels that conduct fishing activity in the Micronesia region often end up with copious amounts of shark by-catch. As such, many Japanese fishing vessels are gradually shifting their catch landing sites from Majuro in RMI to Pohnpei in FSM.

The Nauru Agreement oversees efforts across an even larger area. The eight countries of Palau, FSM, RMI, Nauru, Kiribati, Tuvalu, Solomon Islands and Papua New Guinea, which are dispersed in the shape of a donut in the high seas over a territorial sphere from 4 degrees north latitude to 9 degrees south latitude, established mutual consensus to the regional agreement in 1982 in order to control tuna resources found in the high seas and each country’s EEZ, as well as to ensure due economic benefit as resource-owning nations. The agreement began to have actual acting power from 2010 after the Parties to the Nauru Agreement (PNA) headquarters were established in

RMI's capital of Majuro. In particular, PNA member countries succeeded in increasing economic profit despite placing a cap on catch volumes through the mutual adoption of the Vessel Day Scheme with fishing countries in 2011.

Under this scheme, PNA member countries are apportioned days fishing at sea, which can be sold to vessel owners and traded with other member countries. Member countries with good fishing crops whose allocated units of fishing effort in days have been sold out may choose to purchase additional units from other members. For example, in 2011 the number of days fishing at sea that was assigned to Papua New Guinea and the Solomon Islands were sold out due to bumper catches in the surrounding oceans. Both countries purchased additional days of fishing from FSM and RMI at the cost of several million dollars. This scheme has proven that it is possible to maintain resource levels while ensuring sizeable economic profit. In addition, the scheme has also provided a strong backing for advantageous negotiations with fishing nations such as Japan, United States, Australia, China, Taiwan and South Korea.

With regards to MPAs, the Republic of Kiribati established the Phoenix Islands Protected Area in 2008, which is the third largest of its kind after Papahānaumokuākea Marine National Monument in the northwestern Hawaiian Islands and the Great Barrier Reef in Australia. The Phoenix Islands MPA is well known for being designated as an UNESCO World Natural Heritage Site in 2010 (the Bikini Atoll in RMI was also named as a World Cultural Heritage Site in the same year).

2.3 Background to Selection of Republic of Palau as a Specific Area of Study

As the initiatives mentioned above are large-scale projects carried out at the national and regional levels, it is difficult to ascertain the extent of participation and involvement of the local community. This is because while local residents utilize resources of coastal areas on a daily basis, they do not use resources found in the oceans as often.

The main objective of this project is the construction of an effective protected area model that contributes to the realization of a sustainable society for local communities, one able to withstand environmental pressures and changes brought about by climate change and human activities. To that purpose, field studies were conducted on MPAs in small island coastlines, with which local residents share a close relationship. Consequently, the Republic of Palau was found to possess the following characteristics:

1) Efforts concerning the establishment of MPAs in Palau, which includes securing sustainable financial resources such as the Green Fee, have been carried out at a rapid pace. At present, Palau has advanced from the process of establishing MPAs to boosting its effectiveness. As such, there is a high level of interest amongst local residents, the government, NGOs and other related bodies in examining the nature of effective MPAs.
2) There are many people and organizations engaged in environmental conservation in Palau. There is also an abundance of available information and material.
3) The topography of Palau features a continuous link between watersheds, rivers, mangroves, seagrass beds and coral reefs.

Based on the above, the Republic of Palau was selected as a specific research site for this project because its versatility, sustainable use of resources and conservation of biodiversity makes it the most suitable site for the construction of an effective MPA model.

Figure.2.2. Map of the Republic of Palau. (Bureau of PAN)

Chapter 3 General Outline of the Republic of Palau

3.1 Basic Information

3.1.1 Geography

1) Land Area: 488 km^2
2) Territorial Waters: 629,000 km^2
3) Coastline Distance: 430 km
4) Latitude and Longitude: North latitude 2~8 degrees, east latitude 131~135 degrees
5) Average Annual Temperature and Humidity: Approximately 30°C, average 77%
6) Monthly rainfall: 200mm~400mm

3.1.2 Demographical and Social Statistics

1) Population: 19,907 (Palau Census 2005)
2) Rate of Population Growth: 0.8% (Palau Census 2005)
3) Per Capita GDP: 8,133 USD (2007, ADB)
4) Main Languages: Palauan, English
5) Religion: Christianity
6) Main Industries: Tourism, Fishery
7) Annual Tourist Visitation Rates: Approximately 110,000 (2011, Office of Planning and Statistics)

3.1.3 Politics

1) Official Country Name: Republic of Palau
2) Capital City: Melekeok State (relocated from Koror State in October 2006)
3) Form of Government: Presidential government. President and Vice President are elected directly by citizens. Term of office is 4 years.
4) Current President: Johnson Tribiong (Elected in January 2009, term of office 4 years)
5) Current Vice President: Kerai Mariur (Elected in January 2009, term of office 4 years)
6) Cabinet Ministers: 8 ministerial posts, appointed outside of Cabinet representatives
7) Congress: 2 Houses, the Senate (14 members) and the House of Delegates (16 members)
8) Relationship between nation and states: Palau is composed of 16 states; each state establishes its own constitutional conventions. States are under the jurisdiction of their respective state governments and the national constitution stipulates that the nation does not intervene in state matters. For example, each state's lands and oceans within 12 nautical miles of the coastline, including the management of all resources within the area, are under the jurisdiction of the respective state government.

3.1.4 Traditional Authorities

A number of chiefs are found in each state and the Council of Chiefs is composed of one traditional leader from each of the Republic's states. In Palau, four Paramount Chiefs consisting of a pair of male and female chiefs separately appointed from both the eastern region (Babeldaob) and the western region (Koror and the southwest islands) function as the country's Traditional Highest Authority.

These traditional titles are inherited by family lineage through women and their descendants. While traditional authorities do not hold executive powers in present society, they command respect from the people and are an integral part of Palauan society whose status is held in esteem even by the President.

3.1.5 National Government

1) Office of President

2) Ministries

① Ministry of Finance

Bureau of Budget and Planning, Bureau of National Treasury, Bureau of Public Service System, Bureau of Revenue, Customs and Taxation, Information Systems Support Services, etc.

② Ministry of State

Bureau of International Trade & Technical Assistance, Bureau of Foreign Affairs, Bureau of Domestic Affairs, Office of Protocol, etc.

③ Ministry of Justice

Attorney General Office, Bureau of Public Safety (BPS), Division of Marine Law Enforcement (DMLE), Division of Fish and Wildlife Protection (DFWP), etc.

④ Ministry of Natural Resource, Environment and Tourism (MNRET)

Bureau of Marine Resource (BMR), Bureau of Agriculture, Bureau of Protected Areas Network (Bureau of PAN), Bureau of Labor and Human Resource

⑤ Ministry of Public Infrastructure, Industries and Commerce

Bureau of Commercial Development (including Division of Transportation, Division of Communication), Bureau of Aviation, Small Business Development Center (SBDC), Bureau of Public Works (Energy Program, Division of Roads and Equipment, Capital Maintenance Project, Division of Facilities and Maintenance, Solid Waste Management, Division of Utilities, Water Treatment Plant, Outlying State Water Treatment System, Capital Improvement Projects), Bureau of Land and Survey, Office of the PALARIS: Palau Automated Land and Resource Information System (PALARIS)

⑥ Ministry of Health

Bureau of Hospital & Clinical Services, Bureau of Public Health

⑦ Ministry of Education

Bureau of Education, Division of Personnel & Management, Division of Research & Evaluation, Division of School Management, Division of Curriculum & Instruction

⑧ Ministry of Community and Cultural Affairs

Bureau of Community Services, Division of Parks and Recreation, Division of Youth, Belau Women's Resource Center, Bureau of Arts and Culture, Palau National Archive, Aging Program

3) The Council of Chiefs

The Council of Chiefs consists of 16 traditional leaders, one appointed from each state (please see [4] above). The council is an advisory body that ensures the preservation of traditional ways and the continued success of the democratic government in Palau. For instance, the Council of Chiefs must be consulted in the event that national laws are enacted, or if ratification of international regulations concerning the preservation of Palauan traditions by international bodies or at global conventions is required.

3.1.6 State Governments

The Republic of Palau has both a national government and Congress (there are 16 states with individual legislating bodies), as well as a high level of autonomy at the state-level. The names, population sizes and land areas of the 16 states of Palau are as follows:

1) Aimeliik	270 people,	52 ㎢
2) Airai	2,723 people,	44 ㎢
3) Angaur	320 people,	8 ㎢
4) Hatohobei	44 people,	3 ㎢
5) Kayangel	188 people,	3 ㎢
6) Koror	12,676 people,	18 ㎢
7) Melekeok	391 people,	28 ㎢
8) Ngaraard	581 people,	36 ㎢
9) Ngarchelong	488 people,	36 ㎢
10) Ngardmau	166 people,	47 ㎢
11) Ngaremlengui	317 people,	65 ㎢
12) Ngatpang	464 people,	47 ㎢
13) Ngchesar	254 people,	41 ㎢
14) Ngiwal	223 people,	26 ㎢
15) Peleliu	702 people,	13 ㎢
16) Sonsorol	100 people,	3 ㎢

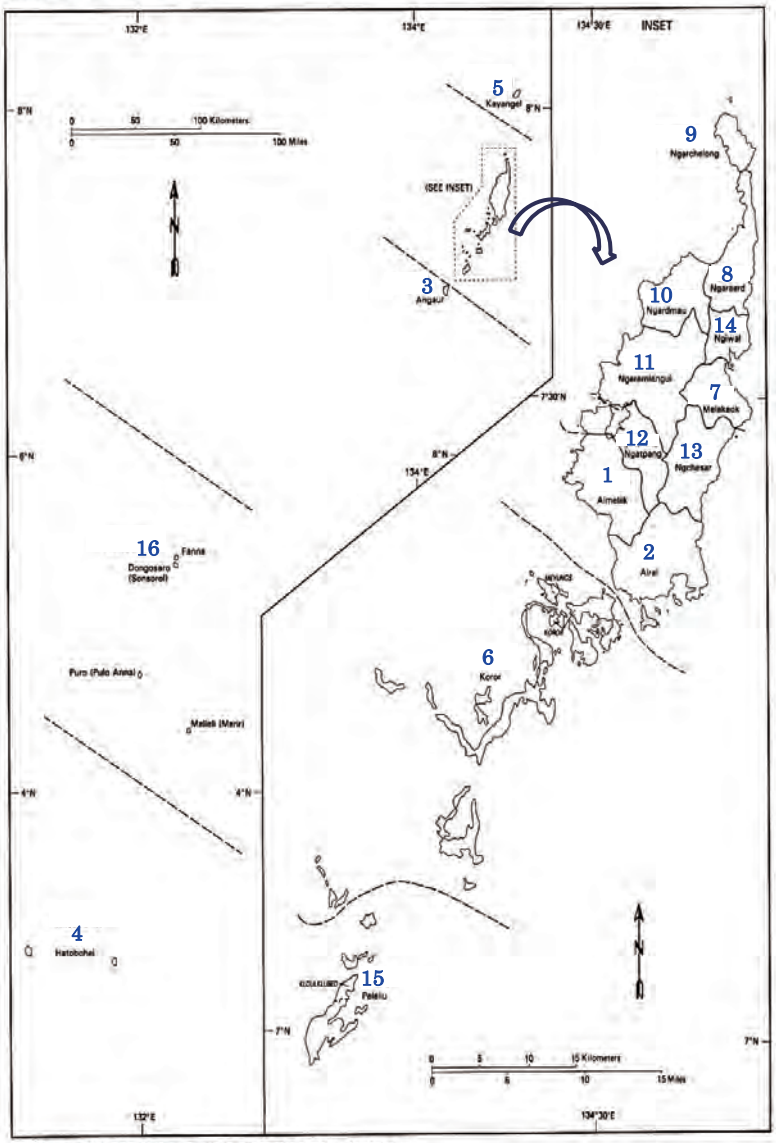


Figure.3.1. Administrative boundaries of the Republic of Palau.
(1990, Office of Planning and Statistics)

Of the national population of 20,000 people, approximately 13,000 reside in the former capital of Koror State, while 5,000 people reside in Babeldaob Island. The remaining 3,000 live in Airai State.

3.1.7 Nature

Palau is internationally renowned for its biological significance to the Earth's natural environment. In addition to numerous publications, the National Geographic Society chose Palau as the first "Underwater Wonder of the World." Palau's unique terrestrial and marine diversity gained additional international attention as one of the world's last living "Edens" by Discovery Channel. Although Palau may not be considered as one of the most biologically diverse countries in the world in terms of sheer number of species, Palau is home to a substantial number of species in terms of exclusivity.

1) Geological characteristics

The Republic of Palau is located in the westernmost part of the Micronesia region. It is represented by the volcanic island of Babeldaob, limestone islands shaped like mushrooms called the Rock Islands, low-lying limestone islands of Angaur and Peleliu or coral reefs such as the Helen Reef. Therefore, Palau has the following features distinguishing it from other countries in the Micronesia region;

① Home to the largest natural lake in Micronesia.
② Ngermeduu Bay is the largest estuary in Micronesia.
③ One of the largest undisturbed tropical rainforests in Micronesia.

2) Marine Biodiversity

Three ocean currents converge in Palau's waters and bring a rich diversity of nutrients that attract a large variety of marine life. These currents also transport larvae of many marine species to the archipelago making Palau's underwater environment one of the most diverse places on Earth. With the exception of Kayangel, Angaur, and the Southwest islands, all of the Palau islands are located within one barrier reef, therefore, numerous marine ecosystems exist in Palau. They include mangrove forests, seagrass beds, fringing reefs, barrier reefs, and marine lakes.

Characteristics of Palau’s marine biodiversity and its species are as follows:

① Supports more coral, fish, and other invertebrates per unit area of marine habitat than any other place on Earth.
② Home to the most isolated *Dugong* population in the world.
③ Home to seven of the nine species of giant clams.
④ Home to 400 species of reef-building corals.
⑤ Home to over 200 species of cnidarian, 300 species of sponges, 249 species of crustaceans, 100 species of ascidians, 2,000 species of mollusks, 70 species of flatworms, annelids and nemerteans.
⑥ Home to 10 species of seagrass.
⑦ Home to 1,387 species of fish, including 19 species of sharks.
⑧ Home to 11 species of ceteans and 1 species of dugong (endangered species).
⑨ Home to 4 species of sea turtles (all of which are listed as endangered species), 2 species of sea snakes and 1 species of crocodile (endangered species).
⑩ Home to 259 species of seaweed.

3) Terrestrial Biodiversity

Palau's landscape is dominated by highly weathered tropical soils of volcanic origin. These soils tend to be acidic, high in aluminum, low in nutrients and organic matter, and easily eroded. Palau's terrestrial habitats include nine types of primary forest totaling 77,248 acres （approximately 313 km^2）, dominated by upland forest followed by Mangrove forest. There are 2,741 acres （approximately 11 km^2）of agro-forests dominated by coconut stands and 21,068 acres of non-forested land, which include urban, grassland, and marsh areas. Only Babeldaob supports a complex watershed with a network of surface streams. All other landforms in Palau sustain a simple radial drainage pattern.

There are approximately 1,260 species and varieties of plants in Palau, of which 830 species are native. There are at least 194 species of endemic vegetation in Palau, the majority of which are located only in Babeldaob. Furthermore, there are 428 known invasive species in Palau.

Palau's terrestrial fauna includes:

① Approximately 5,000 species of insects.
② The largest number of resident bird species in Micronesia.
③ 141 species of birds, 11 species and 9 subspecies are endemic.
④ At least 40 species of freshwater fish of which 4 are endemic.
⑤ 46 species of terrestrial reptiles and amphibians.
⑥ 3 species of bat, 1 species and 1 subspecies are endemic.

（Palau Biodiversity, European Community 2010）

According to the International Union for Conservation of Nature (IUCN), Palau is said to have been a habitat of the *Pteropus pilosus*, a species of flying fox. While this species is thought to be extinct, Palau is home to many other types of endangered plant and animal life.

4) Development of Tourism and Over-Fishing

While the Republic of Palau has a rich abundance of nature, influence from human activities has led to growing disruption of the eco-system.

Annual tourist visits to the Republic of Palau are approximately 90,000 (as of 2010). With the start of the Narita-Koror flight route in December 2010, tourist figures are expected to increase further in future. Main tourist activities include diving, snorkeling and trekking, activities which have increased the direct burden placed on the natural environment. In addition, there is also concern that wastewater deposited by hotels may cause greater impact to the environment.

Soil runoff accompanied by road works is presently occurring on Babeldaob Island. With further development surrounding the construction of new hotels and golf courses expected in the future, direct environmental damage such as red soil runoff from construction works and increased sedimentation in coastal regions are expected to exacerbate further.

In addition, with the fear of over-fishing of sea cucumber in coastal regions, a legislative bill was submitted to the Congress in February 2010 to place controls on the fishing and export of sea cucumber.

3.1.8 Conditions Surrounding Land-Use

Continental areas of approximately 200 islands make up the national land of the Republic of Palau. Most of such continental areas are formed from coral reefs, and are low-lying and uninhabited.

90% of the population of the Republic of Palau resides in Koror State. Residential areas and resort hotels are concentrated in areas with gentle gradients. Babeldaob Island, which is included as one of the research sites for this project, is composed of 10 regions (see Fig. 3.2). The island is home to Palau's highest peak, Mount Nercherechus (242m), as well as a steep range of hills that are located longitudinally from north to south (Fig. 3.3). Surrounding this hilly area is a large expanse of forest, from which streams and rivers flow towards the seas and water catchment areas (see Fig. 3.2). In addition, mangroves are distributed in river mouths and coastal regions, while residential communities are found mostly along coastal lines and near river mouths. Agro-forests, the rearing of livestock and cultivation of agricultural crops in forest glades, can be found in the vicinity of residential communities (Fig. 3.4).

The southern part of Palau houses the nation's airport and functions as the center for logistics and tourism. Grass fields are located in forest interiors in a mosaic-like pattern. In 2006, the Republic's capital was moved from Koror State to Melekeok State in Babeldaob Island, where governmental buildings such as the new National Capitol Building were constructed. In addition, a compact road that circles the island and serves as a vital transportation infrastructure was completed in 2007. Land development on Babeldaob Island is expected to advance further in future.

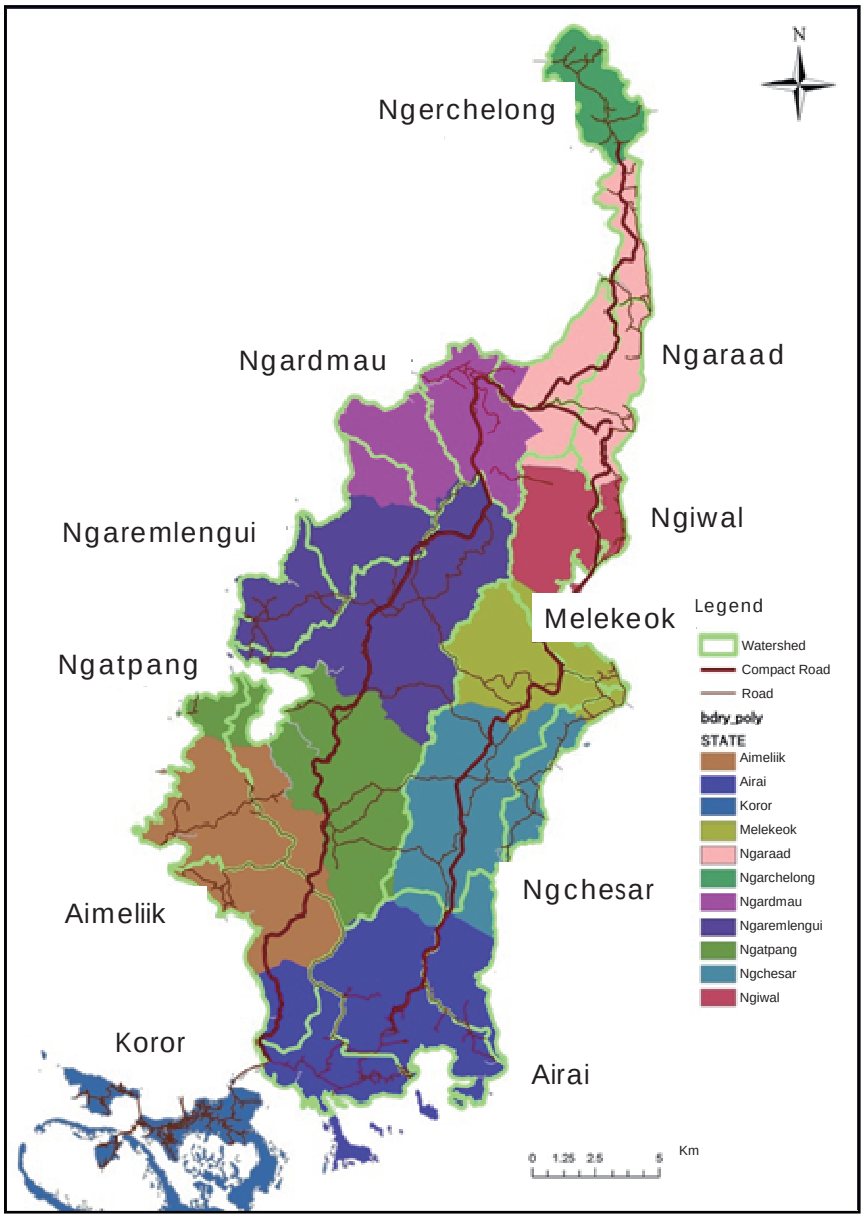


Figure.3.2. Administrative boundaries and Watersheds in the Babeldaob Island.
(2012, PALARIS and Ecosystem Conservation Society-Japan)

GIS data, vector data and DEM information provided by PALARIS have been input through the GIS software from the Ecosystem Conservation Society of Japan, the ESRI created ARC view ver.9.3 and ARC view ver.10, and processed into a selection of formats to produce the map images seen in this section.

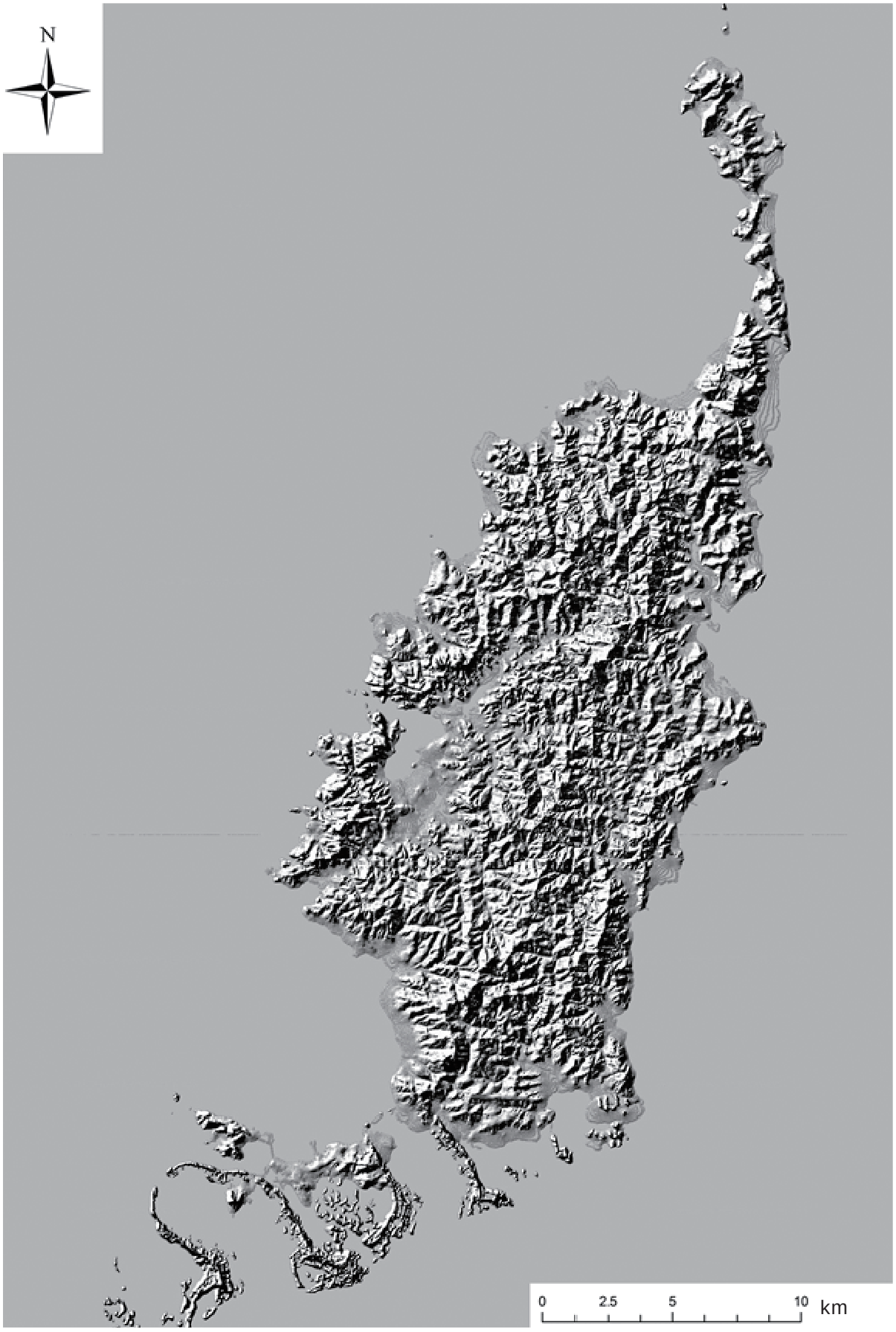


Figure.3.3. Land undulation shaded chart of the Babeldaob Island. (2012, PALARIS and Ecosystem Conservation Society-Japan)

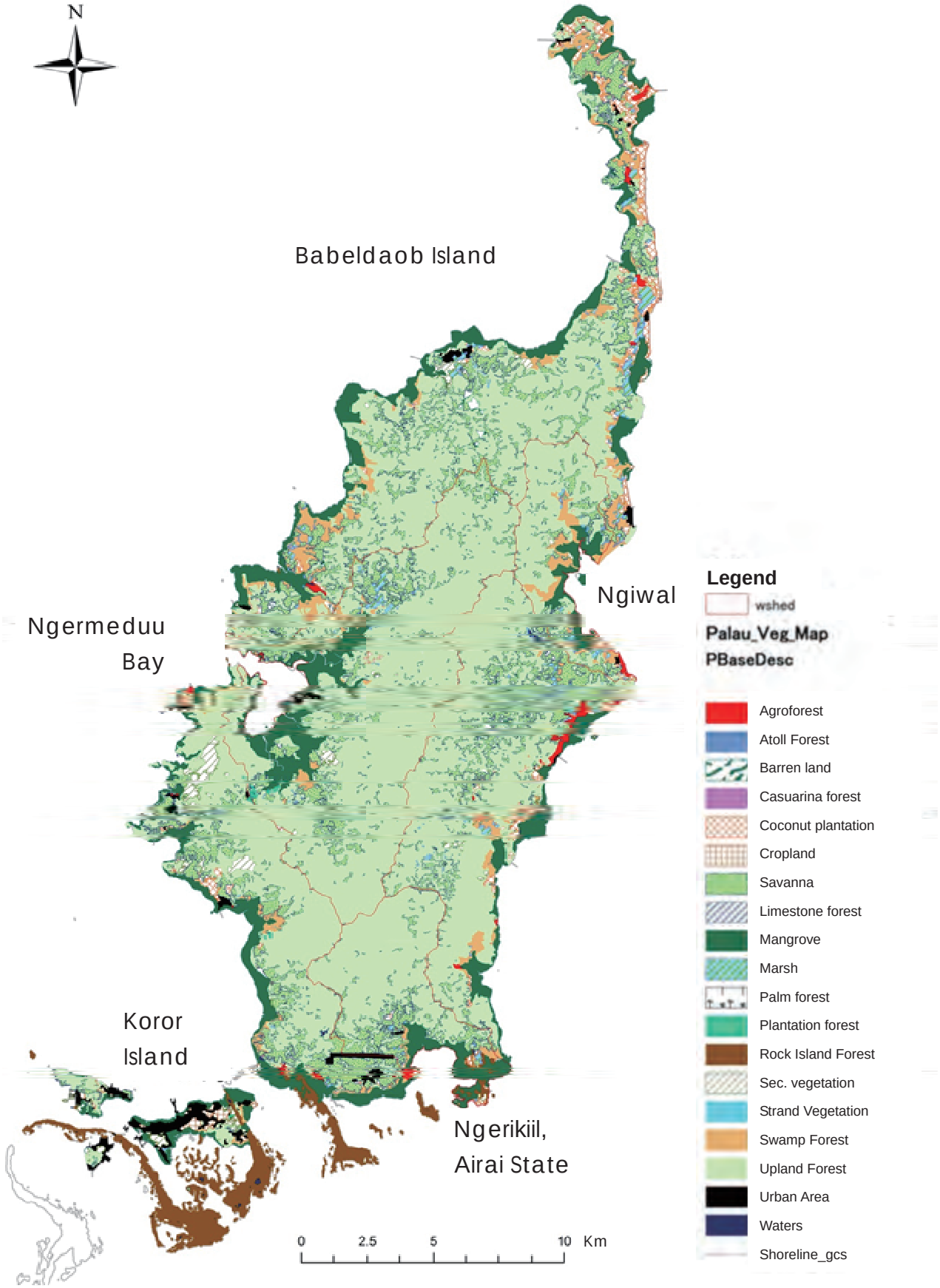


Figure.3.4. Current status of land-use of the Babeldaob Island. (2012, PALARIS and Ecosystem Conservation Society-Japan)

Figure.3.5. Road network of the Babeldaob Island (2012, PALARIS and Ecosystem Conservation Society-Japan)

3.2 Protection of Biodiversity and Needs for Sustainable Use of Resources

3.2.1 Demands on Establishment of Marine Protected Areas

1) Current status

Establishing marine protection areas in the Republic of Palau began with efforts on the state level (community level) in 1990s, aiming at resources recovery, due to the threat of marine resources depletion. State governments gained help from various NGOs in selecting and maintaining areas to be protected, however, there was little data on number or causes of resources depletion, which led to urgent establishing of many sanctuaries, whose entire managed area was designated entirely as no-fishing zones.

On the other hand, before the Republic of Palau gained independence in 1994, domestic and international NGOs turned their attention to biodiversity hot spots, which led to raising awareness on these issues in the Palauan society. As will be discussed hereafter, the nation's dependence on coastal fishing resources has decreased, which shifted the current status of marine protected areas from the efforts aiming at recovery of resources used to the efforts focused on protection of biodiversity.

2) Demands

After the Republic of Palau gained independence in 1994, government employment became more stabilized due to the financial support from the United States, based on the Compact of Free Association. Further, development of tourism industry in the late 1990s led to increase in opportunities for employment in this sector (currently there are both charter and scheduled flights to Palau from Japan, South Korea, Taiwan, Guam or the Philippines. Approximately 90,000 tourists visit Palau each year. Palau Visitors Authority). Therefore, the nation's purchasing power is increasing and the use of coastal marine resources for self-consumption is believed to be decreasing.

Furthermore, thanks to the success of the Green Fee, the state governments (communities) were able to stable financial support from the national government, through registering into the Protected Area Network. Therefore, the needs for current marine protected areas are related to financial support from the national government and gaining support from overseas organizations, rather than promotion of fisheries promotion based on sustainable use of resources.

3.2.2 Food Safety and Possible Changes in Demands in Marine Protected Areas

1) Shifts in GNI per capita

According to the World Bank, in 2009 the GNI per capita in the Republic of Palau was 6,220 USD, a figure that is significantly higher than that of RMI (3,060 USD) and FSM (2,500 USD). Palau's per capita GNI is also higher when compared to those of other countries in the Pacific region, including that of the economically stable Fiji (3,840 USD) and Samoa (2.840 USD.

Palau's GNI per capita was 4,990 USD when it gained formal independence in 1994. This began to exceed 6,000 USD after 1996 before charting a period of sharp growth from 2004 to reach 8,250 USD in 2007. The expansion in GNI per capita is thought to be attributed to positive growth in the tourism industry due to factors such as increased charter flights by Japan Airlines (JAL). However, while GDP per capita was 8,205 USD and 8,704 USD in 2008

and 2009 respectively, GNI per capita over the same period was 6,690 USD and 6,220 USD respectively, indicating a 25% decrease from 2007. This may be attributed to the fact that while Palau has a population of about 20,000, there are currently more than 5,000 foreigners from countries that include the Philippines, Taiwan, China, South Korea and Japan who are employed in the republic's tourism industry.

2) Household Income

Data from the Household Income and Expenditure Survey 2006 (HIES 2006) by the Office of Planning and Statistics indicates that of the domestic working population of 7,469, the 6,740 are engaged in waged work. The majority of salaried workers are employed as civil servants by the national and state governments. (The ODA White Paper of 2009 states that 70% of all employed workers in Palau are employed by the public sector.)

Fiscal resources for civil servant salaries are derived from tax revenue. A large portion also comes from fiscal aid based upon the Compact of Free Association with the United States. (According to the Office of Planning and Statistics, Palau's governmental revenue of US$83 million in 2006 was composed of US$29 million in tax revenue and US$ 45 million in fiscal aid.) Therefore, it is the civil servant salaries, not the tourism industry, that are the major income source of general households in Palau. Further, since most of the income source comes from the financial support from foreign countries, GNI per capita is influenced by such foreign assistance, especially the financial support from the United States.

3) Compact of Free Association with the United States (COFA)

For 15 years, between 1994 and 2009, the Republic of Palau was receiving financial support from the United States based on the 1st Compact of Free Association (Compact 1) (this period was extended for 2 years, therefore Palau continues to receive the support until 2011. The Compact of Free Association ends in 2044, however issues regarding the financial support are to be revised).

As of March, 2011, initiatives aiming at entering in the 2nd Compact of Free Association (Compact 2) are being undertaken. According to the 1st COFA, the government of Palau has the freedom to decide on how the financial support is to be spent, whereas under the 2nd COFA, however, it will be necessary to gain the approval of the U.S. government from the stage of drawing up the budget proposal, thus the freedom of budget implementation is to be limited (obligation to submit budget implementation reports every quarter is also to be imposed). In the Marshall Islands and the Federated States of Micronesia, which renewed their COFAs in 2004, the amount of financial support is gradually decreased annually towards the conclusion of the support in 2023. In exchange for this, it has been decided that the decreased amount is to be disbursed in a trust fund, however reducing government personnel expenses remains a challenge in both countries. The Republic of Palau, too, is urged by the U.S. government to reduce government personnel expenses in the process of negotiations on entering into the 2nd COFA.

It can be said that after entering into the 2nd COFA, it will be difficult to sustain the GNI per capita on the current level in the Republic of Palau.

4) Percentage of Consumption of Imported Foodstuff and Shifts in the Consumer Price Index (CPI)

Information from the Office of Planning and Statistics in 2006 indicates that while fish accounts for 4.2% of the total percentage of purchased commodities in the urban region with a population of 15,000, frozen chicken, corned beef and canned tuna occupy a combined percentage of 16.4%. In the rural communities where the population is

5,000, fish accounts for 12% of all purchased commodities while the combined percentage of frozen chicken, corned beef and canned tuna is 14.3%. If imported meat products (which has not been included in the percentages shown here) are taken into consideration, it can be inferred that the people of Palau depend on imported foodstuff for their protein requirements (imported frozen food products are included in the category for fish and seafood).

On the other hand, imported food prices across the Pacific island nations are influenced by transportation costs, which are in turn sensitive to changes in the price of fuel. Palau's non-core CPI between the three year period from June 2007 to June 2010 rose 15.82 points. In contrast, the CPI for food-related items jumped 31.39 points over the same time period. (Outcomes for the fourth quarter of 2004 have been used as the standard level for CPI values in 2007 and 2008. CPI figures after 2009 are based on standard values derived from fourth quarter results of 2008). The rise in CPI reflects the spike in world grain prices and the cost of crude oil from 2007 to 2009, and such high values have continued into the present.

5) The Possibility of Changes in Demand to Coastal Marine Resources

Against the possibility of a drop in GNI per capita in the Republic of Palau, a shift in demand from imported to domestic protein-based foods is likely if domestic consumption of protein-based foods remains at its present level or increases further, and if costs of imported foodstuff continue to rise. Under such circumstances, the use of coastal marine resources for personal and commercial consumption is expected to exhibit heightened demand.

Table 3-1. Quarterly Consumer Price Index (CPI) from June 2006 to June 2010 based on price index in June 2006 (Palau Office of Planning and Statistics)

Consumer Price Index - Summary Rebase = (June Qtr 2009)

Quarter	CPI	Quarterly % Change	Yr on Yr % Change
Jun-00	80.81		
Sep-00	77.11	-4.6%	
Dec-00	76.79	-0.4%	
Mar-01	77.26	0.6%	
Jun-01	77.18	-0.1%	-4.5%
Sep-01	76.77	-0.5%	-0.4%
Dec-01	76.11	-0.9%	-0.9%
Mar-02	85.02	11.7%	10.0%
Jun-02	76.03	-10.6%	-1.5%
Sep-02	75.96	-0.1%	-1.1%
Dec-02	75.24	-0.9%	-1.1%
Mar-03	75.47	0.3%	-11.2%
Jun-03	75.73	0.3%	-0.4%
Sep-03	75.89	0.2%	-0.1%
Dec-03	79.14	4.3%	5.2%
Mar-04	79.52	0.5%	5.4%
Jun-04	80.02	0.6%	5.7%
Sep-04	81.06	1.3%	6.8%
Dec-04	80.81	-0.3%	2.1%
Mar-05	81.67	1.1%	2.7%
Jun-05	82.79	1.4%	3.5%
Sep-05	84.69	2.3%	4.5%
Dec-05	84.88	0.2%	5.0%
Mar-06	86.20	1.6%	5.5%
Jun-06	86.76	0.6%	4.8%
Sep-06	88.05	1.5%	4.0%
Dec-06	87.90	-0.2%	3.6%
Mar-07	88.43	0.6%	2.6%
Jun-07	89.59	1.3%	3.3%
Sep-07	90.30	0.8%	2.6%
Dec-07	91.92	1.8%	4.6%
Mar-08	94.29	2.6%	6.6%
Jun-08	100.00	6.1%	11.6%
Sep-08	105.46	5.5%	16.8%
Dec-08	103.83	-1.5%	13.0%
Mar-09	102.37	-1.4%	8.6%
Jun-09	101.72	-0.6%	1.7%
Sep-09	102.76	1.0%	-2.6%
Dec-09	102.54	-0.2%	-1.2%
Mar-10	103.56	1.0%	1.2%
Jun-10	104.30	0.7%	2.5%

Chapter 4 Environmental Conservation Efforts in the Republic of Palau

4.1 Relevant Organizations

Various organizations are engaged in initiatives and assistance concerning environmental conservation efforts in the Republic of Palau. This chapter offers a brief introduction of the main environmental organizations in Palau. The term “Protected Area” used here refers to both Terrestrial Protected Areas and Marine Protected Areas.

4.1.1 National Organizations

1) Bureau of Protected Areas Network, Ministry of Natural Resource, Environment and Tourism (MNRET)

The Bureau of Protected Areas Network is an organization that was established based on the Protected Areas Network Act (PAN Act). It was upgraded from its former PAN Office status in 2011. The Bureau of PAN fulfills an important responsibility in managing and controlling the use of the Green Fee. While the organization is not directly involved in the establishment and maintenance of Protected Areas, the Bureau of PAN carries out technical assistance and human resource development, as well as the provision of maintenance fees for Protected Areas registered with the organization.

2) Bureau of Marine Resource (BMR), MNRET

BMR oversees negotiations with fishing nations engaged in tuna fishing in the EEZ, as well as the management of coastal marine resources in the republic. With regards to Marine Protected Areas (MPAs), BMR is involved in the management and sustainable use of resources based on the Domestic Fishing Law.

3) Palau Conservation Society (PCS)

PCS is a local NGO that was formed by a number of key figures shortly before the Republic of Palau gained independence. At present, the organization performs an essential role by engaging in practical support for environmental conservation in Palau through the conservation of ecosystems. PCS was also early in its move to introduce the concept of “Ridge to Reef”, which identifies the continuous inter-relationship between watersheds and coral reefs. Up until around 2008, PCS was engaged in assisting the establishment of terrestrial and marine Protected Areas with local communities, but its main responsibility presently lies with providing technological assistance for the registration of Protected Areas with PAN.

4) Environment Quality Protection Board (EQPB)

EQPB is a governmental organization that is crucial for its role in managing water sources and water quality in rivers found in Protected Areas (particularly with regards to pollution caused by chemical substances). For instance, the organization surveys changes to water quality due to the development of coastal zones (including the clearing of mangroves). With regards to Protected Areas, EQPB is closely involved in water flow from watersheds to coral reefs.

5) Palau Community College (PCC)

Established as a trade school in 1927 during the era of the South Sea Mandate of Japan, PCC was transformed into a 2-year vocational training college in 1969. At the end of the TTPI period in 1978, a series of partner agreements was concluded amongst relevant nations for the establishment of the College of Micronesia together with the two-year colleges of FSM and RMI. In 1993, the institution assumed its present full autonomous status as the Palau Community College under the supervision of then President Kuniwo Nakamura. As a school appointed by the Western Association of Schools and Colleges (WASC), students of PCC may have their attained credits transferred to WASC-appointed schools in the United States to earn academic degrees. Students of PCC have the opportunity to learn about the environment through the Environmental/Marine Science (ES) program. The college is also engaged in environmental campaigns for the protection of dugongs.

6) Office of the Palau Automated Land and Resource Information System (PALARIS)

PALARIS is a body found within the Ministry of Public Infrastructure, Industries and Commerce and receives assistance from the U.S. Department of the Interior for the analytical control of the Geographic Information System (GIS). Data collected through GIS is collectively generated from satellite imagery and on-site studies and functions as an important source of foundational knowledge for the study of vegetation and land use conditions, as well as the distribution of mangroves and coral reefs in Palau.

7) Division of Marine Law Enforcement (DMLE), Ministry of Justice (MOJ)

DMLE conducts crackdowns on IUU fishing (Illegal, Unreported, Unregulated fishing) in EEZ under the jurisdiction of Palau that is within a 12 to 200 nautical miles radius from Palau's coastlines. Vessels from Indonesia and the Philippines are a particular target for crackdown in the seas off the Southwest Islands, which are located close to both countries. MPAs addressed in this project belong to the coastal zone and therefore do not come under the direct jurisdiction of DMLE.

8) Division of Fish and Wildlife Protection (DFWP), MOJ

Based upon the Environment Protection Act, DFWP engages in crackdown activities aimed at the protection of wildlife such as dugongs, Napoleon fish and sea turtles. Enforced areas include oceans located within 12 nautical miles from coastlines governed by each state. DFWP responds to requests for crackdowns by state governments.

9) Belau National Museum (BNM)

The activities of BNM are led by botanist Dr. Ann H. Kitalong and ornithologist Dr. Alan R. Olsen, two former U.S. Peace Corps members who have lived in Palau for many years after marrying members of the local community. Dr. Kitalong is mainly in charge of collecting and managing botanic samples as well as conducting research on the distribution of plant species. On the other hand, Dr. Olsen has been working closely with fellow Palauan ornithologist Mr. Milang Eberdong to survey changes in the population figures of different birds in order to collect data that serves as a form of land environment index. While such research data has yet to be fully utilized in environmental conservation efforts in Palau, the information is crucial when planning future initiatives for the protection of terrestrial ecosystems.

10) Belau Watershed Alliance (BWA)

BWA is a collective body established for the mutual management by state governments of water catchment areas that extend across state borders in Babeldaob Island. The organization was known earlier as the Babeldaob Watershed Alliance, but assumed a different name after being placed in charge of water catchment areas across Palau. While marine territories within a 12 nautical mile distance from coastlines belongs to the state, land in Palau may be owned by individuals, families and the state. Wide-reaching alliances like BWA are effective in promoting understanding amongst local residents on the importance of protecting water catchment areas as a form of collective property.

11) Etpison Museum

The Etpison Museum is a privately-run museum established by Mr. Shalom Etpison, the eldest son of the late fourth President, and his Holland-born wife, Ms. Mandy Etpison. The Etpisons have played a pioneering role in many wildlife conservation activities in Palau, including the protection of dugongs. They are also active in book publishing and have released many valuable photographic materials related to Palau.

12) State Governments

State governments are bound by the national constitution to see to the management of all state lands and coastal marine areas found within a 12 nautical mile distance from state coastlines. As such, MPAs and Terrestrial Protected Areas dealt with in this project are subject to resource management and control, as well as crackdowns on IUU fishing based on the laws of the state concerned. While the national government does not intervene in such management activities with the exception of rendering protection to wildlife as defined by state laws, the country may become involved once Protected Areas are registered with PAN. In addition to the large amount of tourist resources and a sizeable resident population in Koror State, the state also has available human resources and sufficient funds to conduct its own regulatory activities. However, states with lesser funds and manpower rely on cooperative assistance from the national government. Such states also receive technical support from PCS and PICRC.

4.1.2 Micronesia Regional Organizations

1) Micronesia Challenge (MC)

MC is a regional organization established in 2006 by the Republic of Palau, FSM, RMI, Guam and CNMI based upon the Micronesia Challenge Initiative, which is aimed at the protection of regional terrestrial and marine resources. Rather than organizing activities targeted at each Protected Area, the body is concerned with sharing information concerning conservation efforts and the holding of workshops for the nurturing of trained talent and personnel. MC also aims to expand regional networks to boost connections with PAN organizations established in other countries and regions.

2) Micronesia Conservation Trust (MCT)

The MCT is a trust fund operation body established with assistance from TNC for environmental conservation in the Micronesia region. Its regional conservation efforts are mostly concentrated in the FSM state of Pohnpei. MCT

is also in charge of managing the Micronesia Challenge Endowment Funds that have been set up separately in the Republic of Palau, FSM and RMI.

3) Palau International Coral Reef Center (PICRC)

Based on an agreement reached after a series of comprehensive US-Japan negotiations in the 1990s, PICRC was established in 2001 at the extension of gratuitous financial aid from the government of Japan. The center is largely responsible for the monitoring of coral reefs, sedimentary research and technical assistance for the local community. While activities are targeted mainly at the Micronesia region, its base of operation is in Palau. PICRC organizes a variety of workshops with support from JICA and NOAA.

4.1.3 Pacific Regional Organizations

1) The Secretariat of the Pacific Regional Environment Programme (SPREP)

Based in the Independent State of Samoa, SPREP engages in conservation activities for dugongs and other critically endangered species found in the Pacific island nations and jurisdictions. The organization also runs projects regarding solid waste management.

2) Secretariat of the Pacific Community (SPC)

Headquartered in New Caledonia, SPC tackles developmental issues surrounding the Pacific island nations and jurisdictions. With regards to the environment, SPC has conducted the Integrated Water Resource Management (IWRM) Program in recent years. EQPB is the representative body for the Republic of Palau.

4.1.4 International Organizations and NGOs

1) Japan International Cooperation Agency (JICA)

With regards to matters concerning the environment, JICA dispatches volunteers and experts, and offers technical support through moves such as the rendering of grant assistance.

2) Government of Taiwan, Republic of China (R.O.C.)

The government of Taiwan promotes the establishment of Protected Areas by offering a majority of state governments approximately 15,000 USD of financial aid per Protected Area to cover the initial establishment expenses such as the installation of buoys.

3) The National Oceanic and Atmospheric Administration (NOAA), the United States Department of Commerce

NOAA offers assistance with regards to nurturing of trained professionals through cooperation with PICRC and other local environmental groups in Palau.

4) Global Environment Facility (GEF)

GEF provides funding to the Micronesia Challenge Endowment Fund and programs run by IWRM.

5) University of Hawaii (UH)

A team led by Prof. Robert H. Richmond, President of the International Coral Reef Society and specialist on Integrated Coastal Zone Management (ICZM), has been carrying out programs for research and training in the Republic of Palau, FSM, Guam and Hawaii with regards to the establishment of Protected Areas that take into account the continuity from watersheds to coral reefs.

6) The Nature Conservancy (TNC)

An international environmental NGO headquartered in the United States, TNC has set up operation branches in countries such as the Republic of Palau and FSM to render cooperation regarding environmental conservation to governments and local communities. TNC is also closely involved in the Micronesia Challenge Initiative, and is currently providing funding to the Micronesia Challenge Endowment Fund, which has been set up within MCT, by committing to match pledged funds 1:2.

7) Conservation International (CI)

Like TNC, CI is an international environmental NGO that is also based in the United States. Within the Pacific region, CI has given particular focus to Melanesia. Its work in the Micronesia region presently involves fund provision by committing to match pledged funds to the Micronesia Challenge Endowment Fund 1:2.

4.2 Environmental Conservation Efforts in the Republic of Palau after the Establishment of the Autonomous Government

4.2.1 National Government and State Governments

In 1981, a national government and 16 state governments were set up in Palau. Resources were placed under the ownership of the respective state governments and a delegate was appointed and sent to represent each state at the national government. While traditional authorities only possess advisory power at the level of national politics, they play a powerful role at the state (regional) level within boundaries defined by state constitutional laws.

4.2.2 Efforts Undertaken by the Autonomous Government

In the 1980s, efforts towards environmental conservation were beset by difficulties due to insufficient funds, an unstable domestic political situation and friction with the United States surrounding Palau's path to independence. With support from the Japanese government in 1983, Palau was able to upgrade its fishing vessels, ice machines and fishing equipment, as well as embark on improvement plans for its fishing ports. Technical assistance was also conducted through SPC. In 1985, Palau was found with a lack of trained specialists, organizational bodies, fishing control regulations (laws), in addition to insufficient data regarding ecosystems and the fishing industry. Subsequently, advice was sought from local fishermen and traditional authorities, and a significant number of specialists were deployed to bridge the gap that existed between the national government and knowledge that was found at the regional level. In addition to enhanced enforcement abilities and establishment of the Domestic Fishing

Law, the national government's efforts were focused on the development of Protected Areas.

The following concrete activities were conducted:

① Year 1988: Clauses regarding environmental conservation were introduced into existing laws in 1988.
② Year 1988: A survey of the Seventy Islands was carried out with assistance from SPREP.
③ Year 1989: Collection of fishing output and personal consumption data with assistance from SPC.
④ Year 1989: Consultation meetings with fishermen held with support from the Forum Fisheries Agency (FFA).
⑤ Year 1989: Pilot oceanographic survey of Babeldaob Island by EQPB.
⑥ Draft Domestic Fishing Law by TNC.
⑦ Years 1991 to 1993: Execution of Rapid Ecological Assessment (REA) of Southwest Islands and Palau Islands by TNC and Greenpeace.
⑧ Year 1993: Introduction of mooring buoys to diving spots in Koror State by TNC and Greenpeace.

4.2.3 Achievements as of Year 1995

Based on the above-mentioned initiatives, the following achievements were observed in 1995, shortly after Palau gained independence.

① Establishment of implementing agencies at the national level
② Enactment of Domestic Fishing Law
③ Application of first-ever modern Protected Area to coral reef channel located in Ngarchelong State (presently Ebiil Conservation Area)
④ Start of activities led by PCS
⑤ Ban on fishing by Koror State in main diving sites
⑥ Formal independence as Free Association State with the United States

Subsequently, activities were initiated by PCS to enlighten local regions about modern Protected Areas. Koror State moved to develop management capacities for Rock Islands Southern Lagoon (RISL) and also embarked on relationship-building with the tourism industry. Efforts for the establishment of Protected Areas within communities found in Kayangel State, Melekeok State, Hatohobei State and Ngarchelong State were also carried out.

4.2.4 Achievements Up Until Year 2005

Practical initiatives were conducted beyond 1995 to yield the following achievements by 2005.

① Revision of Dugong Act
② Enactment of Shark Fishing Ban
③ Enactment of PAN Act
④ Establishment of DFWP and MOJ
⑤ Setting up of PICRC

Based on the developments listed above, more practical and substantial measures such as the strengthening of management capacities and PAN organizational structure at the local level, together with the reinforcement of benefits of environmental conservation on local communities continue to be carried out.

4.2.5 Efforts Undertaken after Year 2006

After 2006, the following initiatives have been put into place with the aims of guaranteeing sustainable financial resources to ensure lasting efforts for environmental protection and the execution of measures for more effective conservation.

① Micronesia Challenge Initiative

② Enactment of Revised PAN Act

③ Introduction of Green Fee

4.3 Regulations: Palau National Code Annotated (PNCA)

PNCA is a set of laws enacted by the National Congress of the Republic of Palau. Laws are divided into themes and sub-divided into 42 titles. The most relevant regulations that directly concern this project may be found in the following titles: TITLE 24 ENVIRONMENTAL PROTECTION (24 PNCA), TITLE 27 FISHING (27 PNCA), TITLE 35 PUBLIC LANDS (35 PNCA), TITLE 39 REAL AND PERSONAL PROPERTY (39 PNCA).

4.3.1 TITLE 24 ENVIRONMENTAL PROTECTION (24 PNCA)

24 PNCA is divided into three sections, mainly Division 1 - Environmental Quality, Division 2 - Wildlife Protection and Division 3 - Preserves and Protected Areas. Particular attention will be given to the following content in Division 2 and 3, which are namely concerned with the management of MPAs.

1) Division 2 Wildlife Protection

① Chapter 10 Endangered Species Act

A law aimed at conserving endangered species and other plant and animal life under the threat of extinction in the Republic of Palau by prohibiting the hunting, possession, export and other commercial activities surrounding such wildlife. Transgression of this regulation results in a fine of no more than 10,000 USD and/or imprisonment of no more than 1 year.

② Chapter 12 Protected Sea Life

A regulation targeted at protecting sea life in the Republic of Palau that initially consisted of 8 Subchapters. 6 Subchapters currently remain after Subchapter VI (Clams) and Subchapter VII (Cultured Species) were repealed.

This law stipulates protection of various types of sea life as follows: Subchapter II – Sponges, Subchapter III- Mother-of-Pearl, Subchapter V – Trochus and Subchapter VIII – Turtles.

In particular, notes found under “Subchapter I General Provision; Enforcement §1201 Definitions”, as well as “Subchapter IV Dugong §1231 Conservation of Dugongs” define regulations for the protection of dugongs.

③ Chapter 13 Illegal Methods of Capture

Chapter 13 is made up of 2 Subchapters. In “Subchapter I Fishing with Explosives, Poisons or Chemicals”, fishing with the use of materials that destroy sea life such as explosives, poisons or chemicals, possession and sale of sea life that has been hunted with the use of the above-mentioned materials, as well as the setting up of such materials in oceans specifically for the purpose of hunting sea life, are expressively prohibited unless carried out under the permission from the President. Transgressors to this regulation will be subject to fines between 1,000 and 10,000 USD or be imprisoned for a period between 3 months to 2 years. Depending on circumstances, both a fine and jail term may be imposed.

In “Subchapter II Other Prohibitions”, the use of explosives and poisonous substances in the seas of the Republic of Palau, as well as the hunting of sea life that has been killed or rendered unconscious by explosives and poisonous substances are prohibited unless permission for such activities has been obtained from the President. (Punishment for transgression is the same as those for Subchapter I).

④ Chapter 14 Protected Land Life

Within “Subchapter I Birds, §1401 Conservation of Birds”, the hunting of bird species with the exceptions of *Gallus gallus, Porphyrio porphyrio, Kakatoe galerita* and *Halycon chloris* are banned. Contravention results in an imprisonment term of no more than 6 months or a fine of 100 USD (old stipulation that has yet to be revised).

Figure.4.1. A salt-water crocodile found at the Jellyfish Lake (Department of Conservation and Law Enforcement, Koror State Government)

⑤ Salt-Water Crocodile, *Crocodylus porosus*

In the first field study conducted in January 2011, discussions were conducted concerning the designation of the salt-water crocodile as a target for protection due to its status as a species endemic to Palau that is currently vulnerable to the threat of extinction.

Data investigation revealed that salt-water crocodiles are found widely in Southeast Asia, Melanesia and Australia. According to local accounts, salt-water crocodiles were first brought into the Republic of Palau by Germans before WWI, while other descriptions state that they were brought to Palau by the Japanese during the Japanese Mandate Era. With the start of high buying prices for crocodile leather by Japanese merchants during the 1980s in the Republic of Palau, the population of salt-water crocodiles shrank significantly from 2000 to just 200, leading to moves to contain the hunting of crocodiles.

Based on the IUCN Endangered Species Red List, salt-water crocodiles were designated as EN (Endangered) until 1988 before its status was improved by one rank to VU (Vulnerable) in 1994. At present, the species is specified as being LC (Least Concern), and their population numbers have since recovered

considerably. By being removed from the list of endangered species, salt-water crocodiles are no longer part of the list of wildlife subject to law-enforced conservation in Palau.

However, even though the salt-water crocodile is not designated as a protected wildlife species, it is not being aggressively hunted at present. As a consequence, salt-water crocodiles can be seen in Jellyfish Lake and other parts of Rock Islands, as well as on Babeldaob Island. There are also concerns that the crocodiles may pose a as a safety hazard to tourists and local fishermen.

2) Division 3 Preserve and Protected Areas

① Chapter 30 Ngerukewid Islands Wildlife Reserve

Established in 1956 before formal independence, this Protected Area is known as Seventy Islands and is located in the southwestern region of the Rock Islands Management Area in Koror State (see Fig. 4.2, No.36). Entry without permission is prohibited. The Palau National Government aimed to have the Protected Area and the Rock Islands Management Area inscribed to the UNESCO World Heritage List, but the area was designated as a mixed (natural and cultural) site in July 2012.

② Chapter 31 Ngerumekaol Spawning Area

A spawning area for groupers that is located in a barrier reef in the western part of the Ngerukewid Islands Wildlife Reserve. Fishing in this area is prohibited between 1st April and 31st July each year, when spawning season occurs (see Fig. 4.2, No.37).

Ngerukewid Islands Wildlife Reserve and Ngerumekaol Spawning Area are the only two Protected Areas placed under national governance by the Republic of Palau.

③ Chapter 33 Palau International Coral Reef Center

With an established organizational operation, PICRC was set up as a non-profit organization and its activities are specifically limited to scientific research, studies and education.

④ Chapter 34 Protected Areas Network

Chapter 34 consists of two Subchapters. The “Subchapter I Protected Areas Network” stipulates the role and definition of PAN and its relationship with both the Micronesia Challenge Initiative and the national government. In particular, “§3413 Environmental Protection Fee” formally identifies “green fee” as the “Green Fee”. “Subchapter II Protected Areas Network Fund” describes detailed workings of the PAN Fund (PANF), which manages and controls aid for environmental conservation from the Green Fee and the Micronesia Challenge Endowment Fund.

4.3.2 TITLE 27 FISHING (27 PNCA)

27 PNCA is divided into “Division 1 Foreign Fishing” and “Division 2 Domestic Fishing”.

1) Division 1 Foreign Fishing

Regulations are stipulated for fishing activities and fishing rights for foreign fishing vessels in the EEZ, as well

as penal provisions. Penalties for contravention are harsh and set at a maximum limit of 500,000 USD. An expressive ban on shark fishing is also defined in this division.

2) Division 2 Domestic Fishing

Regulations for banned fishing and penalties are stipulated in the Chapter 12 Marine Protection Act of 1994. Laws were revised in 1998, 2002 and 2007, and punitive provisions were also further strengthened. With regards to fishing activities, protection for sea life that has been specified in “24 PNCA Chapter 12 Protected Sea Life” is also defined here.

4.3.3 TITLE 35 PUBLIC LANDS (35 PNCA)

“Chapter 1 General Provision” sets out items concerning the establishment for Terrestrial Protected Areas.

1) §101 “Public lands” defined.

“Public lands” refer to land owned or managed by the Japanese South Sea Mandate and the TTPI government, or national land and domains acquired for public purposes by the national government.

2) §102 National government as owner of areas below high watermark; exceptions

Apart from a number of exceptions, areas below high watermark are defined to be under the ownership of the national government. In addition, clearing of mangroves, together with infliction of damage to lands adjacent to mangroves, are prohibited.

While the regulations concerning publicly-owned lands have been legally defined, there remains much contestation with regards to land ownership between national and state governments against private individuals

4.3.4 TITLE 39 REAL AND PERSONAL PROPERTY (39 PNCA)

“Chapter 3 Land Ownership Generally” stipulates items concerning land ownership rights for Protected Areas.

- Only citizens of Palau may own land located within the Republic of Palau.
- Publicly-owned lands leased by the national government to foreigners and foreign corporations have a maximum lease term of 99 years with the option of renewal.
- Privately-owned lands may be leased to foreigners and foreign corporations for a maximum term of 50 years and an option for a renewal term of an additional 49 years.

4.4 Efforts Surrounding Sea Life Protection - Dugong Conservation

4.4.1 Importance of Protecting Dugongs

Countries such as Australia are home to large populations of dugongs living in the wild. However, dugongs are

being found in increasingly lesser numbers in Japan and Southeast Asia, making them a species of wildlife that has often been identified with efforts for environmental conservation. In Japan, the dugong has been designated as an endangered animal by the nation's Fisheries Agency and has also been named as a protected species. The dugong has been given mention in Annex I of the Washington Convention.

In order to protect dugongs, their natural habitats have to be preserved. Ideally, seagrass beds, which provide dugongs with their staple diet of seagrass, should be conserved together with migration waters used by the animals. Seagrass beds are ecosystems with a high level of biodiversity that includes not only seagrass, but a variety of other marine life such as fish, crabs, shrimps, shellfish, sea cucumbers, sea urchins and starfish. As such, the protection of dugongs may also be said to be the conservation of biodiversity.

Coastal zone environments share a close inter-relationship with terrestrial ecosystems. In general, coral reefs are oligotrophic and do not contain sufficient nutrients for plant life. However, it is thought that plants such as seagrass rely on nutrients that flow from land areas. The continuous inflow of an optimum amount of nutrients that serve to maintain seagrass beds is important in order to preserve the well-being of seagrass bed ecosystems. Such understanding of the relationship between terrestrial areas and coastal zones are crucial for the conservation of dugong populations.

As dugongs have now become the symbol for nature conservation and environmental protection, discussions on dugongs serve to elevate overall awareness concerning the protection of nature. In Palau, whose waters provide a living environment for dugongs, debates surrounding management of MPAs will not be complete without discussions on dugongs and their natural habitats.

4.4.2 Dugongs in the Republic of Palau and Types of Threats to Dugong Habitats

In the Micronesia region, dugongs are found only in the Republic of Palau, where they inhabit coastal marine areas in Koror Islands and Babeldaob Island, waters with abundant supplies of their staple diet of seagrass. While dugongs have been elevated to vulnerable status on the IUCN Red List, their population in Palau has been placed at around 50-200. Dugong populations increase at a low rate of 5% annually (the period from gestation to birth for dugongs is 13 months, and only one cub is born at the time of birth. Female dugongs require 2-7 years to prepare for their next gestation cycle. In addition, death from natural causes account for a reduction of some 5 dugongs a year.), making Palau one of three sites in the world where dugong populations are facing the highest threat of extinction.

As part of tradition in the Republic of Palau, bones from the necks of dugongs have been passed down as symbols of power and authority for traditional chiefs. In addition, dugong meat served as a source of food before meat was imported for domestic consumption. At present, dugong bones are a prized collector's items and dugong meat is still being consumed in some parts of Palau.

The biggest threat facing dugong populations in the Republic of Palau is not deterioration of natural environments, but poaching. While poaching has been banned by conservation laws, the practice continues to be carried out by a number of particular people, who also engage in the sale of poached dugong meat. In 2010, 11 dugongs were killed as a result of poaching.

4.4.3 Strengthening of Dugong Conservation Efforts

As mentioned in earlier sections, the protection of dugongs is stipulated under 24 PNCA §1201, 24 PNCA §1231 and 27 PNCA §1204.

While dugongs were not a target for protection at the time of Palau's independence in 1994, revisions to national laws in 1998 placed the animals in the protected species list. Despite this, punitive penalties for the killing and possession of dugongs remained as the imposition of a jail term of no more than 6 months and/or a fine of no more than 50 USD for first-time offenders, and a jail term of no more than 1 year and/or a fine of no more than 100 USD for felony transgressions.

Against the strengthening of efforts for dugong protection in 2002, laws were further enforced for stricter penalties. Revised regulations formally acknowledged the need for provisions and development of special programs to bring about an increase in dugong numbers, preservation of dugong habitats and also promotion of education for the public. Contravention to protection laws now carried heavier punishment, namely a jail term between 3 months to 1 year or a fine of more than 5,000 USD for first-time offenders, and a jail term of between 6 months to 3 years or a fine of more than 10,000 USD for felony transgressions.

In addition, those found guilty of poaching dugongs will have their hunting boats and other possessions seized by the national government. Individuals who report poaching offenders to the Attorney-General will be given a reward amounting to 50% of the fine imposed on the offender. Revised regulations also stipulate that the authority to enforce crackdowns on offenders has been invested in staff members of MNRET by the Public Security Department, state police and national ministers.

However, due to the existence of people and families who still engage in the tradition of hunting dugongs for their meat, special opportunities for the capture of a limited number of dugongs is allowed each year. While the individuals who carry out such hunting activities have been identified by relevant authorities, apprehension to the law has been requested in place of the enforcement of strict penalties due to concerns surrounding the effect on traditional societies.

4.4.4 Dugong Conservation Efforts by the Private Sector

The "I Love Mesekeu" campaign is an initiative led by Ms. Mandy Etpison of the Etpison Museum. The campaign serves to educate members of the younger generation (tertiary students and younger) that "dugongs are not food but friends" through the production of brochures and a variety of goods, as well as the distribution of posters and stickers.

4.4.5 Other Areas of Sea Life Protection

Other notable examples of wildlife protection include the ban on the hunting of Napoleon fish and sharks in EEZ, including coastal marine areas. Efforts have been taken by educational institutions to instill in children that "sea turtles are friends" that deserve to be protected. Such efforts have led to negative attitudes towards the hunting and eating of sea turtles amongst members of the younger generation.

4.5 Protected Areas

4.5.1 Current status of establishment of protected areas

In 2011, there were 32 marine and 9 terrestrial protected areas (Table 4-1, Figure 4-3. This accounts for 45% of coastline and 10% of terrestrial areas. This means that the target of 30% for coastline areas set forth by the Micronesia Challenge Initiative has already been achieved, and the efforts aimed at achieving the target of 20% for terrestrial areas are progressing as well (as of May, 2012, number and land size of protected areas is increasing. Details shall be given in Chapter 7).

Current challenges include raising the effectiveness of enlisting each protected area into the protected areas network and expanding terrestrial protected areas related to landownership issues. Further, conservation taking into account continuity of terrestrial and coastline areas, is also regarded as crucial.

4.5.2 Definition and Classification of Marine Protected Areas

In order to protect biodiversity such as coral reefs and also to conserve and multiply marine resources, the system of MPAs has been put in place to manage areas targeted for conservation. While common definitions have yet to be formalized, the following descriptions for MPAs, as well as categories for IUCN-appointed protected areas (including terrestrial protected areas) have been set by IUCN and the Convention of Biodiversity.

1) Definitions of MPAs

① IUCN 1994

Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment.

② IUCN 2008

A protected area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values.

③ CBD-COP7 2004

Any defined area within or adjacent to the marine environment, together with its overlying waters and associated flora, fauna, and historical and cultural features, which has been reserved by legislation or other effective means, including custom, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings.

2) Classification of Protected Areas (IUCN)

Ⅰa：Strict Nature Reserve

Ⅰb：Wilderness Area

Ⅱ： National Park

Ⅲ： Natural Monument or Feature

Ⅳ： Habitat/Species Management Area

Ⅴ： Protected Landscape/Seascape

Ⅵ： Protected Area with Sustainable Use of Natural Resources

4.5.3 Definition and Classification of Terrestrial Protected Areas

1) Types of Terrestrial Protected Areas

As discussed previously, marine conservation areas are referred to collectively as MPAs (Marine Protected Areas). Terrestrial protected areas, on the other hand, are classified under various names. The following is the classification types of terrestrial protected areas used in the Republic of Palau:

・Management Area

・Conservation Area

・Wildlife Conservation Area

・Conservation area Set Aside

・Bird Sanctuary

・Nature Reserve

・Important Bird Area

2) Location and scale of Terrestrial Protected Areas

Location of terrestrial protected areas is indicated in Figure 4-4 and their scale in Table 4-2. Marine Protected Areas are widely established in the Republic of Palau, whereas the terrestrial protected areas account for as little as 2% of the total land area. Furthermore, there are no terrestrial protected areas established in Koror Island (As of May, 2012, the number and land area of terrestrial protected areas is increasing. Details shall be discussed in Chapter 7).

3) Jurisdiction over Terrestrial Protected Areas

Many of the protected areas are governed based on state laws.

Figure.4.3. Location of Protected Areas of Palau (2011, Bureau of Protected Area Network, Palau) – red arrows indicate protected areas

Table 4-1. List of Marine Protected Areas (Bureau of Protected Area Network, Palau)

	Name of Protected Area	State	Established Year	Area	Biodiversity	Protected Species
1	Ngeruangel Reserve	Kayangel	1996	34.96 km2	Atoll, Coral reef, Lagoon	Fish, Turtle, Invertebrate
2	Ebill Conservation Area	Ngarchelong	1999	19.11 km2	Coral reef	All marine life
3	Lleyakl Beluu	Ngardmau	2005	0.62 km2	Coral reef	Fish, Edible invertebrate
4	Ngermasech to Bkulachelid Conservation Area	Ngardmau	1998	2.93 km2	Mangrove, Seagrass bed, Coral reef	Fish, Edible invertebrate
5	Mangrove Conservation Area	Ngaraard	1994	1.42 km2	Mangrove	Mangrove
6	Bkul A Beluu	Ngaremlengui			Coral reef	
7	Bkulengriil Conservation Area	Ngaremlengui	2006	1.5 km2	Mangrove, Reef flat	All marine life
8	Oruaol Libuchel Reef	Ngatpang	1999	0.15 km2	Patch reef	Tridacna
9	Crab Conservation Area	Ngatpang	1999	0,15 km2	Mangrove	Blue crab
10	Fish Conservation Area	Ngatpang	1999	0.15 km2	Mangrove, Seagrass bed, Coral reef	Fish
11	Ngermeduu Conservation Area	Ngaremlengui, Ngatpang, Aimeliik	1999	98.00 km2	Mangrove	
12	Melekeok Near Shore Waters	Melekeok	1997		Coral reef, Seagrass bed	Fish
13	Ngerang Clam Conservation Area	Melekeok	1999		Coral flat	Tridacna
14	Ngelukes Conservation Area	Ngchesar	2002	0.50 km2	Patch reef	
15	Ngerchebal Island Wildlife Conservation	Aimeliik	2006		Island, Coral reef	Aves, All marine life
16	Imul Mangrove Conservation Area	Aimeliik	2002	0.43 km2	Mangrove	Plants, mangrove
17	Ngcheschang Mangrove Conservation Area	Airai	1994	0.97 km2	Mangrove	
18	Oikull Mangrove Conservation Area	Airai	2002	0.78 km2	Mangrove	
19	Airai Reef Conservation Area	Airai	2005		Mangrove, Seagrass bed, Coral reef	Fish
20	Ngeream Conservation Area	Airai	1997	1.64 km2	Mangrove	
21	Ngerkebesang Conservation Zone	Koror	2002	0.04 km2	Coral flat	All marine life
22	Ngederrak Conservation Area	Koror	2001	5.98 km2	Seagrass bed, Coral flat	All marine life
23	Ngerumekaol Spawning Area	Koror	1976	2.08 km2	Coral reef	
24	Soft Coral Arch, Cemetery Reef, Any Marine Lake, Ngkisaol Islet	Koror	1999		Mangrove, Seagrass bed, Coral reef, Lagoon	All marine life
25	Ngerukewid Islands Wildlife Preserve	Koror	1956	11.02 km2	Island, Coral reef	All terrestrial and marine life
26	Ngemelis Island Complex	Koror	1995	40.26 km2	Island, Coral reef	Marine ecosystem
27	Teluleu Conservation Area	Peleliu	2001	0.83 km2	Seagrass bed, Coral flat	
28	Angaur Conservation Area	Angaur	2006	0.39 km2	Seagrass bed, Coral flat	
29	Helen Reef Reserve	Hatohobei	2001	163.00 km2	Island, Coral reef, Lagoon	Fish
30	Rock Island Southern Lagoon Management Area	Koror	1997	621.00 km2	Rock island, Lagoon, Barrier reef	
31	Ungelel Conservation Area	Ngaraard	2007	2.675 m2	Mangrove	
32	Marine Life Conservation Area	Ngaraard	1990		Coral reef	

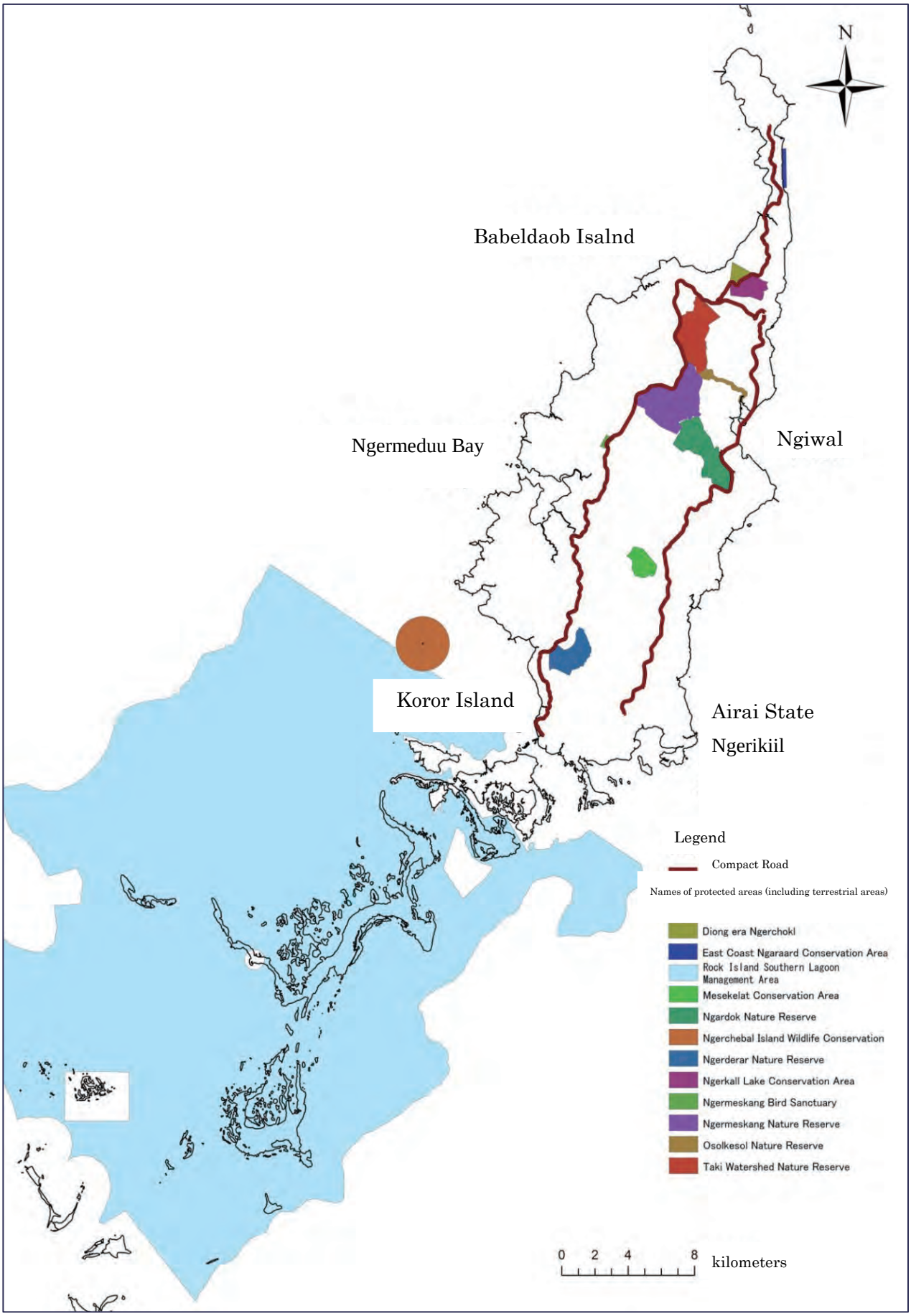


Figure.4.4. Protected Areas (including terrestrial areas) in Babeldaob Isalnd and its vicinity (PALARIS and Ecosystem Conservation Society-Japan)

Table 4-2. Data on Protected Areas in the Republic of Palau (including terrestrial areas)

Name of the Area	Remarks	Location (state)	Classification	IUCN Protected Area Category	Habitat Type	Area (ha)
Helen Reef	Inscripted on May 4, 2004	Hatohobei	Management Area	VI	terrestrial / marine	78191
East Coast Ngaraard Conservation Area	Inscripted in 1990	Ngaraard	Conservation Area		terrestrial / marine	5092
Koror Southern Lagoon	Inscripted on August 30, 2008	Koror	Management Area		terrestrial / marine	222411
Ngerchebal Island Wildlife Conservation	Inscripted in 2006	Aimeliik	Wildlife Cons Area		terrestrial / marine	10112
Ngardok Nature Reserve	Inscripted in January 2008	Melekeok	CA Set Aside	III	terrestrial	13620
Mesekelat Conservation Area	Inscripted on June 12, 2008	Ngchesar	Conservation Area	II	terrestrial	5771
Ngermeskang Nature Reserve	Inscripted in October 2008	Ngaremlengui	CA Set Aside	III	terrestrial	14302
Ngermeskang Bird Sanctuary		Ngaremlengui	Bird Sanctuary		terrestrial	2535
Ngerkall Lake Conservation Area	Inscripted on December 12, 2008	Ngaraard	Conservation Area		terrestrial	6684
Diong era Ngerchokl	Inscripted on December 12, 2008	Ngaraard	Conservation Area		terrestrial	4354
Osolkesol Nature Reserve	Inscripted in July 2009	Ngiwal	Nature Reserve		terrestrial	8652
Ngerderar Nature Reserve		Aimeliik	Nature Reserve		terrestrial	9382
Fana Island		Sonsorol	IBA		terrestrial	2187
Taki Watershed Nature Reserve		Ngardmau	Nature Reserve		terrestrial	12546

Chapter 5　Coastal Fisheries Sector

This Chapter is based on excerpts on coastline fisheries from the “National Fishery Sector Overview: Palau” published in October 2010 by FAO (Food and Agriculture Organization of the United Nations).

5.1　Geographical Composition

5.1.1　Composition of the Palauan Islands and Marine Habitats

The 343 islands of the Republic of Palau are diverse in geological origin and include volcanic, low platform, high platform, and atoll types. The Republic includes the islands of Koror (the economic center), Babeldaob (the largest island in terms of land mass, making up 78% of Palau’s land area), Angaur, Peleliu and several coral outer islands including Sonsorol, Tobi, Pulu Anna, Helen’s Reef and Merir to the southwest, and Kayangel to the north. More than 70% of the population resides in Koror. The major marine habitats of Palau and their approximate sizes are: mangroves – 45 km^2, inner reef – 187 km^2, outer reef – 265 km^2 and lagoons – 1,034 km^2.

5.1.2　Overview of Fisheries and Marine Biodiversity in the Republic of Palau

Marine life in Palau is abundant and diverse with over 1,300 species of tropical fish and over 700 different species of hard and soft corals in the lagoons and reefs. Most coastal habitats and topographical features found anywhere in the Pacific Islands can be found within Palau. The most distinguishing features of the coastal area of Palau as compared to most other Pacific Island countries are the large amount of mangroves and coastal tourism. With respect to the current fishery production, Palau’s fisheries can be placed into six categories: Coastal Commercial, Coastal Subsistence, Offshore Locally-Based, Offshore Foreign-Based, Freshwater, and Aquaculture. Much of the coastal fishing activity is geared to producing for domestic urban markets, while the offshore fishing consists largely of tuna longlining for export to domestic market in the city.

5.1.3　Main Trends and Issues in the Fisheries Sector

Fisheries sector in Republic of Palau has following trends and issues.

1) Trends:

① Increasing exploitation of the coastal resources, especially those close to urban markets.
② Continuing substantial involvement of local and international NGOs in the management of coastal marine resources
③ Growing realization of the inability of Palau’s coastal resources to feed local residents and tourists, and support commercial exports.
④ Increasing interaction between fishing activities and Palau’s thriving tourist trade.

2) Issues

① A large investment in aquaculture development activities over the last 37 years has yielded disappointing results (with the exception of giant clams).

② The opportunity to link fisheries with a large and expanding tourism industry; decrease in fishing grounds usable for coastal fishing and increase for demands on marine resources due to tourism

③ The actions of Pacific region and global effort in ecosystem for management of marine fisheries are clashing with the practical realities of undertaking fisheries management in Palau,

④ Lack of regular monitoring of the landings from coastal fishing .

5.1.4 Marine Fisheries

The fishing industry in the oceans of Palau consists of two main types, namely offshore fishing by foreign vessels engaged primarily in tuna and bonito fishing within the EEZ, and subsistence and domestic commercial coastal fishing in lagoons and around barrier reefs. Coastal fishing is carried out by people living in the Republic of Palau and includes the fishing of species such as trochus for export as ornamental fish and other decorative purposes.

1) Annual Fishery Production in 2008

① Commercial：865 tons (1 kg USD 2.87, equivalent to USD 2,843,000)

② Subsistence：1,250 tons (30% lesser than commercial prices, equivalent to USD 2,511,000)

2) Marine Landing Sites

The catch from small-scale commercial fishing is offloaded, mainly at Koror. Subsistence fishery landings take place in villages and hamlets nationwide.

3) Coastal fishing production means

Coastal fishing is performed mainly only by men and includes such fishing techniques as hand-collection, hook-and-line fishing, underwater spear-fishing, net fishing and trolling. Boat-based coastal fishing activities involve the use of small fishing craft, typically from 4.8 to 7.6 m in length and powered by outboard motors. At least 25% of households in Palau own fishing boats and through the extended family system, most fishers have access to a powered craft of this type. The completion of the Compact Road around the island of Babeldaob several years ago caused considerable change in the marketing of catch and made the island’s boat-owners shift landing places from Koror to Babeldaob. Another aspect of coastal fishing in Palau is the occasional commercial fishing trips from the urban center of Koror to the southwest islands.

4) Main resources

Important species in Palau’s coastal fisheries are: carangidae, sphyraenidae, scombridae, mangrove crabs, lobsters, trochus, giant clams, sea cucumbers and other invertebrates (coconut crabs, land crabs, mangrove clams, nut clams, octopuses, sea urchins, squids, cuttlefish, nautilus).

5) Management of marine fisheries

The management applied to coastal fisheries is shaped by the Palauan constitution, various laws covering fisheries activities, the staff of the Ministry of Natural Resources, Environment & Tourism, NGOs, and communities. The constitution gives the power to manage coastal fisheries in the zone up to 12 nautical miles offshore to the 16 states that make up the country. A salient issue having considerable impact on the fisheries management strategy in Palau is the balancing of nutritional, tourism, and export benefits of coastal resources.

According to Callaghan (1994), the following strategies are recommended as basis for in-shore fisheries management: “first we eat them; second we play with them; third we let visitors eat and play with them, and fourth, we export them.’ In other words, give first priority to fish consumption by Palauans resident in Palau; second priority to sports fisheries and recreation by Palauans; third priority to meeting the food and recreational needs of tourists; and finally fourth (only if the resource reserves permit) do we export them.”

The management objectives of coastal fisheries are not as clear as those for tuna resources management. In general, however, it can be said that these objectives include sustaining of domestic food, recreation for Palauans, and viewing by tourists.

On the national level, management measures for marine fisheries are specified in the legislation and include mesh sizes, bans on types of fishing gear, minimum size limits, catch bans, export bans, and closed seasons. Palau has been a pioneer in the Pacific region in the use of marine protected areas (Table 5-1).

6) Fisheries Management Institutions

The national-level management measures are implemented through the Bureau of Marine Resource of the Ministry of Natural Resources, Environment and Tourism. Lower level management measures are implemented by the 16 state governments which, under the constitution, control all resources from the shoreline up to 12 nautical miles offshore (except for the tuna resources). The Palau Conservation Society (PCS), a local environmental NGO, is an important institution affecting the management of marine fisheries.

7) Fishermen Communities

Nearly all households in the Republic of Palau are involved in coastal fishing activities. It could therefore be stated that all villages in Palau are “fishing communities.”

5.1.5 Freshwater Fisheries

Fresh water edible resources in the Republic of Palau include eels and shrimps, however, only in the island of Babeldaob. There are no major freshwater fisheries, but the larger islands of Palau (especially Babeldaob). The capture of eels, however, is not large due to cultural attitudes. Consumption of freshwater shrimp is performed on a small scale.

5.1.6 Recreation

In Palau there is recreational fishing for both Palau residents and for tourists.

5.1.7 Aquaculture

The Micronesian Mariculture Demonstration Center was established in 1973 by developing, demonstrating and promoting mariculture technology in Micronesia. It was later renamed the Palau Mariculture Demonstration Center and serves as a regional mariculture training centre and a marine science research laboratory.

During the last four decades the culture in Palau of a large number of organisms has been attempted. However, despite these activities significant aquaculture, production in Palau is presently confined to giant clams and milkfish. Since this aquaculture production brings no profit, it is mostly dependent on government subsidies due to lack.

Table 5-1. Examples of Fisheries Management in Communities (World Bank, 2000)

State	Threats Identified by the Community	Local management measures
Ngiwal	Road construction, the disturbance caused by outboard motors, commercial pressure leading to overharvesting, and siltation	· Prohibition on entry or harvesting in the conservation area. · Ban on dynamiting. · Ban on cutting mangrove for use out of state. · Requirement that outsiders ask permission to fish in the site.
Kayangel	Speedboat disturbances, oil spills, and pollution/ rubbish in the lagoon	· No entry/ harvesting in the conservation area. · Ban on commercial fishing in Kayangel Atoll lagoon. · Restrictions on taking giant clam placed in front of the village. · Restrictions on taking turtle in excess of domestic needs. · Ban on the use of gillnets.
Peleliu	Over-fishing, outboard motors, speedboats, exhaust oils, destructive fishing methods, disturbances caused by fishing activities, and mangrove clearing for fish ponds	· Prohibition of net fishing in certain areas within the reef. · Tourist catch-and-release law.
Koror	Sewage, dredging, erosion, oil spills, tourism, and the chemicals used to clean boats	· Requirement to register boats and motors. · Dive permit requirement. · Fishing license fees. · Ban on cutting trees in Rock Islands. · Special requirement for permission for access to Ngemelis/ Ngerchong.
Melekeok	Overfishing, sediment run-off from dirt roads, beach erosion, siltation on reefs and sea grass beds, trash from village dump, past dredging, and disturbance caused by outboard motors	· Banning of net fishing in the rocky/ coral lagoon floor next to the reef. · Prohibition of cutting mangrove trees for sale out of the state. · Law designating a portion of the reef for clam conservation.
Ngeremlengui	Speedboats, erosion, extraction of coral for lime production, over-fishing and destructive fishing	· Mangrove crabs seasonal harvest restrictions. · Marine conservation area. · Prohibition of exporting mangrove trees out of the site.

5.2 Utilization of Marine Resources

5.2.1 Fish Utilization

Approximately 60% of coastal catch is disposed of as subsistence fishing. The remaining 40% of the coastal catch is used for local retail markets, the hotel/restaurant trade in Palau, and for export. The latter category is largely exported as baggage by travelers to family and friends in Guam and Hawaii.

The distribution channel for trochus is quite different, with the meat being utilized locally and the shell for the manufacture of mother-of-pearl buttons. Most of the giant clam exports are for the ornamental aquarium trade.

5.2.2 Fish Markets

Although subsistence fishing remains a major activity, the economic growth of Koror, tourism development, the increasing availability of non-fisheries related employment and a large foreign labor force have together resulted in the establishment of a cash market for fresh fish and other seafoods. These markets are located mainly in the Koror urban area, but some small markets exist in the main residential areas of the states.

The trochus button manufacturing is for markets in Asia and Europe, while marine ornamentals (aquarium fish, juvenile giant clams) are for markets in the USA.

5.3 Fishery Sector Performance

5.3.1 Economic role of fisheries (both coastal and offshore) in the national economy

- Fishing accounted for 2.2 % of the GDP of Palau (2006).
- Fishery products accounted for almost all exports (2007).
- Access fees paid by foreign fishing vessels represent 3.2 % of all government revenue.
- Exports of fishery products are about 100 % of all export in 2007.
- The 2005 census indicates that, of the 13,800 people reporting income in 2004, 305 people (2.2%) reported income from selling fish; of 14,154 people over 18 years old in 2004, 933 people (6.6%) reported some subsistence fishing activity.

5.3.2 Demand

Based on the FAO food balance sheet, the per capita consumption of fish in Palau between 1964 and 1980 (prior to the establishment of the autonomous government) amounted to 93.4kg, between 1981 (when the autonomous government was established) and 1993 (when Palau entered into the Compact of Free Association with the United States (became independent)), it was 81.8kg, between gaining independence and 2007 it was 65kg, and in 2007 to 67.9kg. Generally, fish consumption is decreasing, however, since the fish consumption in other Pacific region countries in 2007 was as follows: Samoa – 48.2kg, the Solomon Islands – 42.3kg, Tuvalu – 48.5kg, Fiji – 37.6kg,

Kiribati – 77.4kg, the FSM – 52.6kg and Japan – 75.5kg. It can be said that consumption in Palau was relatively greater than most other countries in the region (with the exception of Kiribati and Japan).

The per capita protein consumption in Samoa, the Solomon Islands, Tuvalu and Kiribati is either on a stable level or increasing. Should it be assumed that this tendency applies to Palau as well, it can be assumed that the decrease in fish consumption is compensated for with other animal proteins.

Major factors that can lead to decrease in the future demand for fish are emigration, increases in the price of fish and the general per capita GNI. The increase in the future fish demand, on the other hand, can be influenced by such factors as increase in number of tourists due to growth of the tourism industry, increase in number of foreign laborers, increase in the price of imported food products and decrease in the per capita GNI.

5.3.3 Supply

The government has several strategies to increase the national fish supply. These involve supporting the development of aquaculture, and facilitating the capture of under-exploited tuna and bottomfish, and provision of ice at fisheries centers to facilitate marketing.

The government is now contemplating a ban on the export of inshore food fish, with one objective being to prevent a decrease in fish supply for domestic consumption.

Major factors affecting the local supply of fish are over-fishing, transport links from the nonurban parts of the country, and the offloading of fish by the offshore fleet.

5.3.4 Trade

Tuna make up most of the exports of fishery products from Palau. Other items include ornamental fish, giant clams, and trochus.

5.3.5 Employment

For coastal commercial fishing, PCS (2000) 17 reports that there were 200 commercial and 1,100 non-commercial fishers in Palau in the late 1990s. With a gradual movement of people out of fishing employment and into jobs related to tourism, the number of commercial fishers has decreased over the last decade to an estimated 460 fishers in 2008 (number of fishers in commercial fishing has increased, despite the decrease in the general number).

5.3.6 Rural development

The Bureau of Marine Resource of the Ministry of Natural Resources, Environment and Tourism has several activities that are relevant to rural development, including placement of fish aggregation devices (FADs), conducting training in fishing around FADs, promotion of ice plants in rural areas, and promotion of clam farming.

The Palau Conservation Society (PCS) carried out the Inshore Sport Fishing Development Project, in cooperation with the U.S. government, The Nature Conservancy, and the Palau government. The aim of the project

was to conserve and make the best use of the diversity and abundance of Palau's reef fishes by developing a community-based sport fishing industry, primarily in the non-urban areas of Palau.

5.4 Development of the Fisheries Sector

5.4.1 Constraints in the Fisheries Sector

1) External Threats

Given the proximity of the country to Asia, the demand for coastal fishery products (such as groupers and sea cucumbers) by affluent overseas consumers could easily deplete resources to the detriment of domestic fish consumption and tourism.

2) Internal Weaknesses

① Expansion of the fisheries sector is often constrained by main activities in the tourism sector, such as diving or snorkeling. Furthermore, the fisheries sector also suffers from bad reputation due to catches of the ornamental species.

② According to inquiry surveys conducted with Japanese residents in the Republic of Palau and Palauan citizens, the Palauans have a strong sense of division of types of employment. This leads to the assumption that unskilled labor and servant work is performed by foreign laborers from various Asian countries. Therefore, although there is considerable employment in the tuna industry, few Palauans are willing to accept those types of jobs.

③ Considering the substantial support given to aquaculture over the last four decades, the lack of economic activities in this field is disappointing (with the exception of giant clams and milkfish).

5.4.2 Opportunities in the Fisheries Sector

Major opportunities in the fisheries sector include:

・Enhancement of the input of the private sector into the functioning of the Bureau of Marine Resource.
・Enhancing linkages between the fisheries and tourism sectors, including sports fishing and provision of value added fishery products to the tourism industry.
・Improving access by small-scale fishers to the tuna resources.
・Improving fish handling/processing in coastal fisheries.

5.4.3 Research

A very large number of fisheries research projects have been carried out in Palau. Most areas of Palau and most types of fisheries resources have been covered by various research endeavors. Current fisheries research in Palau by the Bureau of Marine Resource and other government agencies includes research on tuna, bycatch, marine biology

of the Northern Reefs, efficacy of several marine protected areas, subsistence fishing, coral disease, vulnerable marine species (crocodiles, dugongs, and sea turtles), and spawning/culture techniques (giant clams, groupers and rabbitfish). Major issues in fisheries research are translating research needs into research activities, analysis of data, collected by research projects, and funding for research.

Other institutions in Palau carry out research that is relevant to the fisheries sector. This includes the Palau Conservation Society (PCS), Palau International Coral Reef Center (PICRC), the Palau Community College (PCC), and The Nature Conservancy (TNC).

5.4.4 Strengthening of the Fisheries Sector and the Development of Coastal Marine Environment

1) Government and private sector policies and development strategies

① Preamble to the Constitution of Palau

Preamble to the Constitution of Palau suggests that some of the fishery policies in Palau are:

- Subject to national regulation, the states own the living and non-living marine resources from land up to twelve nautical miles seaward from the baselines;
- The national government owns and manages the resources outside of twelve nautical miles;
- The national and state governments are responsible for managing all living and nonliving marine resources for the general welfare and security of the citizens of Palau;
- Traditional fishing rights and practices are not to be impaired; and,
- The conservation of the natural environment shall be undertaken for the economic benefit, health and social welfare of the citizens of Palau.

② Fisheries Policy on the National Level

In 2009 the Secretariat of the Pacific Community began preparation to assist Palau in the development of a national fisheries policy. Main points of this policy (including offshore fishing of tuna) are:

- Conserve fishery resources by controlling harvesting within international and regional recognized sustainable limits.
- Establish an efficient government framework to harmonize application of fisheries management policies and practices.
- Minimize detrimental impacts of fishing on coastal and inshore environment.
- Attain an optimum balance in relation to access to the resource between all stakeholders.
- Enhance the overall economic balance between: the necessity for government to generate revenue, financial expectations of the commercial tuna fishery interests, and the interests of other users of the resource.
- Promote Palauans in professional, administrative, research and development positions in the fishery and related industries and government agencies.
- Adherence to Palau’s regional and international marine agreements.

③ Activities of the Bureau of Marine Resource.

The coastal fisheries policies can be inferred from activities of the Bureau of Marine Resource, which include:

- Emphasizing the realignment, restructuring and strengthening of national fisheries laws, policies,

institutions and programs.

- Improving the quality of coastal fishery products through improved handling/marketing.
- Diverting fishing effort from coastal areas to the less exploited offshore tuna and bottomfish resources.
- Giving attention to improved management of the trochus fishery.

2) Education

Education related to fisheries and marine resources in Palau is undertaken in a variety of domestic and international institutions:

① Palau Community College (PCC): Environment and Marine Sciences Program (basic aspects of marine biology and oceanography), Small Engine and Outboard Marine Technology Programme (practical courses of study of fisheries)

② University of the South Pacific (USP, Fiji): academic training in biological, economic and other aspects of fisheries.

③ Secretariat of the Pacific Community (SPC) and Forum Fisheries Agency (FFA): training courses

④ NGOs and universities and research institutions from Japan etc.: training courses and workshops

⑤ Universities in Guam, Hawaii and mainland USA: advanced degrees in fishery-related subjects.

3) Foreign aid

Palau has enjoyed fisheries sector assistance oriented on the Pacific region in general or Palau only.

This support has included the funding of expatriate staff positions within the Bureau of Marine Resource, construction of aquaculture facilities, fisheries infrastructure (docks, refrigeration facilities), equipment costs, the provision of vessels, collaborative research, sector planning studies, and travel costs for training and attendance at meetings.

Important donors have included the US Department of the Interior (through Sea Grant), the US Department of Commerce (Saltonstall-Kennedy allocations), the US Peace Corps, the Japanese Government (through the Japan International Cooperation Agency and Overseas Fishery Cooperation Foundation) and the Pacific Aquaculture Association. Other donors have included UNDP, Australia, New Zealand, and Canada.

Much of the fisheries sector assistance in the past has been channeled through the Bureau of Marine Resource (BMR). Recently the Palau Conservation Society has obtained an increasing amount of marine-related overseas aid. Private foundations are making significant contributions to marine conservation projects in Palau. These include the MacArthur Foundation, Packard Foundation, and Wallis Foundation that are based in the United States, and the Keidanren Foundation in Japan.

5.5 Fisheries Sector Institutions and Legal Framework

5.5.1 Fishery Sector Institutions and their Roles

Palau's main fisheries sector institutions and their roles include:

- Bureau of Marine Resources (BMR): policy formulation, management the marine resources sustainability,

aquaculture etc.

- BMR’s Division of Fisheries and Wildlife and state police: law-enforcement.
- Palau Conservation Society (PCS), the Palau International Coral Reef Center, (PICRC) and the Coral Reef Research Foundation: community outreach and environmental awareness.
- Palau Community College (PCC): academic and vocational training, research trials.
- Palau Visitors Authority (PVA): marine tourism and industry standards.
- Palau Sports Fishing Association: support of the game fishing industry.
- The Environmental Quality Protection Board (EQPB): reviews of coastal development projects.

5.5.2 Legal Framework

The main law relevant to the fisheries sector in Palau is the "Marine Protection Act of 1994." The stated purpose of the Act is to promote sustainably and develop the marine resources of the Republic while also preserving the livelihood of the commercial fishermen of the Republic (Details shall be discussed in Table 8-2, Chapter 8).

Chapter 6　Field Studies in the Republic of Palau

6.1　Information Gathering by Relevant Organizations

6.1.1　State and Public Organizations in the Republic of Palau

1) Bureau of PAN, MNRET

With the immense support and understanding of Director Mr. Joseph Aitaro, the project team was able to conduct a total five field study sessions in Palau. Mr. Aitaro provided much information regarding organizations and individuals related to Protected Areas within Palau, the structure of PAN, workings of the Green Fee and also provided insights into outstanding issues and objectives. In addition, Mr. Aitaro also lent his assistance in coordinating a variety of matters concerning the project's field studies at designated Protected Areas.

Figure.6.1. The relevant players working for environment conservation in Palau. (Hideyuki Shiozawa)

Mr. Aitaro's father comes from a family of traditional chiefs in Koror State, while his maternal relatives are traced to a lineage of chiefs in Melekeok State. In addition, Mr. Aitaro also has close relatives in Ngiwal State and Peleliu State. As such, Mr. Aitaro was not only able to provide valuable advice on environmental conservation, but also on the traditional culture and customs of Palau.

The project team received instruction and information regarding data for all Protected Areas in Palau and the system of PAN registration from Ms. Vicky Riungel.

2) Bureau of Marine Resources (BMR)

The Director of the Bureau of Marine Resources (BMR), Mr. David A. Orrukem, provided the project team with data concerning coastal fishing catch, MPAs for the sustainable use of marine resources (particularly the sustainability of rabbit fish in the MPA of Airai State), as well as issues facing sea cucumber fishing which is funded by foreign capital. In addition, Mr. Orrukem also assisted in coordination with other relevant organizations within Palau.

3) Bureau of Agriculture

The Director of the Bureau of Agriculture, Mr. Fernando M. Sengebau, rendered the project team with information concerning the management of mangroves. The clearing of mangroves is presently prohibited under regulations in Palau. While the use of mangroves as timber is managed by the Bureau of Agriculture, utilization of mangroves as land is controlled by the Ministry of Public Infrastructure, Industries and Commerce.

4) Division of Fish and Wildlife Protection (DFWP)

Sergeant Mr. Israel Brel provided information concerning mobilization readiness and annual arrest rates. With

regards to wildlife such as dugongs that are protected under the 24 PNCA Environmental Quality Protection Act, DFWP is able to organize crackdowns for areas under state control as a national policing unit. However, due to its limited manpower, small patrol boats and fuel constraints, DFWP is unable to conduct regular patrolling. In many cases, units are mobilized in response to reports from members of the public who witness acts of poaching or detect carcasses of protected wildlife. The number of annual arrests remains in the single digits. Although poachers of dugongs have been identified, authorities are attempting to deter such acts through careful persuasion so as to avoid cultural conflict. This is because dugong hunting is a practice that is derived from tradition.

5) The Office of Palau Automated Land and Resource Information System (PALARIS)

On a kind favor extended by PALARIS coordinator Ms. Madelsar T. Ngiraingas and GIS analyst Ms. Darlynne Takawo, the project team received GIS data as well as instruction on data content. PALARIS is run by a team of trained local professionals, who are currently engaged in field surveys that will help to enhance the accuracy of GIS data.

6) Environment Quality Protection Board (EQPB)

The project team worked closely with Ms. Lynna Thomas and Ms. Gwen Sisior, who provided information such as the responsibilities of EQPB. In addition, they also rendered assistance to field studies that were conducted on the watersheds and rivers of Airai State, as well as a watershed survey on rivers in Ngiwal State. EQPB is also responsible for carrying out analytical surveys on water sources and water quality of rivers. However, such surveys test for chemical substances and bacteria coliform and are not related to soil drainage analysis. In addition, EQPB performs a supervisory role concerning the development of coastal zones and mangrove areas.

7) Palau Visitors Authority (PVA)

The project team received information regarding the environment and trends in tourist visitation numbers from PVA staff members that include Ms. Ngedikes Becheserrak and Mr. Kadoi Ruluked. Annual tourist figures reached the 80,000 mark in 2010 and rose further to exceed 110,000 annually from 2011, when air transportation to Palau received a significant boost from an increase in flights and flight routes. In addition to the Guam-Palau-Manila route serviced by United Airlines, the resumption of Japan Airlies charter flights from Narita, the start of the Narita-Palau route by Delta Airlines, an increase in the number of Taipei-Palau flights by China Airlines and Incheon-Palau flights by Asiana Airlines, the inauguration of flights between Incheon and Palau by Korean Air, as well as the launch of low-cost carrier Fly Guam (Guam - Palau), a total of some 25-30 flights a week connect to and from Palau. Visitors from Japan, Taiwan and Korea make up 80% of annual tourist numbers but media coverage of environmental policies of Palau by news agencies such as CNN have led to an increase in the number of tourists from the United States, Australia and Europe.

The expansion in visitor numbers is limited by hotel room capacity, which also places restrictions on the holding of international conventions. Increased burden on sewage treatment has led to a need for the reinforcement of existing facilities, while the growth in the number of divers and tourist activity on land have raised concerns regarding negative effects on the environment.

8) Belau National Museum (BNM) ① Vegetation

Botanist Dr. Ann Kitalong provided information on vegetation found in Palau. Land vegetation surveys have only been carried out on approximately 1% of total land area in Palau. While such surveys are crucial for the protection of important plant species from land development projects in future, a lack of funding from the national government has meant that vegetation surveys are left in the hands of independent scientists. While terrestrial ecosystems have been altered by the human hand during the respective eras of the Japanese Mandate, WWII and TTPI, rivers and watersheds, which possibly had little development value due to the existence of marshland and mangroves, still preserve a great degree of their primeval forests and are home to a variety of endemic plant and animal life.

Before roads were fully maintained on Babeldaob Island, rivers served as the main form of transport for access to villages (now the state of Babedaob Island). At that time, mangroves were cleared periodically to ensure passage for vessels, but with rivers no longer being utilized as a means of transport, together with the imposition of regulations against the clearing of mangroves, mangroves have flourished and are now raising concerns of eventual river blockage. Dr. Kitalong stressed that mangroves require regular pruning like gardens do because of their nature as vigorous plants that grow very quickly.

9) Belau National Museum (BNM) ② Bird Species

Ornithologists Dr. Alan Olsen and Mr. Milang Eberdong provided the project team with information on the species of birds found in Palau, data on population sizes for each species and also details on survey methods. Dr. Olsen and Mr. Eberdong also allowed the project team to accompany them on a population survey. Many species of birds in Palau feed on fruit, so changes to land environments are reflected keenly in changes to the size of bird populations. For that reason, the Palau Fruit Dove (also known as “bib”, Palau’s national bird) is considered to be a suitable indicator of changes to local land environment because of its territorial nature. Bird population surveys are performed by taking note of the types of bird species spotted and the number of bird cries detected at 3, 5 and 8 minute intervals at a specific observation point in the morning between 6 to 8am, when birds are the most active. There are approximately 200 observation points and population surveys are conducted at several observation points each day.

In 2003, the Ngerutechei Bird Sanctuary was established in Ngaremlungui State in northwest Babeldaob Island as Palau’s first Important Bird Area (IBA). In the event that terrestrial ecosystems located in Babeldaob Island are destroyed by natural disasters, birds living in the sanctuary would be vital in spreading plant seeds that will aid the recovery of island ecosystems.

10) Locally Managed Marine Area (LMMA) Network Office

The project team received valuable information from Governor Thomas M. Patris and Delegate Waynne Andrew of Hatonobei State, where the country’s largest LMMA known as Helen Reef is located. In certain regions, LMMAs are MPAs that are managed independently by groups of local residents that are led by fishermen. Apart from Koror State, other states in the Republic of Palau have populations that average a few hundred people, and the relationship between local residents and the state government is close. The number of commercial fishermen is also limited so state-established MPAs may therefore be considered as local community-run MPAs. This may account for why there is little public interest for LMMAs in Palau. The LMMA Network Office, which

acts as a liaison for external parties, is essentially managed by trained individuals from Hatohobei State.

11) Palau Community College (PCC)

President Dr. Patrick U. Tellei provided details on PCC's environment and marine science programs, as well as information on environmental education conducted through participation in dugong protection activities.

6.1.2 State Governments

1) Koror State Government

The project team received information from Ms. Ilebrang U. Olkeriil and Mr. King M. Sam with regards to policing and crackdown activities in the Protected Areas of Koror State. Many MPAs have been established in Koror State such as the large-scale RISL, but the state faces a situation that is different from that of other regions because the considerable number of tourists visiting its MPAs has resulted in a continuous struggle between the need to maintain a balance between the tourism industry and environmental conservation. With its larger fiscal scale and manpower resources, Koror is able to tackle issues in IUU fishing with its policing unit known as the Koror Ranger.

Concerns regarding the impact of an increase in tourist numbers on the environment have led to measures such as the raising of entry fees to Jellyfish Lake from 15 to 30 USD per person in 2010, so as to control the number of visitors to the island. However, this has had limited effect on actual visitor figures and a proposal to enact a new state law to increase entry fees to 100 USD has been approved.

2) Airai State Government

Governor Vicky Ngiratkakl-Kanai and State Government staff members provided information pertaining to initiatives for environmental conservation in Airai State. Airai State is well-known for its rabbit fish, a tasty coastal fish that is popular with the people of Palau. The rabbit fish is also a motif of the state flag. However, dwindling rabbit fish populations have led to the establishment of a large-scale non-fishing MPA in the fish's main living habitat. The decrease in rabbit fish numbers is thought to be influenced by road development, which has triggered changes in coastal environments, as well as climate change, although the actual cause has yet to be identified.

Airai State is the second most populated state in Palau and serves as the location for Palau's international airport. As such, the pace of land development is expected to escalate in future. The need to conserve water sources, including watersheds and estuarine regions of Ngerikiil River, has been keenly felt and there is also strong awareness of the close association between inland and coastal areas.

3) Ngiwal State Government

Governor Masasinge Arurang and Patrol Division Chief Mr. Ismael provided information on the Protected Area in Ngiwal State, and also lent their assistance to field studies conducted by the project team. During the era of the Japanese mandate, Ngiwal was known as Taiyo Village and shared a close relationship with Japan. In addition, Ngiwal is a deeply significant region within Palau, as traditional folklore tells of stories surrounding the birth of Ngiwal (spider spirits and the beginning of natural childbirth, felling of trees, fishing and water hazards etc.) and of spiritual rocks where the souls of the war dead reside. Presently, Ngiwal has a population of approximately 200, so

there is little demand pressure on the current level of fishing resources. (There is only one household engaged in full-time fishing). The source of Ngiwal River can be traced to a waterfall and the state is also abundant in groundwater supply. The watersheds and estuarine regions of Ngiwal River are encompassed in the state's Protected Area and serves as a research site for the University of Hawaii. The Ngiwal state government receives assistance from various organizations as part of efforts to boost the effectiveness of its Protected Area.

6.1.3 NGOs and Regional Organizations

1) Palau Conservation Society (PCS)

The project team received assistance from Ms. Anu Gupta with regards to information concerning the role and activities of PCS in Palau, and the effects of the construction of the Compact Road (1997-2007) on surrounding marine areas. Ms. Gupta also guided the project team on part of their field studies in designated Protected Areas.

Figure.6.2. Ms. Anu Gupta, Director for PCS, on the right and the members of Micronesia Marine Environment Committee at PCS office in Koror. (Hideyuki Shiozawa)

The high level of awareness in Palau and amongst local residents to environmental conservation efforts can be traced to the efforts of PCS. As state governments lack adequate fiscal budgets and trained personnel, assistance from a non-public, independent organization such as PCS is extremely crucial. Support initiatives directed at state governments and local communities for the establishment of Protected Areas were conducted by PCS until 2008. The organization has since moved from the process of establishing Protected Areas to assisting the development of management plans for PAN registration. PCS also plays a central role in bird conservation.

2) Palau International Coral Reef Center (PICRC)

Dr. Yimnang Golbuu and JICA Expert Dr. Seiji Nakaya provided details on the role and responsibilities of PICRC, and also extended their assistance to field studies conducted by the project team. Although the activities of PICRC are targeted not only at Palau but the whole of the Micronesia region, most of its main work is carried out in Palau. With regards to MPAs, PICRC monitors marine ecosystems and conducts sediment analysis, and such research outcomes and technical skills are used in workshops and onsite activities to train related personnel such as state government staff. PICRC is also involved in environmental education and organizes a variety of events such as the production of movies and teaching materials, instructing at educational institutions and poster competitions.

3) Micronesia Challenge Regional Office

The project team received information about the role of the Micronesia Challenge (MC) from then-in charge Ms. Charlene Mersai. MC is a regional initiative that facilitates more effective conservation in Micronesia. Even though this regional office is located in Palau, it is not directly involved in the establishment of Protected Areas or the organizational workings of PAN. MC, however, is largely committed to overseeing conditions for the establishment of Protected Areas in Palau and in other Micronesia country members, as well as sharing monitoring data amongst all members.

4) The Nature Conservancy (TNC) Palau Regional Office

Mr. Steven Victor provided the project team with insights into the activities of TNC. TNC pledges funds to the Micronesia Challenge Endowment Fund and is also involved in the setting up of fishing co-operatives at the local level. Regionally, fishermen sell their catch at small-scale fish markets and supply a portion of their haul directly to hotels and restaurants, but buying prices remain low. An expected increase in demand from expanding tourist numbers, together with the need for larger hauls so as to raise profit intake for fishermen, have led to concerns that such moves may place additional pressure on marine resources. TNC is currently in the process of holding discussions with local residents for the establishment of fishing co-operatives as such mutual organizations are particularly useful in negotiations for the setting of fair prices, fuel cost savings from bulk purchase of fuel as an organization, collection of fishing catch data and the imposition of fishing controls.

5) Oceania Television (OTV)

President Mr. Jeff Barabe, Executive Producer Esq. Ms. Kassi Berg and Marketing Director Mr. Olkeriil Kazuo provided information concerning domestic public relations. OTV began broadcasting in the Republic of Palau in 2008 and expanded its broadcast web to FSM and RMI in 2011 with the introduction of digital broadcasting in the Micronesia region. The station is steadily becoming a regional network with growing coverage of information concerning various regions. Highly concerned with environmental conservation, OTV has a weekly television program that is helmed by Mr. Aitaro, the Director of PAN.

6) Embassy of Japan

H.E. in Palau Yoshiyuki Sadaoka, Japanese Ambassadr to Palau and Mr. Shuji Tsuji, then-researcher in Japanese Embassy gave the project team information about bilateral relations between the Republic of Palau and Japan, and insights into the economic conditions of Palau that are not readily comprehensible from numerical data.

6.1.4 Relevant Persons and Figures

1) The Honorable Noah T. Idechong, Speaker of the House of Delegates

Speaker Idechong is currently serving his second term as a Delegate. Before entering politics, Mr. Idechong was appointed as the Chief of Palau's Division of Marine Resources. Mr. Idechong has been actively involved in the environmental policies of the Republic of Palau since the country's pre-independence days. One of the founding members of PCS, Mr. Idechong also performed an instrumental role in introducing the Green Fee to Palau. Currently, Mr. Idechong is dedicating his wealth of experience and network of connections for the promotion of more effective environmental policies.

The project team was able to conduct discussions regarding expanding tourist numbers, environmental conservation and the Green Fee with Mr. Idechong. With regards to the Green Fee, Mr. Idechong expressed that the current fee of 15 USD is extremely low from a domestic viewpoint. Even if the Green Fee was to be increased to 100 USD, it is possible that visitors from countries such as Japan and Europe would still be willing to pay as long as it is specifically defined that proceeds from the Green Fee are dedicated to efforts for environmental conservation. In addition, the fee increase may also be useful in maintaining the quality of visitors to Palau.

Mr. Idechong said that he predicted the rise in the number of tourists to Palau ten years ago. To quote Mr.

Idechong further, “the introduction of the Green Fee is aimed at ensuring a stable and viable source of funds with which Protected Areas can be adequately managed, and controlling the quality of tourists to Palau so as to elevate the level of awareness to the importance of environmental conservation.

Figure.6.3. Mr. Aitaro (extreme left), the Honorable Idechong (second from left), Dr. Ikeya (center), and others. (Ecosystem Conservation Society-Japan)

“In addition, the Green Fee allows Palau time to improve its domestic infrastructure to cope with the expansion in tourist figures while easing pressures caused to the natural environment by moderating sharp increases in the number of visitors to Palau. When the Green Fee was first conceptualized, an initial fee of 100 USD was considered upon studies of precedents such as Costa Rica. However, based on findings of a tourist visitor survey conducted by UNDP, the fee was revised to 80 USD in the PAN Act of 2003. The Green Fee was later further reduced to 30 USD when the Revised PAN Act was enacted in 2008. When it was finally introduced in November 2009, the Green Fee was set as 15 USD during its initial test period. Two years have passed since the Green Fee has been introduced and the number of tourists continues to rise sharply. The current pace of expansion in visitor numbers is too rapid and may bring negative consequences to the environment of Palau.”

2) The Honorable Faustina K. Rehuher-Marugg, Minister of Community and Cultural Affairs

The project team received information about the traditional interrelationship between local residents and the natural environment from Minister Rehuher-Marugg. Conventional ways of life in Palau were geared towards sustainable use of the natural environment, in a way that is similar to the concept of *satoyama* and *satoumi* in Japan. However, with the rise of a monetary economy brought about by the Japanese and Americans, together with modernization of lifestyles, the traditional balance between human activity and the natural environment has been transformed.

3) Local communities

The project team obtained information regarding the lives of local residents from people residing in Ngiwal State, Airai State and Melekeok State. Residents in these three states share certain similarities. A relatively high level of economic ability and the lack of an overcrowded population have exerted minimal pressure on coastal marine resources, but the construction of roads and changes in climate have led to coral reef destruction and a discernible decrease in marine resources.

6.2 Information on Protected Areas Designated as Subjects of Study

6.2.1 Ngermedellim Marine Sanctuary (Chapter 4, Table 4.1 No.12)

1) Location: Eastern coastal marine region of Babeldaob Island (7.50N, 134.64E）
2) Supervisory Body: Melekeok State Government (Population size: 391)
3) Year of Establishment: 1997
4) Land Area: Unknown
5) Type of Marine Area: Coral reefs and seagrass beds
6) Target of Conservation: Fish
7) Prohibited Activities: Cast net fishing
8) Permitted Activities: Other types of fishing other than cast net fishing
9) Base Regulation: State Law MPL No. 4-16
10) Other Information: Process of sanctuary establishment accelerated after extensive coral bleaching, in addition to a progressive rate of dying corals thought to be caused by sediment increase from the construction of roads and development of the new capital city, were discovered.
11) Observation Details: According to the Melekeok State Government, corals began to die at an accelerating pace ten years ago and coral populations have failed to recover until today. Actual submarine observation reveals that 90% of the survey site is covered with pieces of dead coral. Inflow from outer seas is strong, supplying the coral site with fresh seawater, but dead coral pieces are unsecured and remain unsuitable as an implantation and breeding ground for coral larvae. While observation from snorkeling verified that seagrass beds are growing extremely well, fish species richness and abundance are low and fishes are also small in size.

6.2.2 Ngatpang Conservation Areas (Table 4.1 No.8,9 and 10)

1) Location: Watershed and estuarine regions of Ngatpang River in western Babeldaob Island (7.49N, 134.48E）
2) Supervisory Body: Ngatpang State Government (Population size: 464)
3) Year of Establishment: 1999
4) Land Area: 0.45sq. km
5) Type of Marine Area: Mangroves, seagrass beds, coral reefs and patch reefs
6) Target of Conservation: Giant clams, mangrove crabs, fish
7) Prohibited Activities: Hunting of protected wildlife species
8) Permitted Activities: None
9) Base Regulation: State Law NSPL No.100-98
10) Observation Details: With limited land access to the Ngatpang River watershed, conservation should not pose as a problem as long as large-scale development projects do not take place inland. As such, management of inland areas including watersheds remains crucial.

6.2.3 Ileyakl Beluu (Table 4.1 No.3)

1) Location: Northwestern Babeldaob Island (7.59N, 134.51E)
2) Supervisory Body: Ngardmau State Government (Population size: 166)
3) Year of Establishment: 2005
4) Land Area: 0.62sq. km
5) Type of Marine Area: Coral reefs
6) Target of Conservation: Fish, edible invertebrata (sea cucumbers, shrimps, mangrove crabs etc)
7) Prohibited Activities: All types of fishing, movement of sand, rocks and corals, trespassing of Protected Area, pollution of Protected Area.
8) Permitted Activities: None
9) Base Regulation: State Law NSL No.5-28
10) Observation Details: Ngardmau State was the site of bauxite mining during the Japanese Mandate Era. The lack of topsoil has obstructed vegetation growth and exposed mining remains are painfully obvious. Compared to the eastern side of Babeldaob Island, the western part of the island has large lagoons and plenty of fresh seawater inflow from outer seas. Observation from snorkeling revealed healthy coral reefs and many species of fish of large size. Due to limited manpower and budgetary constraints, the state government receives technical assistance from PCS about four times a year in managing the Protected Area.

6.2.4 Ngermasech Conservation Area (Table 4.1 No.4)

1) Location: Northwestern Babeldaob Island (7.58N, 134.54E)
2) Supervisory Body: Ngardmau State Government (Population Size: 166)
3) Year of Establishment: 1998
4) Land Area: 2.93sq. km
5) Type of Marine Area: Mangroves, seagrass beds and coral reefs
6) Target of Conservation: Fish, edible invertebrates (sea cucumber, shrimps, mangrove crabs etc.)
7) Prohibited Activities: All types of fishing, movement of sand, rocks and corals, trespassing of Protected Area, pollution of Protected Area.
8) Permitted Activities: None
9) Base Regulation: State Law NSL No.5-28

Figure.6.4. The float watch house at Ngermasech Conservation Area. (Hideyuki Shiozawa)

10) Other Information: A foundational study was conducted by PCS in 2007 and a follow-up survey was carried out by the same organization in 2008. PICRC monitors fish species and foreign marine life once every three months (four times a year).
11) Observation details: Mangroves were observed in the boundary between inland and marine areas. The survey site consists of seagrass beds and coral reefs. Buoys have been installed along marine borders and 24-hour surveillance is conducted from a floating guardhouse where staff members of the state government are permanently stationed.

6.2.5 Ngermeduu Bay Conservation Area (Table 4.1 No.11)

1) Location: Western Babeldaob Island (7.50N, 134.52E)
2) Supervisory Body: Ngaremlengui State Government (Population size: 317), Ngatpang State Government (Population size: 464), Aimeliik State Government (Population size: 270)
3) Year of Establishment: 1999
4) Land Area: 98.00sq. km
5) Type of Marine Area: Mangroves
6) Target of Conservation: N/A
7) Prohibited Activities: Non-sustained development activities that will cause extensive influence to the environment
8) Permitted Activities: Sustained development activities that will not cause an influence to the environment
9) Base Regulation: State Law NPL No.4-17, NSPL No.103-99, ASPL No.6-19
10) Observation details: A collectively managed large-scale Protected Area based on an establishment and maintenance agreement concluded by three states. The conservation area consists of estuarine regions from three rivers and waters have extremely poor visibility. Clear demarcation of land and marine areas into administrative units for conservation activities to be conducted separately by ecosystem type is thought to be impossible, so this particular Protected Area would serve as a good case study. Survey of each river by boat revealed that mangroves and primary forests are growing well and favorable forest conditions are being maintained. River waters have poor visibility.

6.2.6 Teluleu Conservation Area (Table 4.1 No.27)

1) Location: Northern Peleliu Island (7.05N, 134.26E)
2) Supervisory Body: Peleliu State Government (Population size: 702)
3) Year of Establishment: 2001
4) Land Area: 0.83sq. km
5) Type of Marine Area: Seagrass beds and reefs
6) Target of Conservation: None
7) Prohibited Activities: Trespassing, fishing, swimming and vessel movement
8) Permitted Activities: Survey activities carried out under permission from the governor

Figure.6.5. Teluleu Conservation Area in Peleliu State. (Hideyuki Shiozawa)

9) Base Regulation: State Law PSPL No.188-01
10) Other Information: Inaugural survey conducted in 2009 by PCS
11) Observation Details: Situated between Peleliu Island and other offshore islands, seawaters in this conservation have poor visibility and flourishing seagrass growth. Waters are a breeding ground for rabbit fish, a popular choice of fish for consumption in Palau. Before the establishment of the Protected Area, the region was traditionally managed by local residents. Peleliu Island is an isolated island and has the second largest

population in regional Palau after Airai State. Many people in Peleliu are engaged in fishing, which makes it necessary for adequate discussions about the establishment and management of MPAs to be conducted with the local community.

6.2.7 Ebiil Conservation Area (Table 4.1 No.2)

1) Location: Northern Babeldaob Island (7.78N, 134.58E)
2) Supervisory Body: Ngerchelong State Government (Population size: 488)
3) Year of Establishment: 1999
4) Land Area: 19.11sq. km
5) Type of Marine Area: Coral reefs
6) Target for Conservation: All forms of sea life
7) Prohibited Activities: Entry into Protected Area, fishing
8) Permitted Activities: Pre-approved surveys and monitoring
9) Base Regulation: State Law NPL No.4-17, NSPL No.103-99, ASPL No.6-19
10) Observation Details: Based on traditional knowledge, the Protected Area was established in 1999 as a spawning area for groupers but targets for conservation were subsequently expanded to include all other forms of sea life. Corals were found to be in healthy condition and waters were clear. Large concentrations of table-shaped acropora were also found. Managed waters in surrounding areas contained large quantities of dead coral, and coral conditions were found to be worse than those found inside the MPA. There were also little fish.

6.2.8 Ngiwal Conservation Area and Nature Reserve

1) Location: Northeastern Babeldaob Island, Ngiwal State, Oselkesol Fall and watershed, Ngerbekuu River and watershed, Ngemai estuarine region, sandbanks, coral reefs in Ngiwal State
2) Supervisory Body: Ngiwal State Government (Population size: 223)
3) Osolkesol Waterfall and Ngerbekuu River Nature Reserve
    - Year of Establishment: 2008
    - Land Area: Unknown
    - Type of Marine Area: Watershed, falls, rivers, river basins
    - Prohibited Activities: Clearing of trees, campfires, hunting and cultivation of land
    - Permitted Activities: Harvest of plants for medicinal use, construction of tourism-related facilities (waiting areas, washrooms, walkways), permitted visits and policing activities
4) Ngemai Conservation Area
    - Year of Establishment: 1997
    - Land Area: Unknown
    - Type of Marine Area: Estuarine region with sandbanks
    - Prohibited Activities: All non-permitted activities
    - Permitted Activities: Permitted entry and visits, policing activities, rescue and relief operations

5) Coral reefs
    - Year of Establishment: 2009 (Enactment of State Law concerning conservation of marine resources in Ngiwal State)
    - Land Area: Unknown
    - Type of Marine Area: Coral reefs, seagrass beds
    - Prohibited Activities: Commercial fishing by foreigners and foreign-capital based vessels, fishing methods utilizing nets, explosives and poisonous substances, scuba diving-based fishing
    - Permitted Activities: Fishing for personal consumption (for personal consumption or for the purpose of carrying out traditional rituals), permitted commercial fishing activities, permitted fishing activities by foreigners
6) Base Regulation: State Law NPL No.7-004, NSPL No.13-2, NSPL No.13-7
7) Observation Details: Mangroves were found to be of favorable growth conditions and although waters had poor visibility, this seemed to be derived from natural causes. Mangrove crabs were found living in the mangroves. Due to road construction between the estuarine region and coral reefs, the side of the road bordering the river had a lot of sediment accumulation. On the side of the road close to the sea, water channels that have been constructed under the road had turbid water flow, and the state of surrounding corals and seagrass are not ideal. Water for coral reefs found between river mouths and outer seas were clear, but waters were shallow and pieces of dead coral were noticeable. Snorkeling revealed few species of fish. Fish abundance and size were also small.

6.2.9 Rock Island Southern Lagoon Management Area (Table 4.1 No.30)

1) Location: Within Koror State South Lagoon (7.22N, 134.27E)
2) Supervisory Body: Koror State Government (Population size: 12,676)
3) Year of Establishment: 1997
4) Land Area: 621sq. km
5) Type of Marine Area: Rock Islands, lagoon, barrier reef
6) Target of Conservation: None
7) Prohibited Activities: Conservation area for Palauans and residents
8) Permitted Activities: Permitted tourism-related activities in a portion of Rock Islands
9) Base Regulation: State Law KPSL K8-207-2009, K8-209-2009
10) Observation Details: Most of Rock Islands is free from the effects of human activity and much primary forest still remains. In marine areas where tourism-related activities including snorkeling are permitted, there are a variety of fish species. Species richness and abundance in fish are high and many large-sized fish were observed.

6.2.10 Airai State Conservation Areas (Table 4.1 No.19)

1) Location: Southern Babeldaob Island (7.34N, 134.55E)
2) Supervisory Body: Airai State Government (Population number: 2,723)
3) Year of Establishment: 2005
4) Land Area: Unknown
5) Type of Marine Area: Mangroves, coral reefs and seagrass beds
6) Target of Conservation: Fish
7) Prohibited Activities: Entry of vessels and fish and fishing
8) Permitted Activities: None
9) Base Regulation: State Law ASPL No.A-4-14-05
10) Observation Details: The Protected Area is completely cordoned off with the use of buoys and ropes, which prevents boats and other vessels from entering. Mangroves in nearby Ngerikiil River are growing well. Land development is more discernible as compared to those of other regions, which leads to concerns of terrigenous fine particles inflow into rivers and coastal areas.

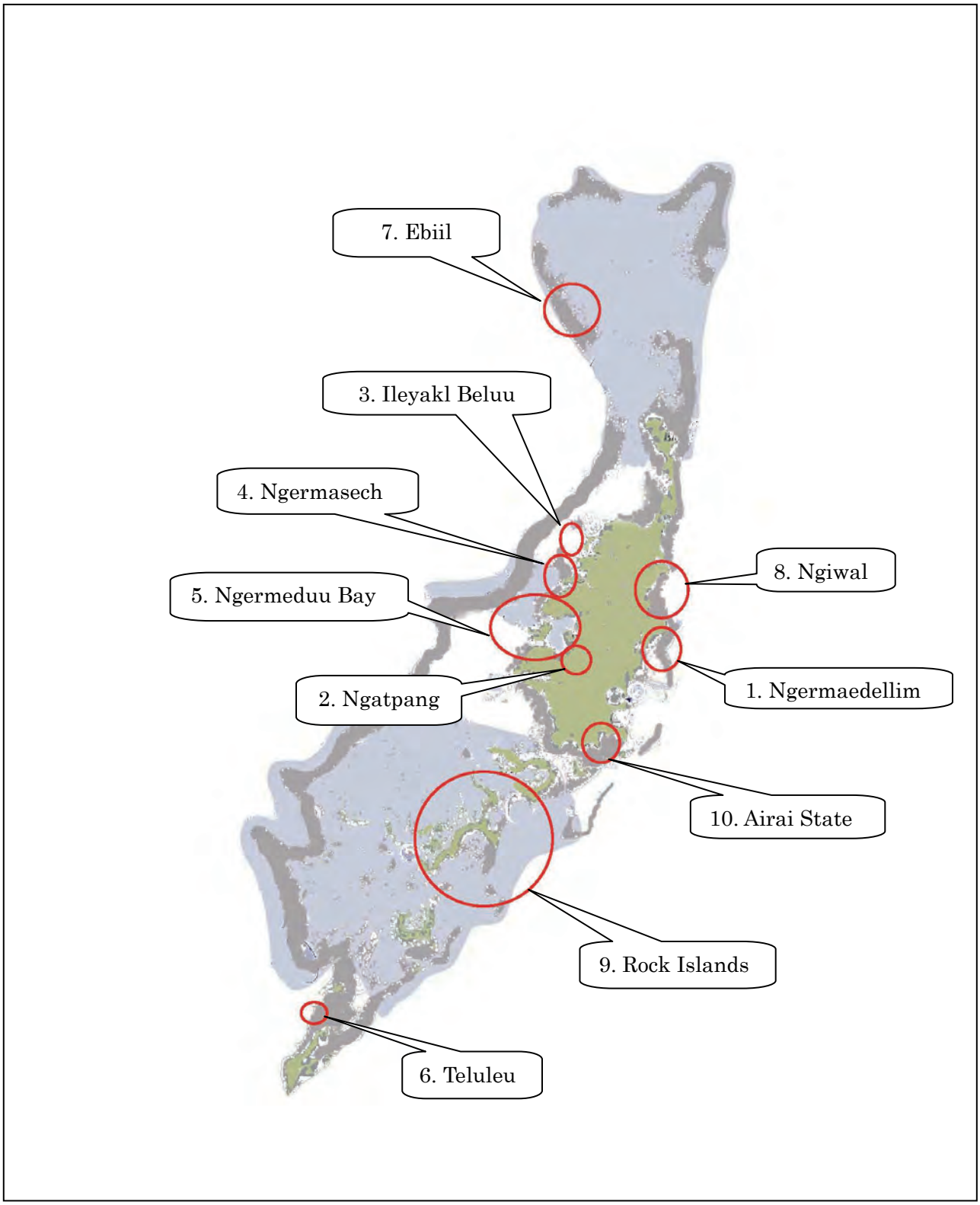


Figure.6.6. Location of the Protected Areas the study team visited.

6.3 Field Studies in the Republic of Palau: Significant Site

The project team established three important survey sites in the Republic of Palau (Ngiwal, Ngaremeduu Bay and Nerikiil) and worked to determine the characteristics of ecosystems found in each survey site. In particular, efforts were made to identify biota found on land, and from mangroves to coral reefs, as well as to collect data related to the conservation management of coastal zones.

At each survey site, members of the project team travelled upstream by boat to observe the growth conditions of mangrove plants and primary species of wildlife, as well as the characteristics of mangrove ecosystems. In addition, research was also carried out on land to observe the landscape of watersheds, growth conditions of plant and animal life and forms of land use. In coral reef areas, the distribution of organisms was conducted. For the purpose of effective data collection, interviews with state government officials and local residents were also carried out as far as possible.

In order to obtain information on material cycle processes within each survey site, samples of sediment and suspended matter were taken from the area extending from mangroves to coral reefs. Samples were tested for size distribution of particles, amount of organic substances and stable isotope ratios. As analysis of test findings require time, analytical results are forthcoming and shall be announced at a later time.

6.3.1 Ngiwal

1) Land and Mangroves

Ngiwal State has a land area of 17 km². Before Palau's capital was moved to Melekeok, the state had a population of 193 people. At present, it remains a relatively small state with approximately 300 residents. While many residents are employed as civil servants, the team was uncertain if a state of such a small scale had the administrative capabilities necessary to manage MPAs. However, such concerns turned out to be unfounded. Necessary documents were organized and in order, while the outstanding insights of the leadership (State Governor) proved astonishing. In accordance with state laws of terrestrial environments and control of coastal areas within 12 nautical miles (policing of fish poaching), a management system is made possible by the responsibility over biotic conservation of national government and state intervention in MPA management through PAN registration and technical supports from PCS and PICRC. This has ensured the administrative structure including reaction to MPA, which can be done by small budget (60% is labor cost) and human capital (who were hired three months ago and a full-time fisherman as an auxiliary, only). Because of this, related documents were astounding in quality and quantity. Information and data found at each relevant organization were also of tremendous quality, quantity and variation.

Figure.6.7. Ngiwal State Office
(Prof. Shunsuke Nagashima)

Flags were found to embody highly symbolic meanings. A red background represents a courageous warrior while

four stars symbolize the four traditional communities that existed in the past. Four foundational stones denote the four respective leaders. A bread fruit tree emerges from a body of water which is the sea, indicating bountiful harvests from the ocean, resulting in a flag that appears to represent the objectives of MPAs.

Figure.6.8. State flag and information of history and cultures of Ngiwal State. (Prof. Shunsuke Nagashima)

Before the war, tour delegations were sent from various parts of the Micronesia region. The then-chief of Ngiwal, who was a participant of one such delegation, began construction of an organized road known as Ngiwal Ginza after his return home in the 19th century. Apart from the communities present today, the chief also relocated two other traditional communities to the coastal region. At present, a wide and straight road facilitates transportation and a church has also been built by local members, a great source of pride to the family where the members belong. A pomelo tree that has been brought from Nagasaki (bearing some 30 or so large-sized fruit, which are popularly used during ceremonies and celebrations) symbolizes the entry of the house belonging to one of the local members.

Inland areas are covered by jungle and vital transportation viaducts continue to Ngiwal from Melekeok, the new capital city. Previously, Ngiwal was only accessible by sea and a ruined pier located in front of the state's main residential community attests to such a past. Goods and produce are transported to the capital for sale. Besides access by sea, the inland region could be reached by motorcycle. Once in the past, there were families who received donations in the form of automobiles bearing words that read "Japan-Palau Friendship Association". There are proposal reports in English that have been compiled by the University of Chiba concerning plans to develop the region into a center for tourism, and a storyboard design by the university has been incorporated into a rest area outside the state government office.

Figure.6.9. Summerhouse in front of the Ngiwal State Office. (Prof. Shunsuke Nagashima)

In the community, there live two women who are fluent in Japanese and remain fond of Japanese imperial education. One of them is a memory keeper who preserves the accuracy of old Japanese songs from the era of the South Sea Mandate. Her renditions of the songs on tapes and verses are truly accurate in both musical pitch and

pronunciation. The woman's husband, who was once the only photographer in the area, kept an album of photographs that he had taken and developed on his own, which serves as a reference for the region's community life in the past. Having been close friends with a Japanese hotel owner, the photographer also safe-kept research reports collated by Japanese people.

Also, in the community, a traditional Japanese pot was found in another home. Its owner explained that pot had been left behind by a friend and was well-used because rice that has been cooked in it would turn out just nice. The community exhibited a spatial quality where elements of Japan could be found through (partial) archival preservation. Located near the mountainside some distance away is Taiyo Village, a settlement built by the Japanese in the past is found. The village measured 612 *choubu* (1 *choubu* is equivalent to approximately 9,917 m²) and had 106 sections of land. 101 households were given permission to settle in the area. Of the six communities that were developed, the number of households in the largest community accounted for 30% of the total village population.

Figure.6.10. Life in Ngiwal. (Prof. Shunsuke Nagashima)

On the way to Ngiwal state on the Compact Road, which extends from the northern to the southern top of Babeldaob Island, the project team observed the presence of many estuaries that have been divided after road construction. Team members conducted visual observation of terrestrial and estuarine regions surrounding the small island of Lkes, which is located in eastern Ngiwal, before traveling by boat to carry out visual observation of river watersheds

The area centered in the island of Lkes is served by roads that were constructed during the Japanese Mandate Era. The Compact Road, which also serves as a breakwater becomes a causeway over the bay. Once a complete bay area, there are now landforms resembling a lagoon on the landward side that separates waters from the outer seas (see Fig. 6.11).

Figure.6.11. The compact road separating the bay and the ocean. (Prof. Shunsuke Nagashima)

Culverts (drainage channels providing passage to small boats) have been constructed in two locations along the causeway, which function as a link between the lagoon area and reef lake. The lagoon is a watershed for four rivers that flow from the terrestrial region.

A mangrove scrub forest grows along the river that flows into shorelines located on the side of the lagoon connected to Babeldaob Island. Judging from satellite images, aerial photographs and topographical maps, it can be seen that mangroves have formed in low-gradient areas. It is common for sediment and organic particles carried by rivers from terrestrial regions to accumulate in areas with flat ground where mangrove forests are found. Normally, sedimentary particles are microscopic, with particle size similar to those for silt and clay. Observation of terrestrial formations in estuarine regions of inflowing rivers revealed volcanic foundations (andesitic) and no distribution of limestone. As riverbeds of inflowing rivers were found to have gentle gradients, their sediment transfer functions weaken into sediment deposit upon approaching mangroves. As such, the percentage of coarse-grained sediments that are transported to the lagoon is thought to be small.

However, waters surrounding the culverts have constant water exchange due to tidal movements as well as outflow from the lagoon to the waters beyond. While it is possible that partial sediment transfer occurs frequently, this process is not thought to have much influence over the movement of fine sediment found across the entire lagoon area.

At the time of observations during low-tide, tidal flats were formed at coral reefs located on the northern part of Lkes Island along Compact Road. Areas were composed mainly of cream-white to white colored limestone sediment and there were no traces of mangrove sediment or particles corresponding to watershed geology such as volcanic rock and mineral substances. Sediment particle diameters were also larger than those of mangrove sediment, indicating that these particles have not been eliminated by selection processes. Shell remains and coral fragments were also found, leading to the conclusion that sediments are made up of substances of biological origins. Upon verification with general soil maps released by the Republic of Palau, Lkes Island has been categorized as “soils that formed coral sand”.

Based on the above observations, it can be inferred that sediment found in the eastern side of the bay area that has been separated due to construction of Compact Road is mainly composed of sediment of biological origins. There is a need to survey the land area of limestone-rich tidal flats in the north of Lkes Island as well as the properties of tidal flats that extend to the mangrove forests in order to further determine the characteristics of the lagoon.

With the objective of elucidating the above, samples of suspended matter and sediment across the marine area from the river to the lagoon and outers waters of Compact Road were taken and analyzed for concentration levels of organic substances. Samples are currently in the process of being analyzed and analysis outcomes shall be reported at a later date. An outline of preliminary findings will be addressed in this report.

Surveys were carried in eight survey locations (refer to Fig. 6.12). Survey sites 1-3 are in the waters on the external side of the road, sites 4-6 are inside the lagoon and sites 7-8 are located

Figure.6.12. The points of collecting water and sediments.

inside the river area. The concentration of suspended particles on the external side of the road (sites 1-3) have shown small values, suggesting the formation of a different environment compared to those found in waters on the internal side of the road (see Fig. 6.13, top). While rivers and the lagoon exhibited high concentrations of suspended matter, samples taken from site 8, which is located further upstream, has shown a lower concentration of suspended particles.

Comparatively higher contents of calcium carbonate, some higher than 80%, were found in sites 1-5 (Fig. 6.13, middle). Calcium carbonate is considered as a substance that is biologically derived from corals, shellfish and foraminifera. As such, the above observations have proven that with the exception of river regions, bottom sediment in the marine areas surveyed have been influenced greatly by coral reefs.

Organic substance content analysis (full carbon content, Fig. 6.13, bottom) produced particularly high values in survey site 6. This suggests the formation of an environment where there is a tendency for organic matter outflow from rivers to accumulate. In sites 4, 5 and 7 inside the lagoon area, comparatively higher content levels of organic substances were detected. This indicates that an environment with a propensity for organic matter accumulation has developed due to the presence of Compact Road.

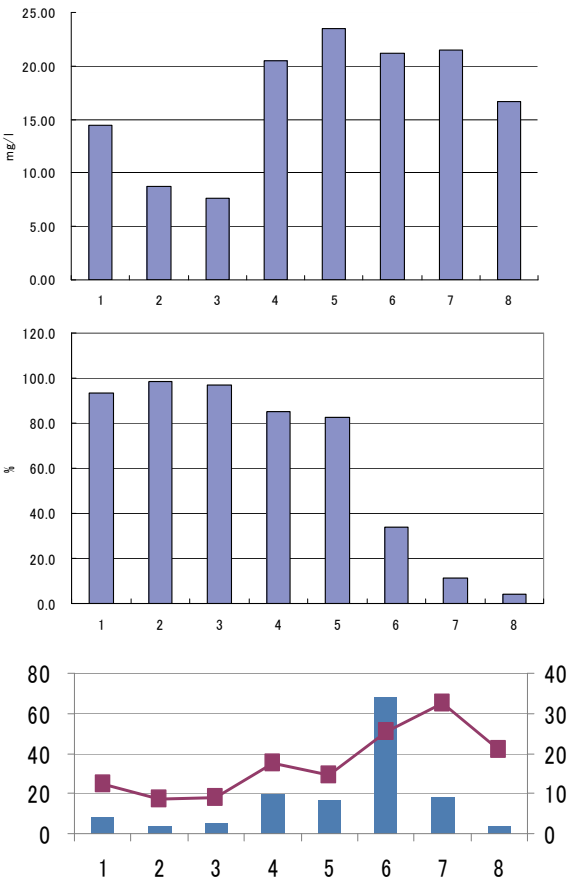


Figure.6.13. The amount of suspended matters on the top, the amount of calcium carbonate in sediments on the middle, and the amount of organic carbon on the bottom. The line graph shows carbon to nitrogen ratio. (2012, University of the Ryukyus)

CN ratio (carbon to nitrogen content weight ratio) analysis for sediment samples taken from survey sites 6, 7 and 8 located between the estuarine region and the upper reach of the river exhibited higher values. Commonly, high values for sediment containing substances derived from higher plants (with thick cell walls) suggest that the survey site, beginning with its mangroves, contains a significant accumulation of matter derived from higher plants.

Mangrove seedlings on both sides of the road are surviving well and further plant growth is said to be possible. As such, it is crucial to consider counter-measures soon.

The region including the lagoon is a Protected Area governed by the Ngiwal State Government (Fig. 6.14). Waters of the lagoon are brackish and there have been reports of unpleasant odors emanating from lagoon waters in recent years. One reason to account for this is deteriorating tidal circulation within the bay after waters were closed off due tothe construction of Compact Road.

The Pacific Reef Heron, White-Tailed Tropicbird and Rufous Night Heron were spotted in the area between the proximity of the river mouth and the coastline. As the Rufous

Figure.6.14. The No Entry board at the bay. (Ecosystem Conservation Society-Japan)

Night Heron is generally extremely wary of human activity and tends to inhabit forests that thrive in coastal regions, it is a species of bird likely to be regarded as a gauge indicating the degree of nature.

To the north of the lagoon-shaped bay is inflow from Ngeredekuu River. Due to information sources, crocodiles are found in large numbers downstream, which accounts for the preservation of very little human entry in the area. Watersheds of this river are included as a target for conservation within the Protected Area, and the hunting and gathering of natural life, together with developmental activities, have been prohibited. Development such as agricultural land expansion has not been carried out at present but pineapple plantations that were started during the Japanese Mandate Era were observed. In these areas, there are no woodlands but low-growing shrubs (Fig. 6.15). Traveling upstream in inflowing rivers at the back of the bay takes one into the dense mangrove jungle (Fig. 6.16). Here, forests are hushed and tranquil, and the endemic Palau Fruit Dove was also spotted.

Figure.6.15. River mouth without forest growth.
(Ecosystem Conservation Society-Japan)

Figure.6.16. Brackish waters among rich mangroves.
(Ecosystem Conservation Society-Japan)

It could have been due to the time of the day that the survey was conducted, but the number of fruit doves that were observed was few in number. The project team was also unable to identify the cries and movements of other bird species.

Team members were able to experience the sheer range of the mangrove jungle by traveling upstream between the long and extensive brace roots of *Rizophora mucronata* and *R apiculata*. Near the estuarine regions, the depth of mangrove forests appeared to be discernible even from the outside. While the actual distance could not be measured, a gradual transformation in natural environments was observed several hundred meters upstream. Crab burrows and mud hills belonging to the mangrove lobster *Thalassina anomala* (Okinawa burrowing mud shrimp) were spotted. However, the project team was unable to confirm if these species inhabit the surroundings of estuarine regions. It is necessary to conduct additional surveys on a day with different tidal conditions.

Traveling further upstream along each water channel and passing the massive the mangrove forests area, team members found the presence of very narrow spaces that would likely turn into dense forests from plant overgrowth in future. There had been plenty of space in these waters for schools of fish to move freely in the past. It may thus be necessary to consider measures to contain plant overgrowth in the near future such as trimming (production of *binchotan* charcoal as fuel and firewood – due proceeds could be utilized as a regional environmental conservation fund), management of water channels (use and protection of marine resources), in addition to a structure for permanent manpower (this will contribute to creation of employment opportunities if such jobs are not limited to the local region) and funding subsidies (which could serve as partial revenue).

As mentioned in earlier sections, the defining feature of this area is the presence of Compact Road, a loop road

which becomes a causeway that serves the circumference of Babeldaob Island. The causeway has been constructed at a distance away from the fringe of mangrove forests, leading to the creation of inland bay-like and closed marine areas. This is believed to have exerted an influence on sea currents and the process of suspended matter sedimentation. Due to the presence of Compact Road, river water containing suspended particles that flows from estuaries does not flow immediately into the sea. Instead, waters remain and accumulate in the water mass between the road and coastal zones. There are two exits large enough for small boats to pass through. Research concerning suspended matter, sediment and water quality in such a marine structure will help to provide much information on various aspects of coastal management.

The state has a population of 223 people (Republic of Palau, 2006) and residential settlements are found on the northeast of the bay along the coastline. State government facilities are also located here (see Fig. 6.17). This particular settlement is separated from watersheds of rivers that flow into the bay. No large-scale crop cultivation or animal husbandry was observed in the surroundings of the settlement. Coconut trees were found to be growing sporadically.

Figure.6.17. Ngiwal State Office and the Honeymoon road. (Ecosystem Conservation Society-Japan)

One of the team members had the opportunity to travel by boat to a river located at the back of the bay as well as seas located just beyond the bridge with state government staff and a fisherman (Mr. Salui, 43 years old) in January 2012. Observations carried out at a point upstream where river widths were extremely narrow revealed glorious mangrove forests that would serve as suitably as a non-developed destination for eco-tourism. However, mangroves here required trimming and care since river access by boat will be hampered by mangrove overgrowth.

In addition, the following points could be observed from general cartographic information:

- 11 rivers flow into the bay area
- The uppermost part of rivers consist of upland forests and grass fields.
- Swamp forests and wetlands can be seen on both sides of rivers in mid to upstream regions
- Mangroves and swamp forests (woodland established in shallow marine areas of approximately 1 meter in depth) are distributed in downstream to estuarine regions
- One residential settlement located at the northern end of watersheds
- By regulation, all other settlements in Ngiwal State are located outside of watersheds
- Carrying out of man-made land cultivation such as agro-forests (forests where trees are planted and mixed cultivation of crops and/or livestock is carried out) and coconut plantations
- Development of secondary vegetation in former plantation sites

2) Coastal Zones

MPAs and Protected Areas in watersheds of Ngiwal have been registered with PAN, and this has allowed them to

receive funding. As entrance to the bay area has been closed off by construction of Compact Road, flow of seawater to and from outer seas take place in two areas. Formation of the bay area is similar to the structure seen in Funaura Bay (*Funaura-wan*) in Iriomote Island, Okinawa. Observation through offshore snorkeling near the bridge revealed brackish waters. Wave movements observed at the time of snorkeling could have caused re-suspension of earth and sand sediment at the bottom of the sea. This marine area is not covered with coral reefs but a shallow seagrass meadow, and a large number of a species of fish similar to the rabbit fish was observed. Many white boundary buoys placed at narrow intervals were also observed.

There is only one person engaged in full-time fishing in Ngiwal. Other fishermen only conduct fishing activities on an occasional basis. There are three fishing boats in the state. Fishing regulations oversee the main activity of spear fishing (day and night), trawl lines outside of reef areas, single hook fishing (using rod and reel), gill netting and mangrove crabs cages. In Ngiwal, demand pressures on fishing catch are comparatively lower than those seen in Southeast Asia. The same can also be said of Palau in general, with the exception of peripheral areas of Koror. It is possible for the fishing industry to be maintained even without MPA fishing regulations.

Project team members who returned to Ngiwal for additional surveys were accompanied by Mr. Salui for participatory observation of the fishing industry (Fig. 6.18 to 6.24). Firstly, rod fishing using squid as bait was conducted in shallow lagoons. Although the team did not expect any catch due to shallow water depths of approximately 1 meter, attempts by four team members in four different locations yielded some 30 fishes, which included two species of common lentjan, honeycomb grouper and big spotted trigger fish. In another location, the team traveled at high speeds in their boat in waters surrounding a central coral reef and fished by herding schools of fish into the corals.

Mr. Salui also engaged briefly in spear fishing. Waters were clear and tidal currents were swift. Swimming and occasionally skin-diving, Mr. Salui searched patiently for fish hiding in spaces beneath micro atolls of porites coral. 30 minutes later, he emerged from the waters with a bluespine sturgeonfish of about 60 cm in length.

The project team also visited a giant clam farm located in front of Ngiwal village. While reinforced steel stakes still remained, fences and cages lay damaged. In terms of large-sized clams, there was only one fluted giant clam with a shell diameter of approximately 60 cm. There were a few bear’s paw clams measuring about 40 cm in diameter found close by. The fluted giant clam was bred using seedlings obtained from Palau Mariculture Demonstration Center (PMDC). Breeding of clams has been suspended since damaged fence means that clam seedlings would be eaten by fish that enter the clam breeding grounds.

The team also entered the bay area to retrieve mangrove crab cages that had been released. Fishing activities were conducted efficiently by Mr. Salui and his wife. Each day, the couple would set some 13 cages in the bay. In Ngiwal, there are three people engaged in mangrove crab fishing. Cages are fitted with Styrofoam buoys as a form of identification so owners of cages can be differentiated by the shape of the floating buoy attached. Bait is changed regularly regardless of whether cages contain crabs. Bait consists of fishes caught by spear fishing. Fishes are split open and tied to the inside of the crab cages. All cages have been made by hand. Pincers of captured mangrove crabs are secured deftly with string.

Mangrove crabs are sold at $7 a pound and make for a good source of income. Three mangrove crabs and one Taiwan mangrove crabs were yielded on the day of observation. An average of 3-4 crabs are caught daily and each crab weighs approximately a pound each, which results in a daily income of about $25.

Figure.6.18. Mangroves and a river.
(Dr. Shinichiro Kakuma)

Figure.6.19. Mr. Salui caught breams.
(Dr. Shinichiro Kakuma)

Figure.6.20. Seagrass, algae, and rabbit fish at the ocean side of the bridge.
(Dr. Shinichiro Kakuma)

Figure.6.21. Mr. Salui looked for reef fish hiding under the corals.
(Dr. Shinichiro Kakuma)

Figure.6.22. Mr. Salui with his long and short spears.
(Dr. Shinichiro Kakuma)

Figure.6.23. A fluted giant clam at the giant clam farm.
(Dr. Shinichiro Kakuma)

Figure.6.24. A mangrove crab caught by the cage trap.
(Dr. Shinichiro Kakuma)

Figure.6.25. Protected Areas, rivers, and roads in Ngiwal State. (PALARIS)

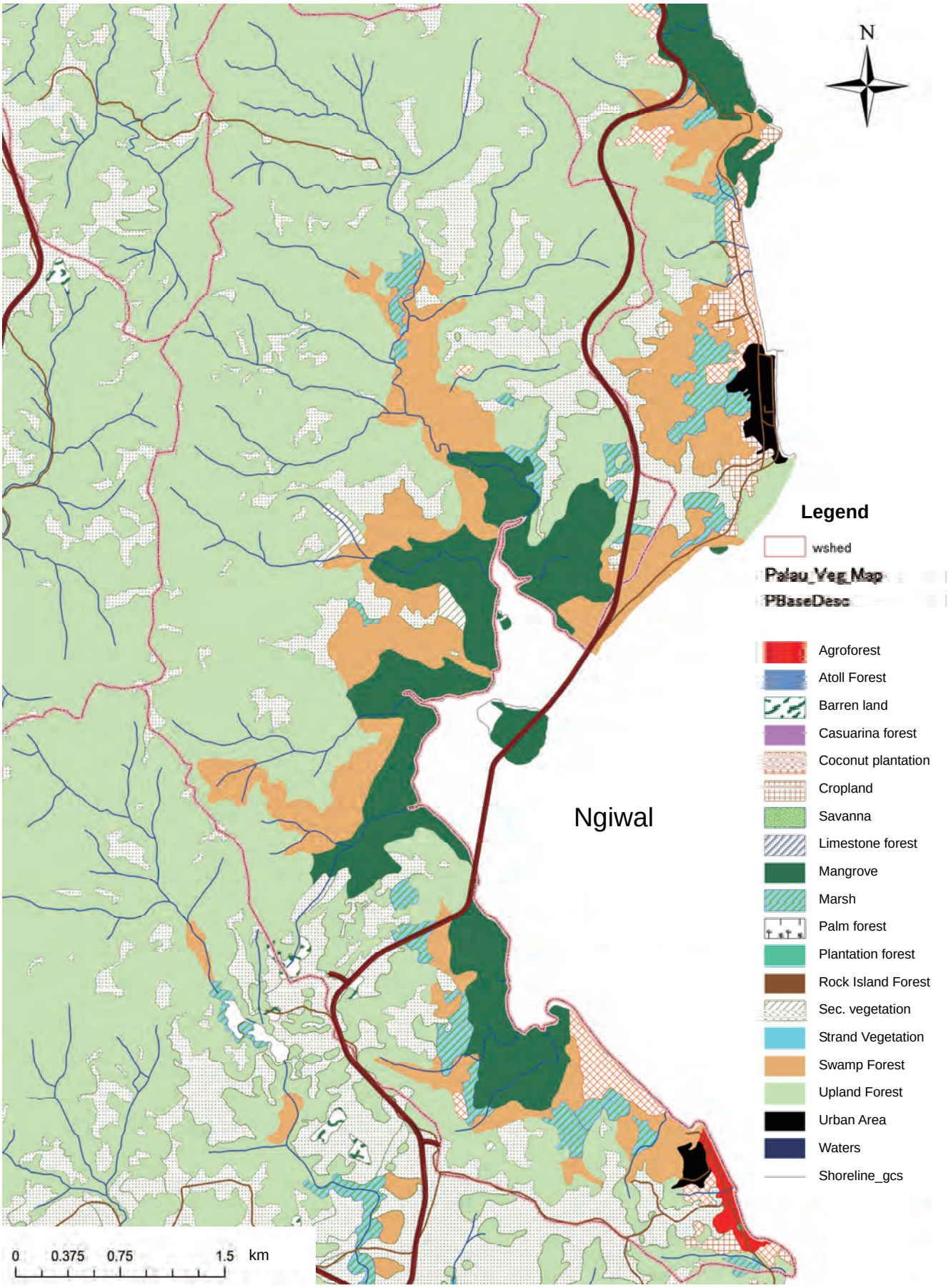


Figure.6.26. Land-use figure in Ngiwal State. (PALARIS and Ecosystem Conservation Society - Japan)

6.3.2 Ngaremeduu Bay

1) Land and Rivers

The project team traveled on Compact Road by car from the south of Babeldaob Island to Ngaremeduu. Upon arrival, the team carried out visual observation of northern watersheds and the area surrounding Compact Road.

This region is centered around Ngaremeduu Bay, which is situated on the west of the island. The bay is surrounded by vast mangrove forests and is enclosed by fields with low-lying hills, where much grassland can be seen. To the north of the bay is the PCS-appointed Ngermeskang Bird Sanctuary (see Fig. 6.27). In addition, watersheds to the south of the bay have been made a Protected Area.

Figure.6.27. The board of Ngermeskang Bird Sanctuary and the Compact Road.
(Ecosystem Conservation Society-Japan)

Zoning within the bird sanctuary has resulted in different areas for permitted activities such as camping, bird-watching and trekking, as well as areas where human activity is prohibited. Elements of the environment are diverse and include forests, grassland and rivers, and many endemic species of birds and other comparatively smaller populations of wild birds such as Micronesian Imperial Pigeon, Palau Fruit Dove, Palau Flycatcher, Micronesian Myzomela, Morningbird and Palau Bush Warbler were observed.

Figure.6.28. Savanna along the Compact Road.
(Ecosystem Conservation Society-Japan)

The landward side of this region has undulating topography with large hills. There are many areas which are covered by trees but large expanses of savanna can also be seen in places (Fig. 6.28). It is yet unknown why and when plant life in this region began to assume their present states. In particular, hills found in the eastern part of the bay front have little vegetation growth. While acacia forests dot the landscape at the top of hills, these trees have been planted by Japanese people, indicating the former presence of a settlement in the area during the Japanese Mandate Era.

Figure.6.29. Red soil bankside along a road.
(Dr. Shinichiro Kakuma)

On the way to Ngaremlungui, which is one of the three states that co-owns the bay, portions of the road had gradient slopes with exposed red soil. When compared to red soil seen in Okinawa, the version seen here was in a comparatively lighter shade of red. If development projects are carried out in the area, red soil pollution similar to phenomena seen in Okinawa can be expected (Fig. 6.29).

In contrast, low-lying lands close to Ngaremeduu Bay had slight undulating topography and were mostly

composed of low wetlands and vast mangrove forests. According to interviews with Mrs. Kitalong of BNM, this area had seen the expansion of mangroves due to an increase of sediment inflow caused by soil erosion.

Judging from the appearance of the portion of the Compact Road that runs through this area, it can be gathered that the road was constructed by cutting across a ridge line and filling up a valley. Observations suggest that the effects of soil runoff were strong at the time of road development, and such effects are believed to have contributed to an increase in sediment inflow into the bay. At the time of the survey, the project team was able to observe red soil run off from terrestrial regions into the sea (Fig. 6.30) from a vantage point where the area from Compact Road to the western coastlines outside of Ngaremeduu Bay could be seen.

Figure.6.30. A view from the Compact Road to Southwest coast of Babeldaob Island after heavy rain. We could find red soil runoff from the river mouth to the sea.
(Ecosystem Conservation Society-Japan)

There were strong rains due to a typhoon on the day before the first site survey, a factor that could have accounted for the soil runoff, but the source of the runoff could not be determined. However, areas of exposed topsoil and a lack of trees and vegetation were observed, suggesting that soil runoff has been occurring at a certain degree of constancy.

During the team's second survey, members traveled upstream from the bay to inflowing rivers close to the bird sanctuary in order to observe rivers with mangroves (Fig. 6.31). Mangroves exhibited active growth and had formed a dense forest. Similar to those observed in terrestrial areas, bird species in this region had comparatively larger varieties and populations such as Palau Bush Warbler, Collared Kingfisher, Palau Flycatcher and Palau Fruit Dove. According to ornithologist Dr. Alan R. Olsen of BNM, the Palau Fruit Dove is an indicator of the formation of healthy forest environments that feeds on local fruit.

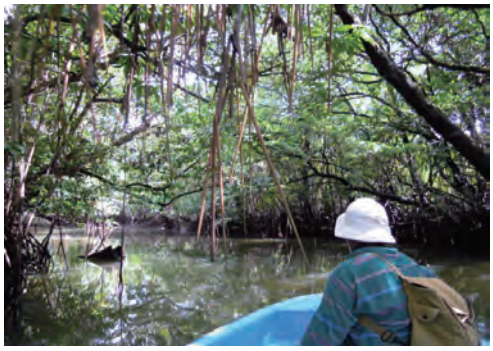


Figure.6.31. Bird watching on the boat on a river with mangroves.
(Ecosystem Conservation Society-Japan)

Ngaremlungui is the village that served as the backdrop of the famous author Bob Johannes' work, "Words of the Lagoon". The project team met up with state government staff at the village pier, who took team members by boat to tour Ngaremeduu Bay, rivers located behind the bay area as well as coral reefs outside of the bay. Halfway upstream though the largest river, both riverbanks were observed to be covered by dense mangroves. The team also came across a boat driven by an influential member of the region (Fig. 6.32). The team spotted mangrove crab cages that had been laid and captured mangrove crabs that had been placed into boxes.

Figure.6.32. Mangroves and a mangrove crab fisherman on a river.
(Dr. Shinichiro Kakuma)

In addition, cartographic data revealed the following points:

- There are seven rivers flowing into the bay with several many tributaries.

・Upstream and midstream areas are mostly made up of upland forests. Grasslands also dot the topography of the area.
・Unlike the other two watersheds, a road that passes over the mountain and connects to the eastern coastline has been constructed at watersheds here.
・Compact Road has been constructed by correcting curvatures and widening the width of the previous road.
・Secondary vegetation can be seen in former plantation lands and farmlands in an area along the road.
・Much grassland is found in hilly and mountainous areas. Such areas could have been the site of settlements during the Japanese Mandate Era.
・Small overall percentage of swamp forests, vast expanses of wetlands and mangrove forests located in mid to downstream regions.
・Compact Road was developed away from mangrove forests but a portion of the road was constructed by reclaiming cleared wetlands and mangroves.
・There is a residential settlement located behind of Ngaremeduu Bay.
・Located some distance away from the settlement is a scattering of coconut plantations and lands that have been utilized for agricultural and forestry purposes.

2) Coastal Zones

Outside of the bay is a large lagoon. Team members traveled up to the middle of a water channel situated on the northern side and snorkeled in southern channel waters (Fig. 6.33).

This naturally formed channel is extremely deep and serves as part of the route taken by Japanese war ship *Yamato* during the war. While Ngaremeduu Bay has considerably brackish waters, the cover degree of corals in channel waters was unexpectedly high. This may be due to the fact that the channel is located at a considerable distance out at sea from the entrance to the bay. Small to medium-sized fishes were spotted in waters at the edge of the channel and various species of sea cucumbers including the highly-valued sea cucumber Holothuria fuscogilva were also observed on the sand-covered sea bottom.

Figure.6.33. Corals at channel outside of Ngermeduu Bay. (Dr. Shinichiro Kakuma)

Coastal zones near the port of Ngaremlungui have been designated as a sanctuary (no fishing zone) and numerous white buoys received with support from Taiwan have been set up.

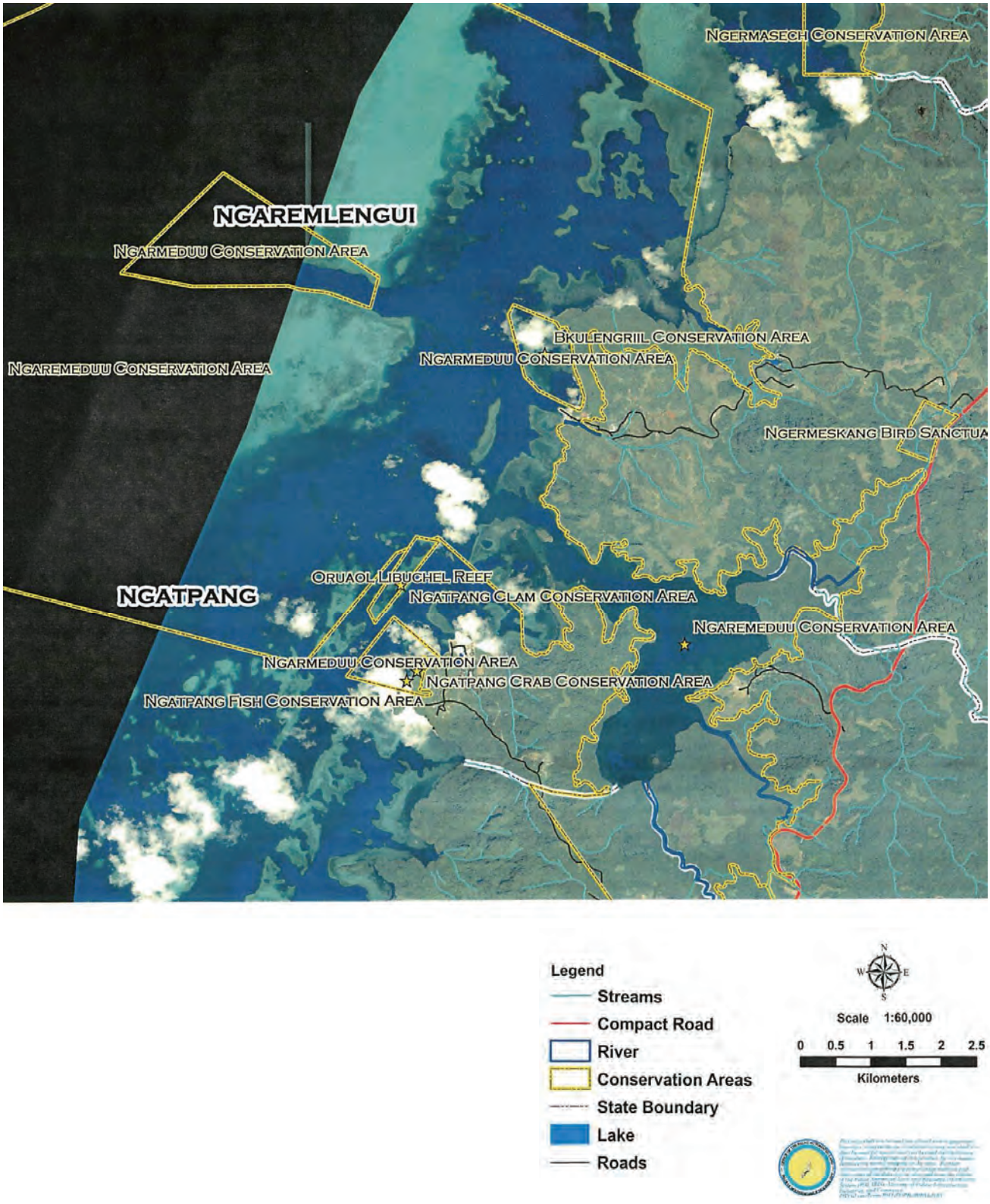


Figure.6.34. Protected Areas, rivers and roads in Ngermeduu Bay area. (PALARIS)

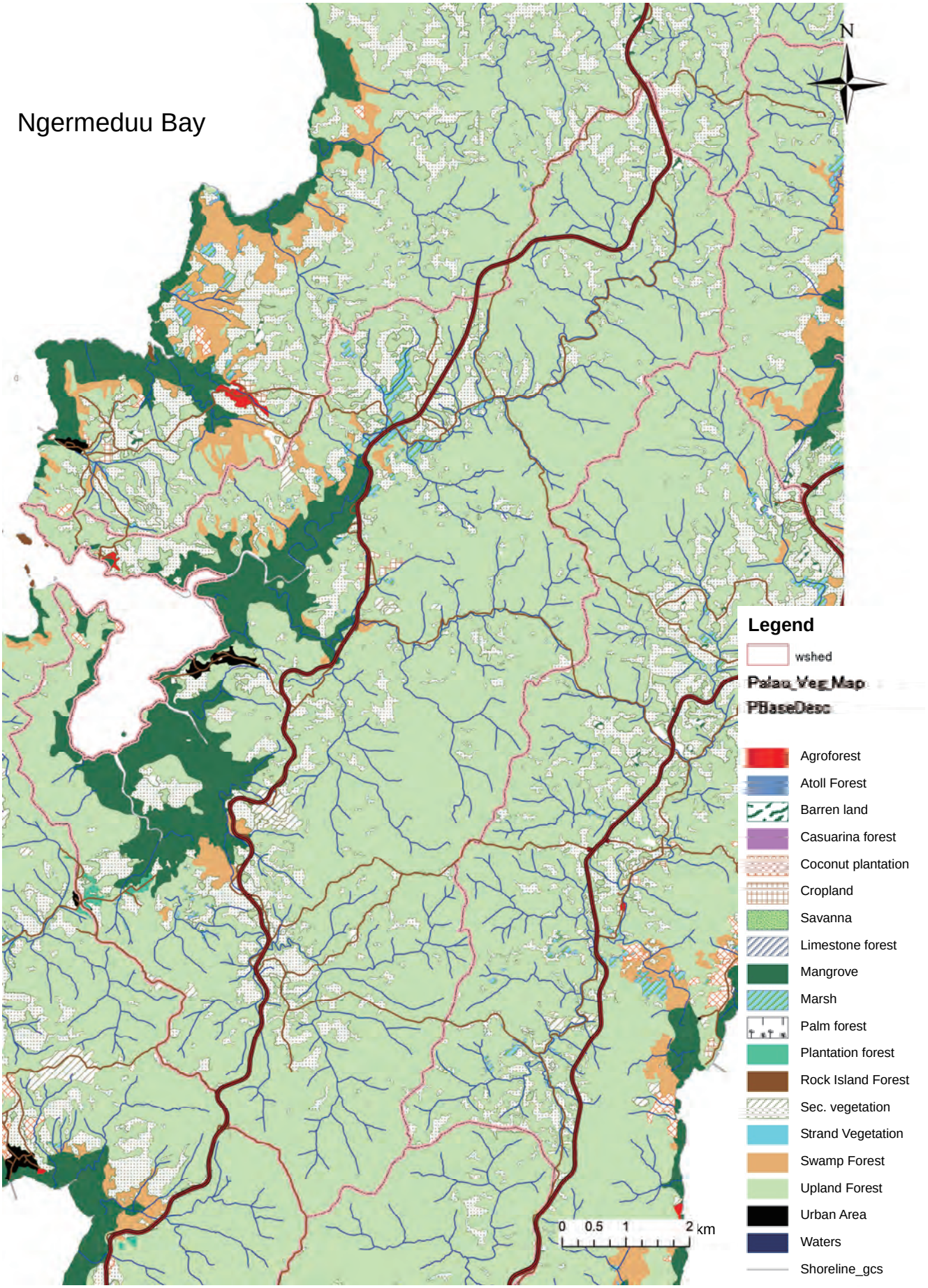


Figure.6.35. Land-use figure in Ngermeduu Bay area. (PALARIS and Ecosystem Conservation Society - Japan)

6.3.3 Ngerikiil

1) Land and Rivers

Airai's state flag carry the design of six rabbit fishes and leaves of the tee tree, while six stars represent the six settlements of the state. The flag design is based on a legend which tells of bountiful fishing catches ever since rabbit fish in pursuit of tee tree leaves were brought to Airai. Legends also speak of how tee trees came to be planted in Airai because of the prosperity that the plants brought to the region. The white background of the flag symbolizes peace for the present and future. This flag also embodies the early ideals of MPAs (Fig. 6.36).

Figure.6.36. The flag of Airai State and the meeting with Governor Kanai at the Airai State Office.
(Prof. Shunsuke Nagashima)

Airai State is the second-most populated state in the Republic of Palau and is also where Ngerikiil River is located. At 2,723 people (as of 2005), it is the state with the largest population on Babeldaob Island. Total land area of Airai State is 55km².

With the International Airport in Airai state and a bridge that connects to Koror Island as well as the Compact Road that links to the rest of Babeldaob Island, Airai State functions as Republic of Palau's key node of transport.

Located close to the center of human activity in Koror and owning jurisdiction over the airport, Airai State faces numerous challenges with regards to access to clean water, as well as sewage and pollution management so as to ensure that coastal zone ecosystems, including MPAs, do not suffer negative consequences. The female state governor of Airai State has emphasized the above in her initiatives and concerns, and her efforts have been praised by other women leaders in Airai. The state has a sister city agreement with Hsinchu in Taiwan, which is well known for its semi-conductor manufacturing industry, and has concentrated efforts in improving the quality of life and the environment, together with promoting traditional culture. Various departments of the state government operate at scales that require the least level of manpower necessary. One of the fishermen interviewed also happened to be an official of the state department for the promotion of agriculture.

According to Mrs. Kitalong of BNM, the state has witnessed growing soil runoffs in recent years, in addition to expanding mangroves in certain marine areas. In fact, savannas with little vegetation in places can be observed from the Compact Road. In addition, extensive construction with bulldozers along roads north of the airport has led to exposed red soil in a number of places (Fig. 6.37).

While development goals for the future remain unsure, situations such as the ones mentioned above have been witnessed with growing frequency since the construction of the Compact Road. These conditions become sources of red soil runoffs when it rains and such effects extend as far as the marine areas.

Recently-built houses have been observed along the Compact Road and residential development appears to be in progress.

There are gradient slopes on the Compact Road and the eastern side of the airport towards the sea and forested areas can be seen by Ngerikiil River (Fig. 6.38). Mangrove communities are similar to those seen in the two other surveyed areas, and discerning characteristics could not be determined.

Mangroves in this marine area are not easily accessed and entry from terrestrial regions appears to be impossible. As such, there has been no development of coastal zones in this area. No large-scale plantations or farms were observed in the surroundings of the residential settlement, although cultivated coconut forests were found scattered across the region.

During additional surveys, the project team chartered a boat to enter inflowing rivers from the bay in order to carry out observations of brackish waters found in areas of active mangrove growth (Fig. 6.39). Mangrove forests here appeared to be comparatively younger than those seen in other surveyed areas of significance. Bird species that were spotted include the Rufous Night Heron and Whimbrel, although these were found in small numbers. The degree of nature also seemed to be lesser as compared to other regions that were surveyed. Topographical feature of this area is a steep gradient from the hilly region to the shoreline, which accounts for why development has not been carried out in areas surrounding the shoreline. In contrast, there has been significant development around Compact Road. Development of areas along the road is expected to progress further in future.

Figure.6.37. Ground leveling near the Compact Road. (Ecosystem Conservation Society-Japan)

Figure.6.38. Forests and mangroves on the east side of the International Airport.
(Ecosystem Conservation Society-Japan)

Figure.6.39. Mangroves along Ngerikiil river.
(Dr. Shinichiro Kakuma)

Team members conducted observations of rivers and their surroundings by boat from near the estuary, by car from the bridge, and then from water collection points found upstream. Water supply was found to be plentiful. Up until water collection points, waters also serve as a habitat for salt-water crocodiles. Apart from site observations,

the team was given detailed explanations from Mrs. Kitalong who spoke using materials such as photographs, maps, pictorial books and academic theses. Her husband is a chief in Airai, who is well-read in local matters and used to participate in the hunting of salt-water crocodiles. Crocodile hunters used to hunt all over Palau over a period of several months and their catch was usually shipped to Japan. It has been said that crocodile numbers fell to one-tenth of their original numbers as a result, but populations have recovered significantly since then.

Rabbit fish, which are the symbol of Airai, come to the coastal zones in large numbers at fixed times. The scientist's husband informed the project team that the activity patterns and water routes in mangrove forests of rabbit fish are easily predictable, and pointed out the specific fishing spots and trap points for rabbit fish that he had memorized on a map. However, due to decreasing human activity and natural neglect from the establishment of an MPA in the area, waterways have become narrower and fish routes have started to change. The scientist's husband raised concerns that human activity and fish routes would be permanently altered if nothing was done to clear the waterways soon.

Under the guidance of PICRC staff members, the team also conducted observations in areas besides mangrove forests. Along the way to examine areas near the upstream region, members passed residential housing, taro patches and farms to arrive at a destination located some distance away from the river. The team found it beneficial to have been able to learn more about how areas surrounding the river have been utilized, although members remain concerned at the large number of places where significant red soil runoffs have taken place.

In addition, cartographic data revealed the following observations:

- There are six rivers that flow into the bay but there is only large river with tributaries. Almost all watersheds are consolidated into these rivers.
- Mountainous areas are mostly made up of highland forests.
- There are no roads permitting human access into mountain regions.
- There are many roads apart from Compact Road mid to downstream, but these have been built mainly for accessing coconut plantations and cultivated fields.
- There is a distribution of coconut plantations in a region along the shoreline, and access to this area is thought to conducted by sea.
- Partial areas in savannas found in the mid-stream area show signs of vegetation removal due to development and have become sources of red soil erosion.
- Agro-forests are distributed along roads that are easily accessible from residential settlements.
- The airport's runway is part of the region's watersheds. Rainfall on the runway is not absorbed but flows over the surface at once, which may cause transportation of red soil.
- Shorelines are covered with mangrove forests that prevent projects aimed at developing the area.

2) Coastal Zone

Heading for Ngerikiil from the pier in front of PICRC on a boat belonging to Airai State, the trip resembled a cruise tour when the boat passed islands with no waves at high speed (Fig. 6.40). Moving upstream along Ngerikiil River where large numbers of salt-water crocodiles are said to be found, the team found glorious mangroves in surrounding areas that would make for utilization as a tourist spot (Fig. 6.39).

People in Airai State are fond of rabbit fish, which has also been named as the state fish. In southern Ngerikiil, there is a vast Protected Area dedicated to the conservation of rabbit fish. Limits to this Protected Area have been denoted by the installation of white buoys. Airai State has also established a rabbit fish breeding and seedling production facility in the south (Fig. 6.41).

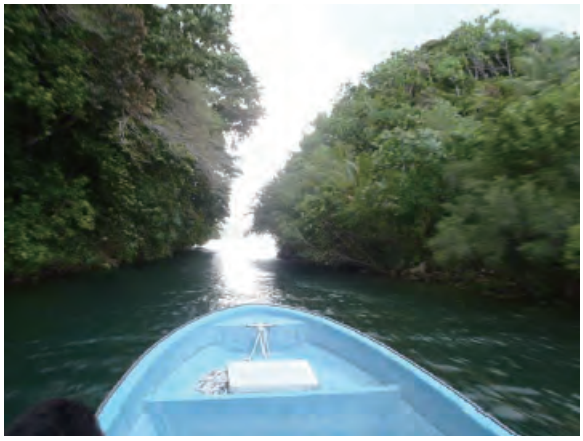


Figure.6.40. Cruising through rock islands with a speed boat. (Dr. Shinichiro Kakuma)

The team also visited the Airai State Government Office and spoke with Mr. Jack Masters, who engages in sport fishing. Mr. Masters travels out to sea about three times a week to carry out night spear fishing as well as fishing by draw ropes and gill netting on a 25 horsepower, 16-feet boat. There are many people who engage in sport fishing in Airai. While that number of sport fishers is approximately 200, the number of boats in possession is less than 100. Compared to Ngiwal, fish markets here appear to be crowded. When asked about plans by the Marine Resources Agency, PICRC and environmental NGOs to establish a fishing co-operative, local fishermen responded favorably, saying that the move was a “good idea”.

Figure.6.41. Rabbit fish breeding facility in Airai State. (Dr. Shinichiro Kakuma)

This region has well-developed coral clusters dominated by healthy ramiform and tabular acropora that are spread over a wide area. The team was able to confirm the existence of marine areas with large expanses of coral reefs that have communities of diverse species of fish. While there was suspended matter consisting of fine particles from mangrove regions, waters with high visibility were present. Further surveys are necessary to determine the flow of seawater and movement of suspended particles and sediment in this area.

Staff members of PICRC showed the team to areas surrounding the shorelines. The basic structure of coastal zones in these areas extending from the shoreline and estuaries to offshore waters was found to be composed of a pattern consisting of mangroves-tidal flat-seagrass beds-corals, and such a formation was observed by the team from the shore. While it is necessary to construct management plans and establish MPAs that emphasize inter-relationships not only between terrestrial and coastal zones but also diverse ecosystems in coastal zones, the gathering of scientific information as backing for such moves remains as a task to be completed.

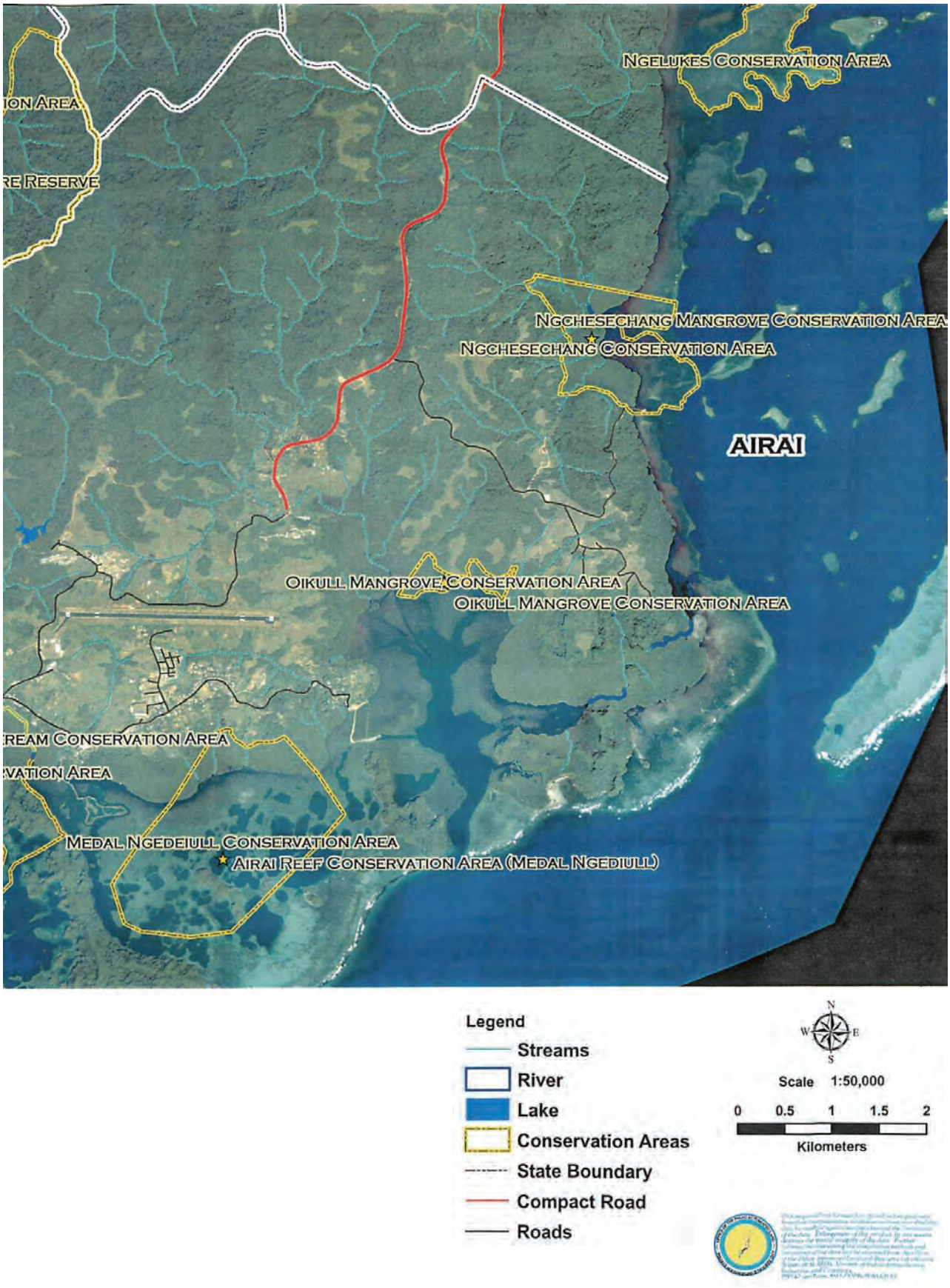


Figure.6.42. Protected Areas, rivers and roads in Airai State. (PALARIS)

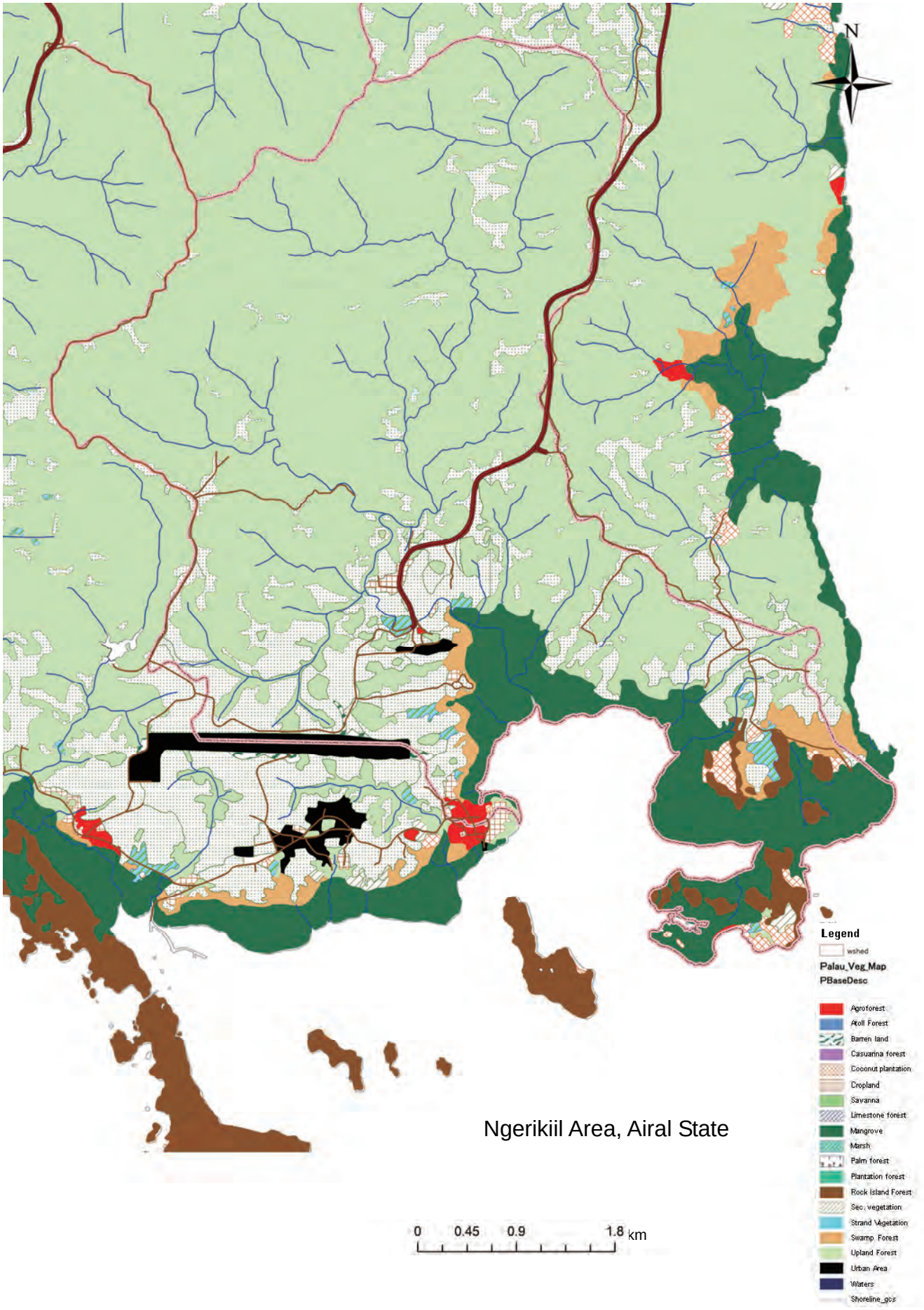


Figure.6.43. Land-use figure in Airai State. (PALARIS and Ecosystem Conservation Society - Japan)

Chapter 7　Protected Areas Network (PAN)

7.1　PAN Act and Revised PAN Act

The Republic of Palau has been carrying out the establishment of Protected Areas since the era of TTPI but such moves became more active due to initiatives adopted by state governments and NGOs after 1994, when Palau gained independence. Due to stipulations in the national constitution which state that the country shall not intervene in local initiatives over which state governments maintain jurisdiction, establishment and management of Protected Areas have been carried out independently by each state without involvement of the national government.

Into the 2000s, with global concerns over the effects of climate change and domestic apprehension over environmental damage caused by developmental pressures and population increase, the Republic of Palau began to move away from individual state management to seek the consolidated supervision of national land and its coastal regions for the effective conservation of biodiversity and sustainable use of resources. However, the following issues are some of the many challenges faced by the state, which is directly responsible for managing Protected Areas, and also by the national government, which has jurisdiction over environmental conservation across the whole of Palau.

【State Level】

1) Inability to hire manpower and equipment for maintenance and management due to limited fiscal scale.
2) Weak policing functions due to insufficient manpower and equipment.
3) Weak punitive provisions in civil law.
4) Low level of scientific knowledge and understanding amongst state government staff and local community.
5) No operation of ecosystem monitoring and no consolidation of data on ecosystems.
6) Lack of maintenance strategies in some cases. Even when such proposals exist, they are not viable due to the reasons stated above.

【National Level】

1) Inability to intervene in degrees beyond those stipulated under national law with regards to initiatives carried out at the state level.
2) Inability to determine existing conditions and respond swiftly to changes due to a lack of consolidated data on local environments.
3) Inability to coordinate response measures with related states for matters concerning ecosystems that straddle state borders.

The government of the Republic of Palau has concluded that in order to carry out dialogue with local communities and key personnel in and outside of Palau, as well as to resolve outstanding issues, it would be effective to enhance the efficacy of Protected Areas by enabling national intervention and establishing links for information concerning Protected Areas, namely through networking. This was followed by the enactment of the Protected Areas Network Act (PAN Act, RPPL 6-39) in November 2003.

The main onus of the PAN Act is its role in defining that the national government plays a supporting role to environmental initiatives carried out at the state-level. But specifically, the PAN Act states that the government of Palau would provide technical assistance or render a structure of fiscal funding for the implementation of technical support, in addition to facilitating coordination amongst states with regards to ecosystems that straddle state borders, in order to fulfill the objectives of establishing new Protected Areas in areas with high terrestrial and marine eco-diversity or in areas that have been identified with distinct biological habitats, as well as enhancing the effectiveness of existing Protected Areas.

The enactment of the PAN Act within the Republic of Palau was followed by adoption of the Micronesia Challenge Initiative in 2006 by three countries and two U.S. jurisdictions. In line with the initiative's main goal to "effectively conserve at least 30% of the near-shore marine resources and 20% of the terrestrial resources across Micronesia by 2020", the agreement pledged assistance to the creation of a network amongst various Protected Areas, as well as the establishment of a common fund in each country/jurisdiction to ensure sustainable fiscal resources for maintaining Protected Areas and the construction of mechanisms for the generation of sustainable funding for target countries.

Based upon the Micronesia Challenge Initiative, the Revised PAN Act (RPPL7-42) was enacted in May 2008 to pave the way for the establishment of sustainable financial resources and a network for present and future Protected Areas. This set of regulations saw the setting up of a PAN Office (known presently as the Bureau of PAN) within the Ministry of Natural Resource, Environment and Tourism (MNRET), establishment of the PAN Management Committee and Technical Committee to facilitate PAN registration of Protected Areas in each state, introduction of the Green Fee as a sustainable financial resource, setting up of the NPO known as PAN Fund (PANF) to manage proceeds from the Green Fee and maintain workings of the Micronesia Challenge Endowment Fund, as well as a strengthening of penal provisions applicable to all PAN sites.

7.2 Roles of Relevant Organizations

In order to facilitate understanding of the structure of PAN specified within the Revised PAN Act, this section presents a summary of the roles and responsibilities of various related organizations.

7.2.1 National Level

1) Minister of MNRET

In order to enhance the efficiency of inter-relationships amongst PAN sites, the Minister of MNRET reviews sustainable management plans every five years under the guidance of the PAN Management Committee. In addition, the Minister is the highest-ranking national official with final decision making authority over the approval and withdrawal of approval concerning applications for PAN registration of Protected Areas.

2) Bureau of PAN, MNRET

Under supervision of the Minister, the Bureau of PAN is the overall body in charge of PAN-related matters within MNRET. Together with the PAN Management Committee, the bureau conducts management of PAN sites,

execution of decrees concerning PAN sites, formulation of general state-level environmental plans and management strategies, as well as fiscal and technical assistance for the sustainable development of PAN sites (including functioning as an intermediary for the hiring of specialists).

3) PAN Management Committee

The PAN Management Committee is an organization established for the overall management of PAN as specified under the Revised PAN Act. Committee members are composed of the Minister of MNRET, Minister of Finance, one state representative each from states with PAN sites, a representative from the Governors' Association and the Council of Chiefs respectively, the Palau Public Land Authority, as well as two individual representatives selected by two-thirds approval of both the Palau National Senate and the House of Delegates.

Responsibilities of the committee include PAN structure and management, applications for registration with PAN, annual management of overall PAN systems and monitoring of PAN operations and budget execution. The committee also advises the Minister of MNRET with regards to matters concerning the provision of funding and advancement of sustainable development plans that focus on technical assistance in each state.

4) Technical Committee

Under the guidance of MNRET and the PAN Management Committee, the Technical Committee has been established as a five-man body whose members have been selected from organizations and research institutes involved in a wide range of areas such as the environment, culture, environmental conservation, marine sciences and land sciences. The committee advises MNRET and the PAN Management Committee on matters related to applications for PAN registration by Protected Areas.

5) PAN Fund (PANF)

Based upon the Revised PAN Act, PANF is an NPO that has been founded by members that comprise the Minister of Finance, the Minister of MNRET and one donor representative. In addition to managing and controlling the Endowment Fund that has been established based on the Micronesia Challenge Initiative, as well as proceeds from the Green Fee, PANF assigned funds to the respective state governments and the Bureau of PAN based on relevant legal regulations and management plans for PAN sites (Fig. 7.1). Decision-making functions within PANF rests upon the Board of Directors that is composed of the Minister of Finance, the Minister of MNRET, representatives from TNC, as well as a nine-member team comprising of four representatives from CI and five community representatives nominated by the President. Matters such as the management of financial resources are decided upon agreement from a two-third majority of the board. In addition, daily work duties are carried out by a general manager employed by the Board of Directors.

While PANF holds the key to the management of PAN, employment of a general manager was decided in December 2011 and the organization's official duties began in 2012. Up until then, fund utilization and management had been decided based upon outcomes of committee meetings.

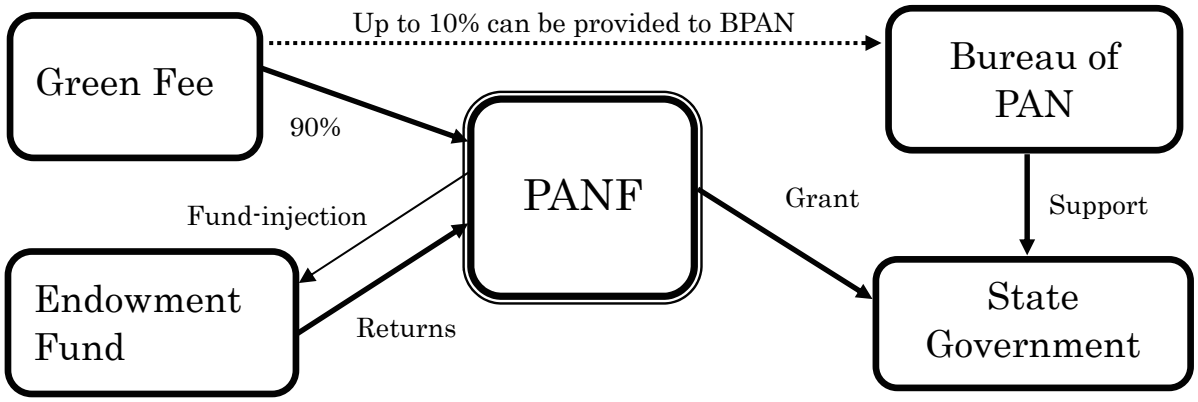


Figure.7.1. Role of PANF.

7.2.2 State Level

1) State governments

With the exception of Koror State, the other states of the Republic of Palau have small populations. As such, it is common for both the staff and assembly members of state governments to be comprised of representatives of families living in the state. It is also possible to regard state governments and local communities as being on the same level. While the national constitution decrees that state governments have ownership over Protected Areas, respective state ownership of Protected Areas is not infringed upon by the national government even within the PAN framework. It thus follows that state governments are responsible for establishing Protected Areas, enacting state laws to facilitate such moves, formulating proposals for their maintenance, as well as conducting policing activities in Protected Areas such as crackdowns on illegal fishing.

2) Palau Conservation Society (PCS)

The largest environmental NGO in Palau, PCS is directly involved in the proceedings of PAN as it dispatches representatives to the PAN Technical Committee. In addition, PCS also provides support to state governments that are seeking PAN registration by assisting in the formulation of management plans for Protected Areas, the submission of which is necessary when applying for registration. PCS also carries out training for human resources required for managing Protected Areas.

3) Palau International Coral Reef Center (PICRC)

PICRC is a research institute that conducts activities across the Micronesia region. Like PCS, PICRC is allowed direct involvement with PAN through the sending of representatives to the PAN Technical Committee. PICRC aids in the monitoring of ecosystems, which is crucial in the process of managing Protected Areas, and also trains human resources at the state-level to carry out such monitoring functions.

7.3 Enforcement of Penalties and Merits of PAN Registration

7.3.1 Penalties Arising from PAN Registration and Strengthening of Law Enforcement Efforts

1) Strengthening of Penal Provisions

Protected Areas not registered with PAN are managed according to respective state laws. As such, punitive measures for transgressors under state laws consist mainly of fines of approximately 50 to 100 USD.

With regards to PAN sites however, penal stipulations under the Revised PAN Act apply. Sentences for first-time offenders is a fine of not more than 500 USD or a term of imprisonment of not more than one year. Felony offenders are fined not more than 2,500 USD or are jailed for a period of less than 2 years. Repeat offenders (three times or more) will be fined no more than 10,000 USD or jailed for a period no more than five years.

2) Strengthening of Policing Activities

With the exception of violations related to the Marine Protection Act, state governments are required to conduct policing activities for Protected Areas not registered with PAN. As state government rangers do not carry weapons and have access to little equipment such as boats, their enforcement abilities remain weak, especially against illegal fishing vessels from abroad. Based on national laws, staff members of national organizations (police and staff of Ministry of Justice and MNRET) have the authority to carry out policing within PAN sites.

7.3.2 Merits

As mentioned in previous sections, overall awareness concerning the importance of conservation has increased across Palau and many Protected Areas have come to be established by state governments and other organizations. In line with the objectives of enhancing the effectiveness of Protected Areas and providing support for all natural environments in Palau, the national government has enacted the PAN Act.

However, between May 2008 when the Revised PAN Act came into force and September 2009, there were no state governments who took up the move to register their Protected Areas with PAN. Reasons to account for this include unwillingness amongst state governments and local residents to have the national government intervene in initiatives conducted at state-level, as well as an inability to clearly distinguish merits of PAN registration due to a lack of transparency concerning PAN's fiscal framework.

With the introduction of the Green Fee in October 2009, two Protected Areas were registered with PAN in May 2010 but the overall progress of PAN registration remained slow-moving.

The turning point came in June 2010, when PAN registration increased dramatically after media reports that revenue from the Green Fee over a period of nine months surpassed the one million USD mark. The following month in July, there were additional media reports that the national government would be distributing 30,000 USD worth of maintenance funds to state governments with PAN sites. Reports also said that in order to facilitate technical assistance for successful registration, fiscal aid of between 5,000 to 15,000 USD would be given to state governments aiming for PAN registration. After such media coverage, there was a sharp increase in the number of state governments who approached the Bureau of PAN for assistance for the registration of existing Protected Areas as well as the establishment of new PAN sites.

At present, understanding of the following mutual merits for state governments (and local residents) as well as the national government has become the main motivating factor for PAN and its structure of Protected Areas.

1) Merits to State Governments and Local Residents of Registering Protected Areas with PAN
   - Stable funding for manpower costs and purchase of equipment
   - Increased employment opportunities for local residents
   - Enhanced penal provisions

2) Merits to National Government of the PAN Framework

The building of a networking of Protected Areas in various states will bring the national government the following merits.

- Preservation of an ecosystem that transcends state borders and the ability to provide support to overall environmental conservation within the country.
- Consolidating and understanding biological data and environmental conditions of registered Protected Areas.
- Ability to indirectly intervene in management of registered Protected Areas.

7.4 Structure of Public Finance

7.4.1 Green Fee

The Green Fee is a fixed fee imposed on all visitors to Palau at the time of their exit from the country. Proceeds go towards the conservation of natural environments in Palau through PANF.

The government of the Republic of Palau planned the introduction of the Green Fee by referring to similar fee systems that are being utilized in Costa Rica and Galapagos. In a preliminary survey conducted in 2002 with support from UNDP, it was concluded that a fee of 80 USD per person would not have an impact on the number of tourists visiting Palau. However, proposed fees were reduced to 50 USD after talks with tourist industry players in Palau. The fee dropped further to 30 USD upon the enactment of the Revised PAN Act in 2008. The Green Fee was eventually set at 15 USD during its initial trial period before being officially introduced in November 2009.

Revenue from the Green Fee does not go into the country's general account but are channeled to PANF for management. As of January 2012, accumulated proceeds exceeded 2.1 million USD (Point of reference: Fiscal budget for the Republic of Palau in 2012 was approximately 60 million USD). The number of tourists to Palau has continued to rise, and this has prompted the Palau National Government to raise the Green Fee to 30 USD in 2012.

Before PANF began operation in 2012, revenue from the Green Fee was utilized upon deliberation outcomes of National Assembly meetings, with a portion of proceeds transferred to the Endowment Fund set up at Micronesia Conservation Trust under the Micronesia Challenge. In addition, the usage of 10% of revenue from the Green Fee was decided by MNRET. With regards to maintenance of the five PAN sites, the respective state government with jurisdiction over Protected Areas was given 10,000 to 30,000 USD based on the content of their Management Plans. This funding is used to pay for the purchase of equipment to facilitate the establishment of Protected Areas, such as the purchase of buoys and ropes, as well as payment for human resources and manpower.

The effect of tourist numbers on general tax revenue in Palau is extremely difficult to determine. However, as mentioned earlier, proceeds from the Green Fee do not go into the country's general account but are managed by and controlled by PANF. As funds are channeled directly to local communities that maintain Protected Area, the Green Fee framework can be said to be an effective structure for connecting tourists who utilize the environment with state governments who are engaged in environmental management (Fig. 7.2).

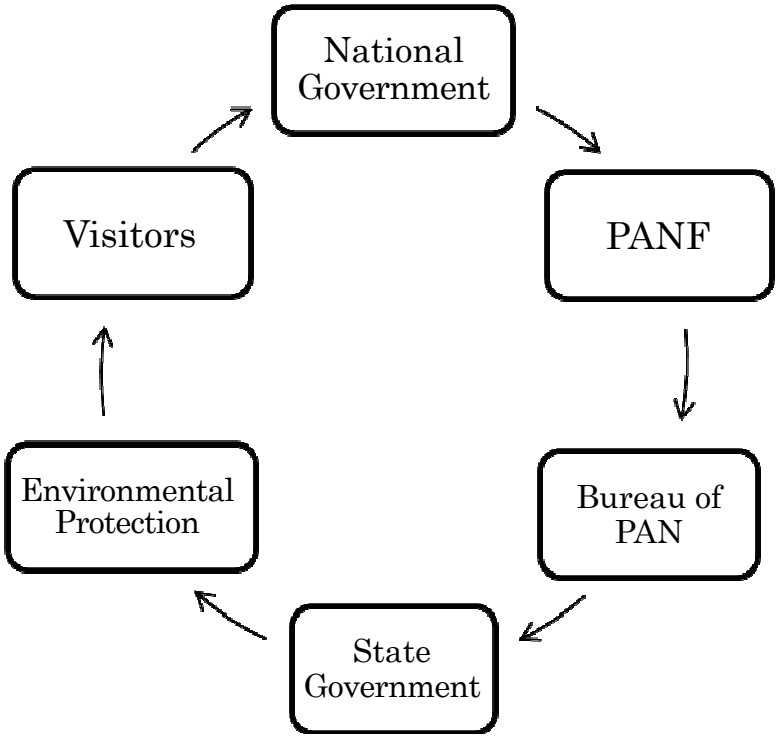


Figure.7.2. Circulation of Green Fee.

7.4.2 Micronesia Challenge Endowment Fund

In 2006, three countries and two U.S. jurisdictions that include the Republic of Palau, FSM, RMI, Guam and CNMI pledged their commitment to "effectively conserve at least 30% of the near-shore marine resources and 20% of the terrestrial resources across Micronesia by 2020" through the establishment of the Micronesia Challenge Initiative.

Under this initiative, it was decided that for Republic of Palau, FSM and RMI, efforts would be made to procure sustainable funds in each country/jurisdiction as maintenance resources for Protected Areas (such as the adoption of the Green Fee in the Republic of Palau), in addition to the setting up of an endowment fund within the Micronesia Conservation Trust (MCT). MCT is an NPO that was established in the FSM state of Pohnpei in 2002 with funding from TNC, an international NGO in the United States.

Annual operating profit from the Endowment Fund is anticipated to be 4-5% and total target figure for all three countries is 100 million USD. TNC and Conservation International (CI) entered an agreement with the respective governments for fund contributions to be matched at a ratio of 1:2, at a maximum donation of 300,000 USD each. For all funds provided by each government, TNC and CI would match those funds by donating twice the amount to

the endowment fund. In 2011, the Republic of Palau contributed 500,000 USD in proceeds from the Green Fee and this was matched by a donation of 1 million USD from TNC. In addition, the Global Environment Facility (GEF) provided an individual contribution of 600,000 USD to the Endowment Fund.

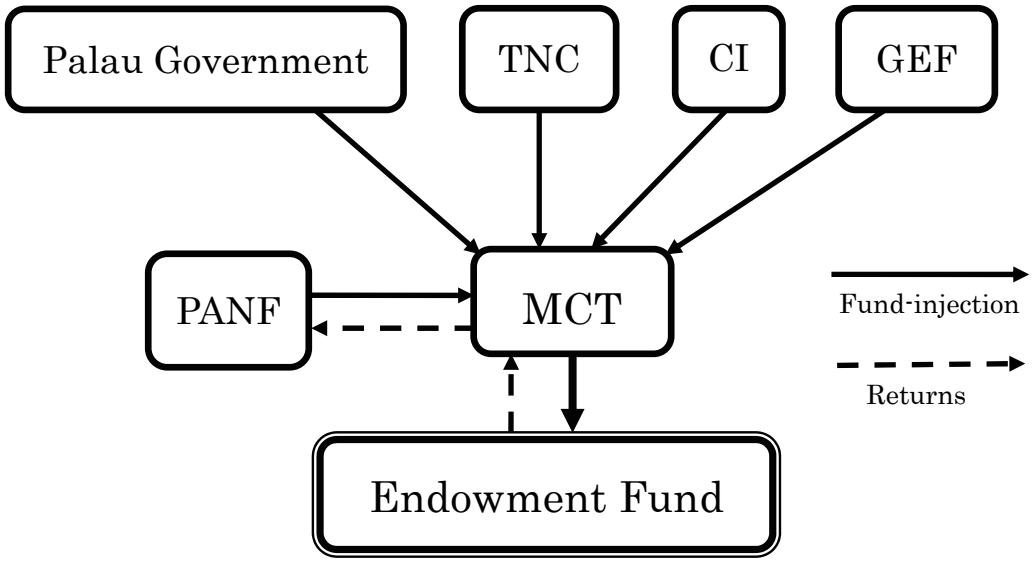


Figure.7.3. Mechanism of Micronesia Challenge Endowment Fund.

7.5 Mechanisms of PAN

This chapter has dealt with the background to PAN as well as the various roles and responsibilities of other relevant organizations. As a conclusion, the following section provides further elucidation on the structure and workings of PAN.

7.5.1 Registering with PAN

1) Formulation of Management Plans

State governments establish Protected Areas based on state laws and characteristics of ecosystems and biological habitats found within territories under state jurisprudence (land including rivers and waterways, as well as marine areas within a 12 nautical mile radius from state shorelines). In order to register state Protected Areas with PAN, information concerning the land area of Protected Areas, types of biological species, reasons for selection, a five-year management plan and budgetary plans for maintenance of the Protected Area must be compiled for submission. However, with limited manpower and fiscal resources, most state governments are unable to prepare the required information on their own. As such, they rely on PANF funds from the Bureau of PAN so that they may seek assistance from external organizations. Talks with stakeholders such as land owners and local residents are carried out by state governments.

PCS accepts both independent and Bureau of PAN-derived requests to assist state governments in drawing up Management Plans. The Bureau of PAN acts upon guidance from the Technical Committee to advise state

governments on improvements to the content of their Management Plans. The bureau also acts as an intermediary for the hiring of external specialists using PAN funds. Foundational biological data necessary to decide suitable areas for designation as Protected Areas is provided through the support of PICRC.

In this way, state governments receive support required for the formulation of Management Plans by hiring the services of third-party organizations such as PCS and PICRC using Green Fee-derived PANF funds provided through the Bureau of PAN. Information regarding the location and land size of designated Protected Areas are determined through the utilization of data obtained via the assistance of external organizations. A decision regarding approval for Management Plans is made upon dialogue from the Bureau of PAN and the Technical Committee, during which advice for improvements is received. Finally, Management Plans are officially approved by passing them through state legislatures and governors (Fig. 7.5).

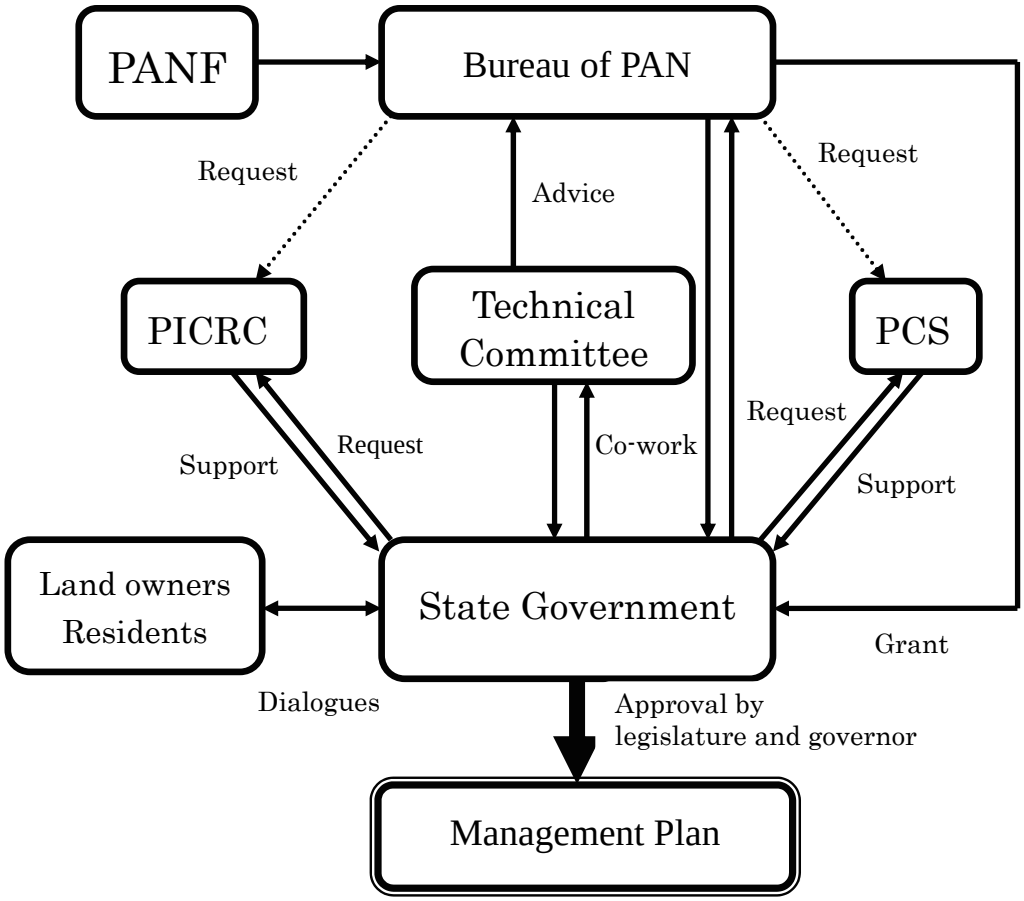


Figure.7.4. Mechanism of building a Management Plan by state governments.

2) Approval by State Governments and Authorization by the National Government

State governments respond to questions listed under the nomination form for PAN site registration before obtaining the state governor's official signature. The form is then submitted together with the Management Plan to the Bureau of PAN. Submitted documents are reviewed by the bureau's PAN Management Committee members before application outcomes are made known to state governments within a timeframe of about two weeks. Once

PAN site registration has been agreed upon by a two-third majority of the PAN Management Committee, recommendation for acknowledgement by the Minister of MNRET will be made. Approval for the registration of PAN sites is ultimately executed by the Minister (Fig. 7.6).

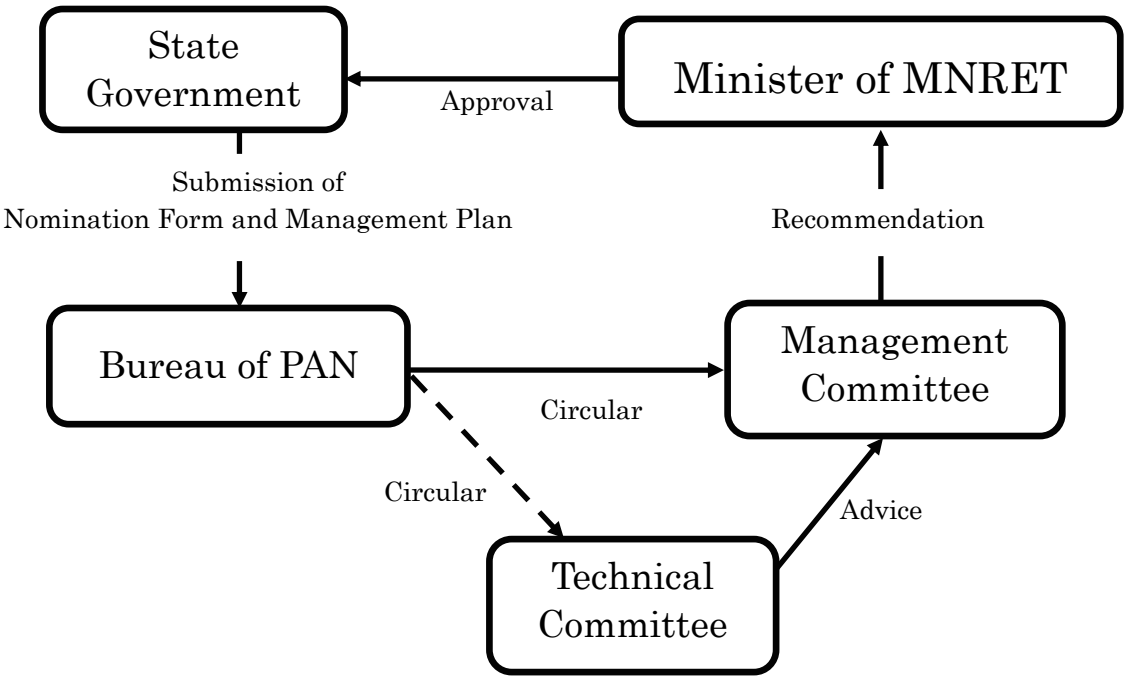


Figure.7.5. PAN site nomination process. (Based on Revised PAN Act)

7.5.2 Mechanisms of PAN

Fig. 7.6 is a diagram denoting the inter-relationship between the Bureau of PAN, state governments, PAN sites and related organizations.

Based on Management Plans for PAN sites, the Bureau of PAN allocates maintenance funds received from PANF to state governments. In addition, the Bureau of PAN accepts management reports from state governments, carries out assessments on management systems, provides advice on measures for improvement and also holds workshops for enhancement of technical expertise.

State governments utilize funds received for activities related to the management of Protected Areas such as equipment purchase and installation, as well as the employment of maintenance staff. With regards to the sphere of management activities, detected cases of illegal fishing to which state governments are unable to respond are brought to the attention of DFWP at the Ministry of Justice so that policing measures can be strengthened. In order to assess the effectiveness of Protected Areas and introduce improvements, monitoring of coral reefs and sea life are commissioned to PICRC. Collected data from monitoring processes is reported to the Bureau of PAN.

In addition, the Bureau of PAN relays information related to PAN in Palau to the Micronesia Challenge Regional Office based on requirements set under the Micronesia Challenge Initiative. The Micronesia Challenge Regional is in charge of feeding such information back to the respective Micronesia Challenge focal points of FSM, RMI, Guam and CNMI. The office also provides information and data gathered from these countries and regions to the

Bureau of PAN.

In this way, the government of the Republic of Palau is taking steps towards the realization of sustainable use of resources and conservation of biodiversity for the future through PAN by establishing new Protected Areas at the state-level, enhancing the quality of their management processes and consolidating information for Protected Areas within the country.

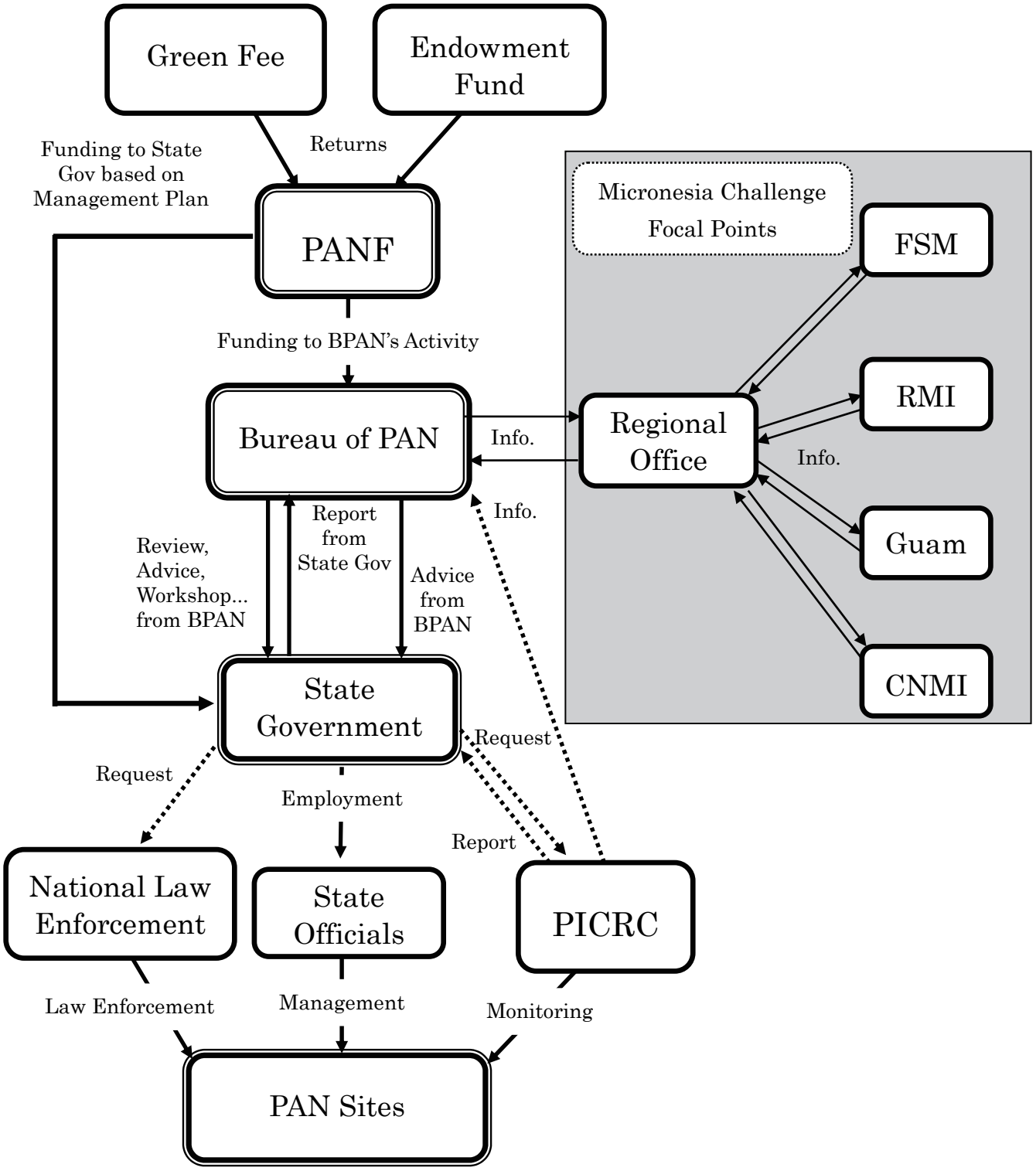


Figure.7.6. Relationships of related organizations for management of PAN sites.

7.6 Current situation of the Protected Areas and Protected Areas Network (as of May, 2012)

In this report, we have discussed the number and surface of Protected Areas (see 4.5) based on materials available at the time of the field study (November 2011). Even during the field study, establishment and support of new protected areas was being conducted by the Bureau of PAN, Palau Conservation Society, Palau International Coral Reef Center, state governments and other institutions, and registration procedures of new protected areas was in progress. However, information on this was spread around various entities and therefore, reliable data was unavailable.

New information was supplied by Mr. Aitaro, Director of the Bureau of PAN, after the first edition of this report had already been drawn up in May 2012. Therefore, the following section on the current situation of Protected Areas and PAN in the Republic of Palau shall be supplemented to this chapter.

7.6.1 Situation of the Establishment of Protected Areas

As of May 2012, in the Republic of Palau there was a total of 45 Protected Areas (Table 7-1, Figure 7-8), which includes 34 Marine Protected Areas (some of which include also terrestrial and mangrove areas) and 11 Terrestrial Protected Areas (including waterfalls, rivers and lakes). These areas account for 58% (286,830 ha) of coastal zones and 20% (41,027 ha) of land mass, which means that the goals set forth by the Micronesia Challenge Initiative ("effectively conserve at least 30% of the near-shore marine resources and 20% of the terrestrial resources across Micronesia by 2020") have already been achieved. Therefore, the next goals for Palau regarding these areas include "effective conservation," and registration of these areas to the PAN is in progress.

As discussed in 7.5, in order for state governments to apply for registration of a Protected Area with PAN, they need to draw up a management plan, for which support and consultations with relevant institutions is necessary. This process is utilized by the Bureau of PAN, which suggests the size or modifications in location of a Protected Area established by a local government, taking into consideration scientific data and information on terrestrial and coastal zones, in order to make the Protected Area more effective. Such utilization of the PAN structures is an example of moderate involvement by the national government in the states' jurisdiction.

7.6.2 Current status of registration with PAN

The revised PAN Act was enacted in May 2008, however interest towards the PAN demonstrated by state governments and local communities, with the exception of some state governments, was rather low. This was due to the fact that the state governments feared interference of the national government in their autonomy guaranteed by the Constitution. However, in November 2009 the Green Fee was implemented and according to the domestic media, it was expected to give the estimated annual revenue of $2,100,000. Therefore, since June 2010 the state governments' and local communities' will to register with the PAN has increased.

As of May 2012, 18 out of the 45 Protected Areas are certified as registered PAN sites (number and period of such certification is as follows: 2008 – 5 areas, 2009 – 1 area, 2010 – 4 areas, 2011 – 8 areas). The number of PAN state-members has increased to 9 (Ngarchelong, Ngaraard, Ngardmau, Ameliik, Ngiwal, Melekeok, Ngchesar, Airai, Hatobohei), and in 5 out of the remaining 7 states - Sonsorol, Kayangel, Ngeremlengui, Peleliu and Koror - work

towards registration and admission to the PAN is in progress.

Thus, thanks to the success of implementation of the Green Fee and activities raising awareness by the Bureau of PAN, networking of the Protected Areas is expected to be completed for the most part in 2013, and the relationship between the national government and states and local communities is expected to deepen. The next concerns include evaluation of effectiveness of the Protected Areas, and verification and revision of management plans.

7.6.3 Revision of the Green Fee

The circumstances regarding the introduction of the Green Fee and increase in its amount in 2012 were already discussed in 7.4.1, therefore we will now discuss what followed this situation.

Palau's sewage treatment facility is located in the state of Koror, the most populated area in Palau and the nation's former capital. This facility was established in 1970s thanks to the financial support from the United States, therefore it has only the capacity to serve 13,000 people - the maximum future population estimated at the time of construction. However, the rapid increase of foreign visitors observed in the recent years (Figure 7-7) has surpassed the facility's capacity, which led to insufficient sewage purification and outflow of contaminated water. Such outflows of contaminated water lead not only to eutrophication, but also to the increase of the colon bacteria, which may pose threats to coastal environment and health of the residents.

In order to address these issues, in March 2012, the National Congress of Palau (lower house and upper house) passed a bill (RPPL No.8-40) to raise the Green Fee from $15 to $30, which is to take effect in October 2012. It has been announced that the revenue increase (approximately $1,500,000) resulting from this law, is to be allocated to water supply and sewage management, and that $200,000 out of the first portion of this revenue increase is to be allocated to water supply source management in Airai State. Further, thanks to securing such stable source of revenue, Palau will be able to gain loans from Asian Development Bank or donor countries, due to improvements in the sewage management facility.

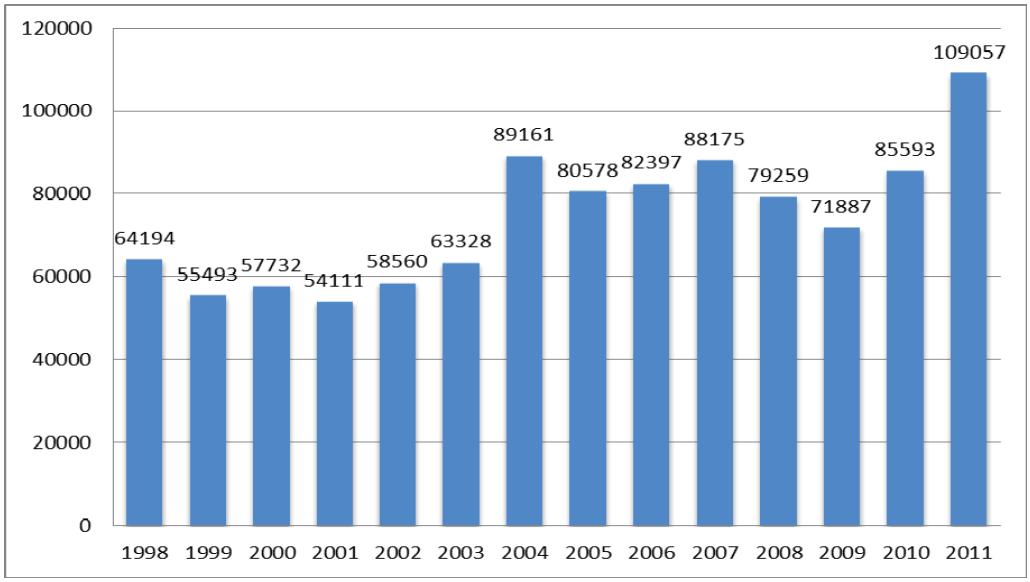


Figure.7.7. Transition in number of foreign visitors to Palau (based on data by PVA)

7.6.4 The Integrated Water Resource Management (IWRM) Project

Currently in the Pacific region, Global Environment Facility Pacific IWRM Project (GEF Pacific IWRM Project) is being implemented in Tuvalu, the Republic of Kiribati and the Republic of the Marshall Islands, thanks to the support of such entities as GEF (Global Environment Facility) and Applied Geoscience and Technology Division of Secretariat of the Pacific Community (SOPAC).

Johnson Toribiong, president of the Republic of Palau, signed the IWRM in April 2012. Therefore, it is expected that more projects oriented at management of water from inland catchment areas to coastal areas will be undertaken in the future.

Table 4-1. List of Protected Areas in the Republic of Palau (May 2012, Bureau of PAN). Green lines are for terrestrial protected areas.

#	Name	Ecosystems or species included	State(s)	Year estab.	Approx. Size (km2)	Marine	Ter.	Mostly marine	Mostly ter.	PAN Member
1	Ngaruangel Reserve	Atoll island, reefs, lagoon	Kayangel	1996	34.96	x	x	x		
2	Northern Reefs Management Area	Reefs, lagoon, terrestrial, islands	Ngarchelong	Management Plan in development		x	x	x		
	Special areas within the Northern Reefs Management Area:									
3	Ebiil Conservation Area	Grouper spawning aggregations	Ngarchelong	1999	19.11	x				2008
4	Ngaraard Mangroves Conservation Area	Mangrove	Ngaraard	1994	2.88	x	x		x	2011
5	Ungellel Conservation Area	Mangrove	Ngaraard	2007	0.32	x				2011
6	Ngerkall Lake and Metmellasech Watershed	Forest, pond, watershed	Ngaraard	2008	2.23		x			2011
7	Diong Era Ngerchokl Conservation Area	Forest, stream, watershed	Ngaraard	2008	0.91		x			2011
8	Ongiil Conservation Area	Mangrove and reef	Ngaraard	2010	2.00	x				2011
9	Ngermasech Conservation Area	Mangrove, reef flat, seagrass bed	Ngardmau	1998	2.93	x	x	x		2010
10	Ileakelbeluu	Patch reef	Ngardmau	2005	0.62	x				2010
11	Ngerchelchuus	Forest, Mountain vista	Ngardmau	2005	0.30		x			2010
12	Ngardmau Waterfall (Taki)	waterfall	Ngardmau	2005	6.12		x			2010
13	Ngermeskang Nature Reserve	Upper Watershed, river, forest	Ngaremlengui	2008	8.86		x			
14	Ngermeskang Bird Sancturary	Swamp forest, forest	Ngaremlengui	2008	1.50		x			
15	Ngaremeduu Bay Conservation Area	Estuary, mangroves	Ngaremlengui, Ngatpang, Aimeliik	1999	98.00	x	x	x		
	Special areas within Ngeremeduu Bay Conservation Area:									
16	Bkulengriil Conservation Area	Mangroves/Seagrass bed	Ngaremlengui	2006	0.71	x	x	x		
17	Bkulabeluu and Temachel Mlengui Conservation Areas	Northside of channel, reef	Ngaremlengui		0.30	x				
18	Mokad Recreation Zone	Reef	Ngaremlengui	2009						
19	Ngatpang Clam Conservation Area	Reef/Clams	Ngatpang	2003	0.15	x				
20	Ngatpang Crab Conservation Area	Reef/Crabs	Ngatpang	2003	0.15	x				
21	Ngatpang Fish Conservation Area	Reef	Ngatpang	2003	0.15	x				
22	Imul Mangrove Conservation Area	Mangrove	Aimeliik	2002	0.43	x	x		x	
23	Ngerchebal	island, reef flat	Aimeliik	2006	0.30	x	x	x		
24	Ngerderrar Watershed Conservation Area	forest	Aimeliik	2008	3.80		x			2011
25	Ngemai Conservation Area	Reef flat	Ngiwal	1997	1.00	x				2008
26	Olsolkesol Waterfall/Ngerbekuu River Nature Reserve	river	Ngiwal	2009	1.05		x		x	2008
27	Ngardok Nature Reserve	Lake, wetlands, watershed, forest	Melekeok	1999	5.00		x			2008
28	Ngermedellim Marine Sanctuary	Reef	Melekeok	2010	0.30	x				
29	Ngelukes Conservation Area	Patch reef	Ngchesar	2002	0.50	x				2011
30	Mesekelat Conservation Area	watershed, forest	Ngchesar	2002	0.50		x			2008
31	Ngchesechang Mangrove Conservation Area	Mangrove	Airai	1994	0.97	x	x		x	
32	Ngeream Conservation Area	Mangrove	Airai	1997	1.64	x	x		x	
33	Oikull Mangrove Conservation Area	Mangrove	Airai	2002	0.78	x	x		x	
34	Medal Ngediuul Conservation Area	seagrass bed	Airai	2006	0.30	x				2011
35	Rock Islands Southern Lagoon Management Area	Rock Islands, lagoon, barrier reefs	Koror	1997	621.00	x	x	x		
	Special areas within Rock Islands Southern Lagoon (RISL) Management Area:									
36	Ngerukuid Islands Wildlife Preserve	Islands, reefs, lagoon	Koror	1956	11.02	x	x		x	
37	Ngerumekaol Spawning Area	Grouper spawning aggregations	Koror	1976	2.08	x				
38	Ngkisaol Sardine Sanctuary	Mangrove, sardine aggregation	Koror	1999	0.05	x	x	x		
39	Ngederrak Reef	Seagrass bed, reef flat	Koror	2001	5.98	x				
40	Ngerkebesang Conservation Zone	Reef flat	Koror	2002	0.04	x				
41	Ngemelis Island Complex	Islands, reef, dive sites	Koror	1995	40.26	x	x	x		
42	Teluleu Conservation Area	Seagrass bed, reef flat	Peleliu	2001	0.83	x				
43	Angaur Conservation Area	Seagrass, reef flat	Angaur	2006	0.39	x				
44	Fana Island Important Bird Area (IBA)	Island	Sonsorol	Traditional	0.40		x			
45	Helen Reef Reserve	Atoll island, reefs, lagoon	Hatohobei	2001	163.00	x	x	x		2009

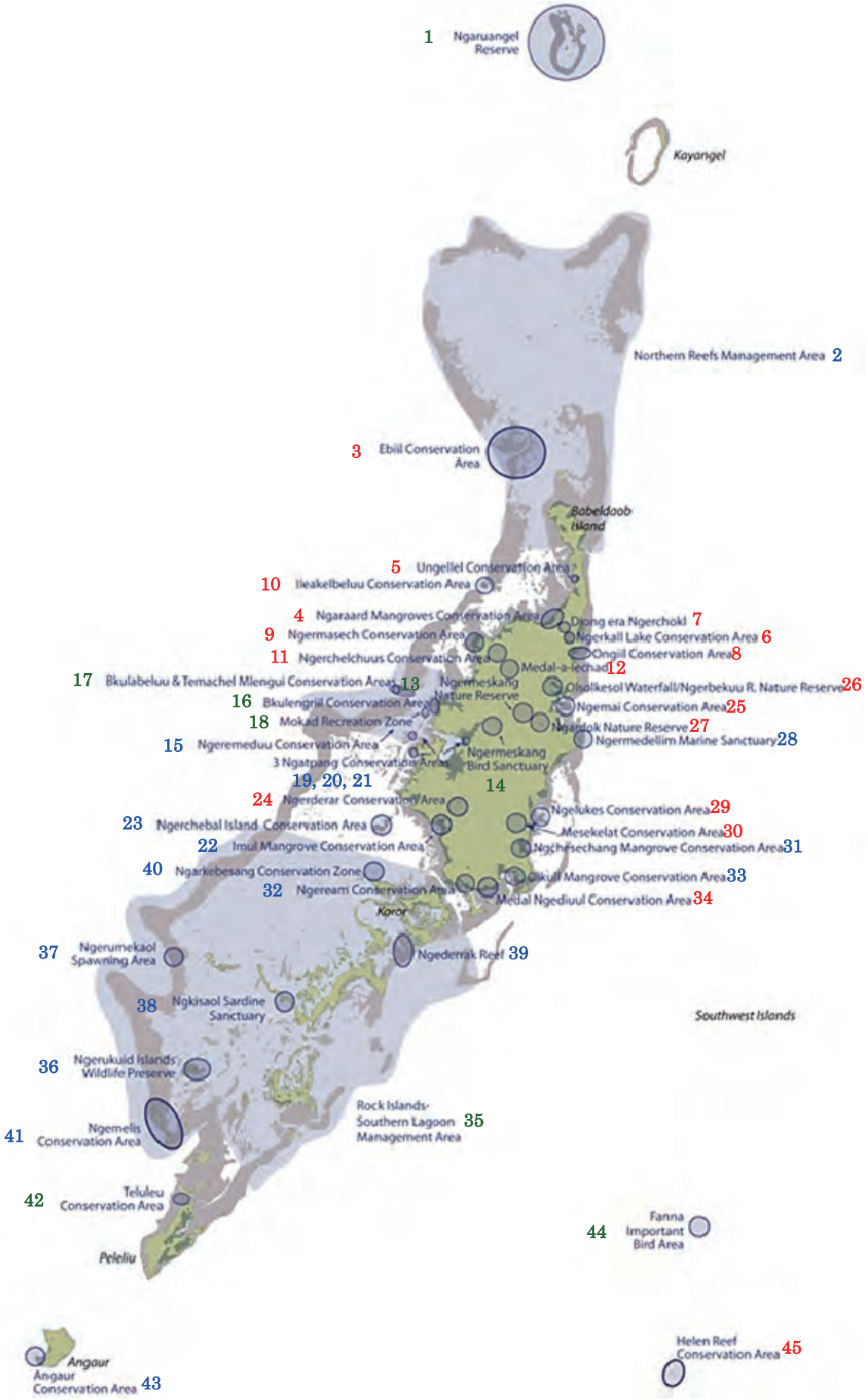


Figure.4.2. Protected Areas in the Republic of Palau (November 2011, PCS).The numbers correspond to the table 4.1. Red numbers are for PAN sites. Green numbers are for protected areas on the process of nomination for PAN.

Chapter 8 Discussion

8.1 Introduction

Findings from this project with regards to Marine Protected Areas (MPAs) of Micronesian countries, with a particular focus on the Republic of Palau, have been collated from several data sources such as site surveys and dialogues with numerous relevant persons. While moves by Micronesia to establish MPAs for the ultimate achievement of conserving natural environment and ensuring sustainable use of marine resources have become the focus of much global debate, such approaches in Micronesia have yet to be subjected to sufficient scientific examination.

While current measures remain centered on coastal zones, the need to place an emphasis on the relationship between terrestrial and marine areas has been pinpointed in the course of countless discussions. The situation remains similar in the Republic of Palau, where there is a number of designated Protected Areas containing both terrestrial and marine regions. This chapter will summarize findings from research conducted by the project team and present the problem areas that have been identified.

8.2 MPAs in Terms of Management of Marine Resources

8.2.1 Design and Maintenance of MPAs

1) Cooperation with Management Bodies

MPAs designated and managed independently by nations have often been made the object of international goals in discussions surrounding MPAs during global conventions such as COP10. Within the Asia-Pacific region however, there is a need to increase the number of jointly managed MPAs where responsibility and authority for its establishment and management are shared between the government and local communities (Kakuma, 2007). With a top-down system of management by the government, allocation of adequate manpower, and effective patrolling and policing become difficult. Relevant costs for management will also increase. On the other hand, when management processes are left entirely in the hands of local communities, support from the government becomes necessary due to limited manpower and fiscal resources.

In order for the Micronesia region to promulgate the establishment of more effective MPAs, cooperation between national and local governments, NGOs and local communities is of utmost importance.

2) Maintaining a Balance between Use and Conservation

Methods for managing MPAs differ significantly for MPAs that are strictly no-take zones and those that have been permitted for sustainable use of marine resources. One of the characteristics of Palau's integrated MPAs is their objective to ensure compatibility between the conservation of ecosystems and sustainable use of resources.

Systems such as the three large-scale MPAs of north and mid-west Babeldaob Island, as well as Rock Islands'

Southern Lagoon, with small core no-take zones that are surrounded by wider buffer zones where regulations are more flexible (also termed as sustainable use zones and multi-purpose zones) are considered to be an effective approach. Traditional fishing methods and tourism activities are allowed within buffer zones, while detrimental fishing techniques and developmental activities have been prohibited.

In recent years, the concept of *satoumi*, which has been the topic of much discussion in Japan, has become essential when taking into account the balance between the conservation and utilization of resources. *Satoumi* refers to coastal zones characterized by the harmonious co-existence of nature and people. More than just being a mere representation of the concept of *satoumi*, MPAs are rather the basis for the creation of *satoumi* with vibrant biodiversity (Kakuma, 2011).

3) Effective MPAs

During the CBD-COP10 when Japan was the host country, the Aichi Target 11 was passed with the goal of establishing MPAs in at least 10% of all marine areas by 2020. To this end, the establishment of MPAs in the Asia-Pacific region is expected to progress, although little effect is expected to be achieved by merely increasing the total land area of MPAs. The term “MPAs” serves as a general term to refer to target regions for marine conservation policies. With their varying regulatory levels, a lack of observation to rules would lead MPAs to exist only in name regardless of how large they may be in physical size. For example, there are more than 1000 MPAs designated by law in the Philippines, a pioneer country in terms of MPA policies, but less than 30% of them are said to be truly effective. As such, it is crucial to establish MPAs that have actual efficacy instead of focusing on their numbers and land areas.

As of 2012, MPAs have been set up on 37 locations in the Republic of Palau. Monitoring of all MPAs revealed that only the following five MPAs are functioning with a certain level of effectiveness - Ebiil Conservation Area (Ngarchelong State), Helen Reef (Hatohobei State), Ileyakl Beluu Conservation Area (Ngardmau State), Ngemai Conservation Area (Ngiwal State) and Teluleu Conservation Area (Peleliu State) (based on private correspondences with Dr. Nakaya).

When assessing the establishment of MPAs, the following four perspectives are of particular importance – (1) Have patrolling and policing been sufficiently carried out? (2) Is the location of the MPA appropriate? (3) Has land area been adequately secured? (4) Is the post-establishment timeframe for the MPA sufficient? In Pacific island nations, there are many examples where no-fishing zones of limited time periods have been set up in line with tradition in village areas. A good example can also be found in Okinawa, when MPAs that are established during spawning season or at times when young fish populations gather, have proven to be highly effective (Kakuma, 2009). Instead of conserving resources through the establishment of MPAs that are enforced all year-round, the efficacy of those implemented seasonally suggests the need for further examination.

4) Alternative Sources of Revenue and Utilization of Tourism

Policies to secure alternative sources of revenue are crucial for the management of marine resources in the Asia-Pacific region. This is because fishermen are expected to reduce their catch during the early stages of marine resource management. In order to ensure that fishermen are still able to provide for their families, substitute sources of income to supplement their intakes from fishing becomes necessary in many cases.

With regards to MPAs, there is a growing number of cases where the development of eco-tourism has led to an increase in alternative sources of income. Under most circumstances, revenue from eco-tourism also serves to cover necessary costs for the management of MPAs. In a majority of approaches to resource management, the first option for substitute income is usually the breeding of fish and other seafood. An example can be seen in the Republic of Palau's efforts to introduce the farming of giant clams. Breeding of giant clams is carried out at respective fishing villages with seedlings produced by the Bureau of Marine Resource (BMR) and MNRET's Palau Mariculture Demonstration Center (PMDC). While PMDC is also involved in the breeding of the highly-valued grouper, breeding techniques for tropical fish species that fetch the highest market prices including the *Plectropomus leopardus* have yet to be developed.

Fish Aggregating Devices (FADs), an approach to disperse fishing catch pressures on coral reefs to outer seas (Kakuma, 2006), is also another viable source of alternative revenue. Beginning in the 1990s, projects to establish FADs were carried out in the Republic of Palau and other Pacific island nations, but these measures only lasted for a short period of time due to damage sustained by elements such as typhoons. In response, JICA has carried out technical training for intermediary FAD (which are almost unaffected by typhoons) in Okinawa. Achievements of such research are taking place in countries such as the Republic of Fiji and the Kingdom of Tonga.

5) Monitoring of MPAs

At the Palau Conservation Consortium Meeting held in January 2011 at the Palau International Coral Reef Center (PICRC), indices based on monitoring outcomes for MPAs were announced. While indices include information such as population numbers for corals, fish and benthos, there were no index readings related to the fishing industry. For MPAs to fulfill their main objective of expanding marine resources, it is important for them not only to increase biodiversity within each MPA and raise fish population sizes, but also to boost fishing catch for the local community. To this purpose, it is necessary not only to monitor fish numbers through underwater observations, but also to create forms of indices that reflect data on fishing catch. The most basic index that measures marine resource levels does not determine fishing catch per se, but rather CPUE (Catch Per Unit Effort, i.e. fishing catch that is yielded per unit of effort). Amounts of fishing catch are broken down into units such as daily catch per capita or hourly catch per capita. The higher the CPUE, the more the MPA is assessed as having succeeded in increasing marine resources, and the more their benefits may be expounded to members of the local community. If the MPA in question is a no-take zone, the CPUE of waters closest to the MPA is measured in order to determine the extent of spillover effect.

With regards to the Republic of Palau, there exists reports on CPUE of invertebrates such as giant clam (Kitalong, 2008), Data concerning invertebrates harvested using traditional fishing methods performed by women placed prices at 6.2kg/h/ha, and such prices are said to fluctuate significantly. The accumulation of such information is vital for future discussions aimed at enhancing management of coastal zones.

6) Management Effectiveness Assessment

In order to ensure sustainability for MPAs, effects should be assessed objectively as far as possible and be subjected to enhancements whenever necessary. The Management Effectiveness Assessment Tool is a mechanism specifically designed for such purposes. Here, the Management Effectiveness Assessment Tool (MEAT) (National

CTI Coordinating Committee, 2011) that has been used in the Philippines serves as a point of reference. MEAT is a four-stage self-appraisal system designed to determine the management conditions of MPAs. In order to place focus on sustainability and progress, levels become more difficult along with time. MPAs that have been established for longer periods of time accumulate higher points. Along with objective methods of assessment, this system of self-appraisal becomes a useful learning tool for responders, who are able to reflect on the inadequacies of their management methods and consider ways to improve as they go through the appraisal questions.

There are few biological indices in MEAT, and there are no questions that address improvements to ecosystems such as queries about increases to population numbers of fish and exacerbation of damage sustained by coral reefs. After the introduction of this system of appraisal to MPAs, there was a shift in assessment methods from an emphasis on the outcomes of MPA management to the actual contents of management processes. This is derived from the fact that improvements and damage to ecosystems are greatly influenced not only by activities within the respective local community but also by other externally-derived factors. In addition, an extremely long period of time is required for coral reef ecosystems to register concrete signs of improvement. However, the presence of biological monitoring serves as a target area for assessment. A summary of contents in MEAT is presented in Table 8.1. Micronesian countries are currently conducting the same appraisal tool on a trial basis, but it would be effective to enhance applicability of this appraisal method by making the necessary improvements.

Table 8-1. Management Effectiveness Assessment Tool (MEAT) System for the MPAs (Marine Protected Areas) in the Philippines

- MEAT is an assessment system designed for more effective management for numerous MPAs in the Philippines.
- The system puts emphasis on continuity, specifying 4 assessment levels applied to the number of continuous years. Each level is composed of several questions, for which points are given, with compulsory questions being given more points. All compulsory items must be fulfilled.
- Points are given according to the categories and the MPA can be evaluated by its weak and strong categories.

Level 1: MPA is established. 17 items (necessary points: 27)

no	Question	Compulsory	Allowable points
1.1 Establishment based on participatory process (maximum 5 points)			
1.1.1	Has the idea of the MPA been explained to the persons concerned?		0 or 1
1.1.2	Has the MPA been accepted by the local community and regional government?		0 or 1
1.1.3	Has the basic assessment been implemented?	○	0 or 3
1.2 Drawing up of the official management plan (maximum 6 points)			
1.2.1	Has the proposal for the management plan been drawn up?		1 or 1
1.2.2	Has the management plan been prepared based on the participatory idea?		1 or 1
1.2.3	Has the function of the management body been explained through IEC (Information, Education and Communication)?		1 or 1
1.2.4	Has the management plan been implemented?	○	0 or 3
1.3 Legal System (regional government regulations, proclamations by the president or ordinances by the Republic, maximum 5 points)			
1.3.1	Has the proposal for legal regulations announcing the MPA establishment been prepared?		0 or 1
1.3.2	Have there been discussions with stakeholders regarding the legal regulations?		0 or 1
1.3.3	Have the legal regulations been implemented?	○	0 or 3
1.4	Management body formed and functional (maximum 11 points).		
1.4.1	Has the management body been determined and identified?		0 or 1
1.4.2	Has the management body been formed and have their roles been clarified?	○	0 or 1
1.4.3	Has the budget for at least 1 year been allocated?	○	0 or 3
1.4.4	Have the IEC (Information, Education and Coordination) activities been coordinated by the management body?		0 or 1
1.4.5	Have the MPA boundaries been delineated?		0 or 1
1.4.6	Have the MPA enforcers been identified?		0 or 1
1.4.7	Have the biophysical monitoring activities been coordinated by the management body?		0 or 1
	Total Score for Level 1		maximum 27

Level 2: MPA is effectively strengthened (for at least 3 years after its establishment). 9 items (necessary points: 31)

no	Question	Compulsory	Allowable points
2.1The MPA is effectively strengthened.			
2.1.1	Is the enforcement plan or its equivalence in place?		0 or 1
2.1.2	Have the marine enforcement team members been trained?		0 or 1
2.1.3	Are patrolling and inspection measures being conducted regularly?	○	0 or 3
2.1.4	Are violation reports being documented properly?	○	0 or 3
2.1.5	Are cases filed for apprehended violators or are they penalized?	○	0 or 3
2.1.6	Are funds allocated and used?		0 or 1
2.1.7	Are facilities (boundary buoys, billboards, boats etc.) being maintained?		0 or 1
2.1.8	Is the IEC program being implemented to sustain public awareness and compliance?		0 or 1
2.1.9	Has participatory biophysical monitoring been conducted for the past three years?		0 or 1
	Total Score for Level 1		maximum 15

Level 3: MPA mangement is effectively sustained (for at least 5 years) 11 Items (necessary points: 47)

no	Question	Compulsory	Allowable points
3.1 Has the MPA management been effectively sustained (for at least 5 years)?			
3.1.1	Has the management plan been reviewed in response to law ordinances?		0 or 1
3.1.2	Have the financial sources been generated and accessed in the past 2 years?	○	0 or 3
3.1.3	Is the management body functioning and able to access technical support when necessary?		0 or 1
3.1.4	Has the enforcement system been sufficiently operational in the last 5 years?	○	0 or 3
3.1.5	Is the IEC (Information, Education and Communication) program enhanced?		0 or 1
3.1.6	Is performance monitoring of the management body conducted regularly?	○	0 or 3
3.1.7	Is regular participatory monitoring conducted?	○	0 or 3
3.1.8	Is socioeconomic monitoring conducted regularly?		0 or 1
3.1.9	Is sustainable financing strategy established?		0 or 1
3.1.10	Have violators been prosecuted and sanctioned?	○	0 or 3
3.1.11	Is the feedback system in place?		0 or 1
	Total Score for Level 3		maximum 21

Level 4: MPA management is effectively institutionalized (for at least 7 years) 11 Items (necessary points: 63)

no	Question	Compulsory	Allowable points
4.1MPA management plan effectively institutionalized (for at least 7 years)			
4.1.1	Is there political support from the provincial council or local governments?		0 or 1
4.1.2	Has the MPA management plan been incorporated into broader development plans?	○	0 or 3
4.1.3	Is the management body able to get funds from external sources?		0 or 1
4.1.4	Are the relationships with local governments and other groups defined and formalized?		0 or 1
4.1.5	Has ecological and socioeconomic impact assessment been conducted?	○	0 or 3
4.1.6	Is performance monitoring and evaluation system linked to an incentive system?	○	0 or 3
4.1.7	The IEC (Information, Education and Communication) has been sustained for 7 years.	○	0 or 3
4.1.8	Can management body adjudicate certain cases?		0 or 1
4.1.9	Have expansion strategies and resource enhancement programs been initiated?		0 or 1
4.1.10	Have support facilities (guardhouses, visitor centers etc.) been constructed?		0 or 1
4.1.11	Has the MPA been self-sustaining in the past 7 years?	○	0 or 3
	Total Score for Level 4		maximum 21

MPA Management Items by Category

	Field and question number	Maximum
1	Management Planning（1.2.1 + 1.2.2 + 1.2.4 + 3.1.1 + 4.1.2）	9
2	Management Body（1.2.3 + 1.4.1 + 1.4.2 + 3.1.3 + 3.1.6 + 4.1.1+ 4.1.4）	11
3	Legislative System（1.3.1 + 1.3.2 + 1.3.3）	5
4	Community Participation（1.1.1 + 1.1.2）	2
5	Financing（1.4.3 + 2.1.6 + 3.1.2 + 3.1.9 + 4.1.3 + 4.1.11）	12
6	IEC (Information, Education and Communication)（1.4.4 + 2.1.7 + 2.1.8 + 3.1.5 + 4.1.7）	7
7	Supervision and Enforcement（1.4.5 + 1.4.6 + 2.1.1 + 2.1.2 + 2.1.3 + 2.1.4+ 2.1.5 + 3.1.4 + 3.1.10 + 4.1.8）	20
8	Monitoring and Evaluation（1.1.3 + 1.4.7 + 2.1.9 + 3.1.7 + 3.1.8 + 3.1.11+ 4.1.5 + 4.1.6）	16

8.2.2 Underwater Studies

Even if it is for a short-term quantitative survey, third-party organizations carrying out situational investigations of MPAs are recommended to carry out visual onsite observations so as to directly ascertain the conditions of corals and fish. This is because there are cases where actual environmental conditions cannot be determined through interviews and literature research. In addition, people of local governments and communities may be inclined to over-evaluate MPAs under their jurisdiction. There have been several cases when outcomes gathered from interview-based research were found to be drastically different upon underwater observation of MPAs.

Although Okinawa is located in the sub-tropics, the types of fish found in its waters are similar to those seen in tropical oceans because of the warm Kuroshio current that flows from the west. In 2003, a comparison of the species of fish found in the markets of Okinawa and the Republic of Fiji revealed surprisingly similar types of fish. Relative prices were also comparable (groupers were priced the highest in markets of both regions). However, as the species of fish found in each respective MPA possess unique characteristics that may on occasion reflect the conditions of the MPA, it would be desirable if quantitative surveys could be conducted through underwater surveys by specialists able to identify species levels. In the Republic of Palau, PICRC has carried out quantitative monitoring in a number of MPAs, and technical knowledge and analytical outcomes from such monitoring are anticipated to be promulgated in MPAs managed by state governments.

Growth of tourism-related utilization for the sustainability of MPAs is anticipated to increase in future in Micronesian countries, which makes the transparency of seawater an extremely important factor. While water visibility changes according to the weather, it is pertinent to ascertain approximate water transparency levels through underwater observation.

Ngaremeduu Bay has a number of comparatively large inflowing rivers but waters within the bay area are turbid because of the small entryway into the bay. As such, corals located outside of the bay were expected to be of poor condition, but channel waters were found to have a high degree of transparency and a high rate of coral coverage. Waters in this area are categorized as a multi-purpose zone and large numbers of mid-sized fish were spotted. In no-take zones outside Ngiwal Bay, the presence of seagrass beds caused seawater to be turbid. Swift currents and

clear water visibility were found in the lagoon located on the north side, which is also the site of dive fishing. While underwater observations could not be carried out in the waters of southern Ngerikiil, underwater images were taken with the use of an underwater camera submerged from the water surface. Photographs of the sea bottom revealed many pieces of dead coral and a low coverage rate of living corals.

The Ebiil Conservation Area is an MPA dedicated to the conservation of groupers. Team members who conducted surveys by snorkeling only managed to spot two grouper fishes. This is thought to be due to the tendency of groupers to hide in rock shadows and the fact that the survey was not conducted during spawning season, when groupers tend to appear in large numbers. Fish were found in limited numbers in seagrass beds and the conservation areas of northwest Babeldaob Island. Although the team was told that this MPA may contain populations of sea cucumbers, a target for fishing catch in the area, members could only find small lolly fish, a species that fetches low prices in fish markets.

Further outdoor surveys for the collation of additional data on distribution patterns and population sizes of main species of fish, as well as species composition, is necessary in the future.

8.2.3 Fishing Regulations

A summary of fishing regulations for major species of fish stipulated under Palau Domestic Fishing Laws (2007) is presented as follows.

Table 8-2. Summary of Palau Domestic Fishing Laws 2007

Genus	Species	Minimum size	Harvesting season	Other restrictions	Penalties / Fines / Imprisonment				
					Genral	First conviction	Second conviction	Third conviction	Thereafter
Groupers	Brown-marbled grouper Camouflage grouper Squaretail coralgrouper Blacksaddled coralgrouper Coralgroupers		Closed April - July			up to $250	up to $500 and 30 days in jail	up to $1000 and 6 months in jail	up to $5000 and 1 year in jail
Rabbitfish	White-spotted spienfoot		Closed February - March			up to $250	up to $500 and 30 days in jail	up to $1000 and 6 months in jail	up to $5000 and 1 year in jail
	Baffalofish	Closed permanently	Closed permanently	no possession, no export		up to $250	up to $500 and 30 days in jail	up to $1000 and 6 months in jail	up to $5000 and 1 year in jail
	Humphead warsse (Napoleonfish)	Closed permanently	Closed permanently	no possession, no export		up to $250	up to $500 and 30 days in jail	up to $1000 and 6 months in jail	up to $5000 and 1 year in jail
Aquarium species				Aquarium Permit		up to $250	up to $500 and 30 days in jail	up to $1000 and 6 months in jail	up to $5000 and 1 year in jail
Spiny lobsters	Painted spiny lobster Socorro spiny lobster Longlegged spiny lobster	3.5 inches across length of carapace		No export; no taking of egg-bearing females whatever the length; no possession of undersized specimen		up to $250	up to $500 and 30 days in jail	up to $1000 and 6 months in jail	up to $5000 and 1 year in jail
	Mangrove crab	6 inches across width of carapace		No export; no taking of egg-bearing females whatever the length; no possession of undersized specimen		up to $250	up to $500 and 30 days in jail	up to $1000 and 6 months in jail	up to $5000 and 1 year in jail
	Coconut crab	4 inches across width of carapace		No export; no taking of egg-bearing females whatever the length; no possession of undersized specimen		up to $250	up to $500 and 30 days in jail	up to $1000 and 6 months in jail	up to $5000 and 1 year in jail
	Green sea turtle	34 inches across length of carapace	Closed June - August, December - January	No taking of eggs; no taking of female while she is on shore	Up to 6 months in jail or $100, or both of the above				
	Hawksbill sea turtle	27 inches across length of carapace	Closed June - August, December - January	No taking of eggs; no taking of female while she is on shore	Up to 6 months in jail or $100, or both of the above				

Genus	Species	Minimum size	Harvesting season	Other restrictions	Penalties / Fines / Imprisonment				
					Genral	First conviction	Second conviction	Third conviction	Thereafter
Giant clams	Crocea sea clam, *Tridacna gigas*, Elongate giant clam, *Tridacna crocea*, *Hippopus hippopus*, *Hippopus porcellanus*			No export (except cultured specimens)	No less than $300 for each violation or up to 2 years for each violation, or both of the above				
	Black-lip pearl shell	4 inches diameter across the shell	Closed August - December		$100 or up to 6 months in jail, or both of the above				
	Tectus niloticus	3 inches basal diameter	Designated from year to year	State governments can designate closed areas during open seasons	$100 for each undersized trochus				
Sea cucumbers	Joker's Boomerang coral, *Holothuria scabra*, Actinopyga mauritiana, *Actinopyga miliaris*, Pinapple sea cucumber			No export		up to $250	up to $500 and 30 days in jail	up tp $1000 and up and 6 months in jail	up to $5000 and 1 year in jail
	Dugong	Closed permanently	Closed permanently	No possession, no export		5000 ドルか 3 月-1 年	up to $10,000 or 6 months - 3 years in jail		
Sponges, hard corals and marine rock				No export	$100 or up to 6 months in jail, or both of the above				

Other prohibited actions	Penalties / Fines / Imprisonment				
	Genral	First conviction	Second conviction	Third conviction	Thereafter
Fishing while using underwater breathing apparatus other than a snorkel	up to $500 or 1 year in jail for each violation, or both of the above				
Making an entry or statement in writing in connection with the export of fish that is false.	up tp $400 or 6 months - 2 years in jail for each violation, or both of the above				
Using gill or surrounding net with mesh of size less than 3 inches Using kesokes net with mesh of size less than 3 inches		up to $250	up to $500 and 30 days in jail	up to $1000 and 6 months in jail	up to $5000 and 1 year in jail
Fishing with poison or explosives	Felony: $100-2000 and 6 months - 2 years in jail Others: $100 and 6 months in jail				

Groupers: Main species of groupers are listed at the top of the table. Of the five targeted grouper types, fishing is prohibited between April and July for *Epinephelus fuscoguttatus, Epinephelus polyphekadion* and *Plectropomus*. Sale and possession of these groupers during this time period are also prohibited. Grouper spawning is at its most active between April and July, and groupers usually appear in large schools to spawn during this period. This not only leads to higher catch efficiency but also triggers the danger of mass catch, which calls for the increased need for conservation.

Penal provisions for transgression of fishing regulations for groupers differ according the number of offenses. First-time offenders are fined no more than 250 USD, second-time offenders a maximum of 500 USD and imprisonment of 30 days. Third-time offenders are subject to a 1,000 USD fine and 6 months imprisonment, when other multiple offenders face a strict sentence of 5,000 USD in fines and 1 year of imprisonment. Instances of contravention of regulations concerning other major species of fish are subject to the same punitive measures.

Siganus canalculatus: Fishing is prohibited in February and March, when spawning is most active. The Republic of Palau is the only country that lists rabbit fish as the nation's second most important species of fish. While Palauans appear to favor rabbit fish, it is not as highly regarded and does not fetch as high a price in other Pacific island nations or Okinawa. It is also interesting that *Siganus canalculatus* and not the *Siganus guttatus* species of rabbit fish is regarded as the most expensive species of fish in Palau. This may be because the particular species produces large clusters of eggs when spawning.

No fishing of *Bolbometopon muricatum* and Napoleon fish is allowed at all times of the year. In addition to being targeted as fishing catch, these two species are also representative of coral reef fish. The main text of the Domestic Fishing Law states concerns of decreasing marine resources and utilization in tourism as reasons for the above-mentioned prohibition.

Crustaceans: Smallest possible catch size is stipulated as 3.5 inches in shell length for lobsters (1 inch is 2.5cm), 6 and 4 inches in shell diameter for mangrove crabs and coconut crabs respectively. Export bans and hunting of incubating crustaceans are also stated in fishing laws.

Along with other regulations, smallest possible catch size, prohibited fishing times and export bans apply to other forms of sea life such as sea turtles, giant clams, *Pinctada margaritifera*, trochus, sea cucumbers, dugongs and corals (hunting of dugongs is strictly outlawed). Punitive provisions differ according to the type of sea life. As part of additional fishing regulations, bans and limitations are exercised over the use of diving apparatus,

falsification of export applications, utilization of mesh netting such as gill nets (less than 3 inches), as well as fishing with the use of poisonous substances and explosives.

8.2.4 Important Resources

There are MPAs dedicated to specific species of sea life in the Republic of Palau. Even for MPAs with fishing bans on all species of marine life, there are cases where particular target species are determined for conservation. This includes sea cucumbers, groupers, giant clams, mangrove crabs, lobsters, Napoleon fish and dugongs.

1) Sea Cucumbers

In the Republic of Palau, the fishing of sea cucumbers became active from around 2011. This is due to the entry of buyers from Taiwan and Korea who have triggered demand with active purchasing. Such conditions have been witnessed not only in the Republic of Palau but also in other Pacific island nations and Okinawa. Demand for dried sea cucumber is high in China and the Japanese *Stichopus japonicus* species of sea cucumber, particularly those from Japan, is transacted at several ten thousand yen per kilogram in markets of Hong Kong. Sea cucumbers harvested in tropical waters and sandfish are also traded at high prices (Akamine, 2011).

Exports of six species of sea cucumber have been banned under the Palau Domestic Fishing Laws of 2007. As demand for sea cucumbers apart for export purposes remain low, recent fishing of sea cucumbers has been targeted at species that are outside of those specified under the fishing ban. At BMR, the project team was shown purchase records of two particular fishing traders that were dated 1st and 2nd of January 2011. Records contained catch obtained from Ngiwal State. While this accounts for a portion of total transaction volumes, the two traders had purchased more than 10 tons of fishing catch in two days. Of the purchase of five species that was recorded, a large number of transactions involved the brown sandfish (*Bohadschia vitiensis*). As sea cucumbers have limited movement capabilities, they are extremely easy to fish, making them a susceptible target for over-fishing. Fearing a depletion of resources from sudden increases in sea cucumber catch triggered by rising purchase prices, BMR distributed a report on 28th June 2011 titled “Monitoring of Export-Use Sea Cucumbers” to all relevant personnel and organizations. According to details of this report, business operators who are involved in the export of sea cucumber must have their purchasing, preparation (boiling, salt curing and drying), packing and export processes stringently checked by BMR staff. Permission to export will be denied if such checks have not been performed.

Based on the outcomes of several studies that confirmed a sharp depletion of sea cucumber resources in a particular marine area, the Palau National Government passed an emergency legislation on 28th February 2011 to ban the export of all species of sea cucumbers. The government will monitor the current situation over a period lasting at least a year before the decision to reopen exports is made upon surveys on resource level conditions.

In addition to sea cucumbers, trochus is another species that is being fished mainly for export as a special seafood product. Trochus shells are in demand abroad because of its use in the manufacturing of products such as clothing buttons. In order to manage trochus resources, the Domestic Fishing Law places size regulations on the fishing of trochus and also implements a short open season that lasts only for a few weeks. In addition, state governments have also begun to designate MPAs dedicated to the conservation of trochus in marine areas under their jurisdiction. A system similar to that for trochus is also in place for sea cucumbers.

2) Groupers

Groupers are the most important group of target fishing resources amongst coral reef fish. The same can be said for Okinawa, where grouper catch in Yaeyama Islands accounts for 30% of total catch earnings.

There is a number of MPAs that have been established for the purpose of protecting schools of spawning groupers. The existence of similar MPAs set up to care for spawning groupers (of similar species listed under the Republic of Palau's Domestic Fishing Law) has also been confirmed in the FSM state of Pohnpei. Within the Republic of Palau, overfishing of schools of groupers that had gathered for spawning has led to cases of disruption of resources at the local level. In Yaeyama Islands, Okinawa, MPAs are established in the five major spawning locations for all species of fish (primarily emperor breams and groupers) during the time when spawning activities are at their most active (April to June).

In 2010, the Yaeyama Fishing Cooperation set up MPAs specifically for the white-speckled grouper, which forms extremely large schools for spawning over a short period of time according to the lunar cycle. Although these MPAs were only established for a period of five days, such measures succeeded in protecting spawning schools of white-speckled groupers. With the system of protecting spawning groupers with the use of MPAs garnering attention, the internationally organization SCRFA (Society for the Conservation of Reef Fish Aggregation, http://www.scrfa.org) is currently in the process of collating data from countries in the Asia-Pacific region with regards to the protection of spawning groups of sea life such as groupers.

3) Giant Clams

There is a breeding center for giant clams in the village area of Ngiwal, although facilities have sustained considerable damage from waves. Similar breeding facilities that have been established at the bottom of the sea, together with fish cages located under the ocean surface, are thought to be found in many parts of the Republic of Palau. Holding areas for farm-bred giant clams have also been constructed at the port of Ngaremlengui.

Seedlings for the breeding of giant clams are produced by PDMC. While the operating conditions of PMDC could not be ascertained, the organization has been providing giant clam seedlings to communities in various locations despite having a low success rate in breeding other marine species.

Seedlings for giant clams are produced for both breeding as well as for release into the wild. As giant clams are a stationary marine life, they are easily discovered, which greatly affects its chances of survival. Giant clam resources have decreased in many Pacific island nations, prompting the Republic of Palau, Kingdom of Tonga, Independent State of Samoa, Republic of Fiji and the FSM among others to develop projects for the recovery of giant clam populations through seedling production and release into the wild. The release of giant clams is conducted not only for eventual harvesting, but release areas are set up within MPAs so that clams may be protected until they are ready to spawn. In this way, clam larva is distributed in the waters, leading to expectations of an increase in population numbers.

4) Mangrove crabs

The Republic of Palau not only has coral reef MPAs but also several MPAs for mangroves. The most important marine resource in mangrove MPAs are mangrove crabs. Mangrove crabs are popular with tourists, so demand and market prices are anticipated to be high. Revenue from crab sales can also be utilized as a source of income for the

management of MPAs.

Mangrove crabs are caught with the use of fishing cages, and care is needed in order to prevent overfishing. There have been warnings of declining mangrove crab populations worldwide. For the purpose of sustainable mangrove crab fishing, it is pertinent to designate all fishing areas as no-take zones and manage pressures exerted by fishing by setting up special fishing zones, so that limits can be imposed on the number of people who engage in mangrove crab fishing.

Mangrove crabs are difficult to rear because they eat each other. In Okinawa, seedling production for mangrove crabs has proven to be successful, but revisions to regulations concerning the use of drug agents for breeding has become an obstacle to bulk breeding and seedling release into open waters.

8.2.5 Fish Markets

1) Current Market Conditions

The project team visited a fish market in a city located in Koror State. The market is situated inside a small building and differs significantly from those usually seen in Japan. Ten cooler boxes measuring 200cm×80cm×80cm used to store fish were found inside the market. There are no fish auctions and fishing catch is landed in succession mostly in the morning, although landing times are not fixed. Customers do not come to the market at fixed times but schedule their arrivals according to times when there are more fish.

Team members confirmed fish prices during their tour of the fish market. Eight pounds (approximately 4kg) worth of reef fish were being traded at 17 USD, making each pound worth about 2 USD (1kg is worth about 300 JPY). The team also received a list of fish prices which they had printed by the person in charge. According to the list, prices per pound of fish are as follows: unicorn fish – 2.20 USD, typical reef fish – 2.15 USD, groupers – 2.50 USD, parrot fish – 2.20 USD, tuna – 1.25 to 1.50 USD, lobsters – 7 USD, mangrove crabs – 6 USD.

Figure.8.1. Fish Market (1). A building with the blue roof.
(Prof. Shunsuke Nagashima)

Fish are cleaned and prepared in a small building next to the fish market at an additional fee of 0.15 USD per pound. Many notifications concerning fishing regulations were pasted on market premises, but these carried regulations of Koror State and not those found under Palau's Domestic Fishing Law.

There were also people at the fish market who were there to buy fish upon the requests of friends and family in Guam and Hawaii. Requested fish are promptly shipped to their respective destinations after purchase.

Figure.8.2. Fish Market (2).
(Prof. Shunsuke Nagashima)

2) Fishery Cooperative Frameworks and Its Distribution

NGOs such as BMR, PICRC and TNC have teamed up for efforts to create fishing cooperatives within the Republic of Palau. There are two main purposes for establishing fishery cooperatives; the first is to facilitate management of marine resources and MPAs, and the second is the re-vitalization of the fishing industry. Rising prices of fish will serve as a trigger for the further establishment of fishing cooperatives. Institutionalization and the consolidation of catch shipments will contribute to higher selling prices, which will in turn lead to the possibility of maintaining revenue levels with smaller catch volumes and better management of marine resources.

Figure.8.3. Fish Market (3).
(Prof. Shunsuke Nagashima)

3) Problems Faced in the Process of Boosting Fish Markets

The biggest challenge facing fishermen is the maintenance of stable fish prices. On one hand, fish markets are ill-equipped and have a limited range and quantity of fish. On the other hand, however, direct distribution to hotels and restaurants places them at a disadvantage because a limited selection of fish forces them to lower their selling prices. As a suitable counter-measure, the construction of larger fish markets must be pursued, or the institutionalization of fishing cooperatives must be carried out in order to boost negotiation capabilities.

In fish markets, prices decrease as the freshness of fish deteriorates. As a source of added value to the sale of reef fish, retail of vacuum-sealed smoked fish products was started (see Fig. 8.3) In the Micronesia region, the sale of smoked fish had been carried out since before the war. On an offshore island in the FSM state of Pohnpei, earnings from smoked fish served as a foundation for an educated society because such revenue was used to establish education funds for the island's residents. Apart from smoked fish products, an initiative by the Overseas Fishery Cooperation Foundation of Japan (OFCF) in the FSM state of Yap is also notable. In Yap State, fish of declining freshness are minced and fried to produce cooked fish products. Due to limited output by existing mincing machinery, fried minced fish are consistently sold out at supermarkets. As such, orders for the fish products are also accepted in advance. As the region is home to a food culture that is centered on the consumption of fish, much possibility remains for the development of new products in the future.

While MPAs do not directly facilitate the promotion of marine products, its overarching functions are the prerequisite and cornerstone for the creation of a society of law-abiding fishermen.

8.2.6 Destructive Fishing Method

It is crucial to pay consideration to damaging fishing methods such as dynamite and poison fishing, a characteristic example of destructive fishing methods, ensures the effortless harvesting of large amounts of fish by utilizing force from blasts caused by explosives such as dynamite (Fig. 8.4). On the other hand, poison fishing involves injecting cyanogen compounds and plant poisons into gaps in coral reefs. The poison immobilizes ornamental fish and groupers, allowing for their capture and shipment as live fish. Although both fishing methods impose overwhelming effects on coral ecosystems, they are still being carried out in several countries. While

dynamite and poison fishing has been outlawed, policing and crackdowns are difficult in the Asia-Pacific region because of the presence of numerous islands and remote outlying areas.

Dynamite and poison fishing are prohibited in the Republic of Palau, and is a target for policing and crackdowns. In Southeast Asia, cyanogen compounds are commonly used in poison fishing, although the use of bleach and plant poisons are widespread in the Micronesia region. As legal counter-measures against destructive fishing that have been prohibited by law, strengthening of patrolling and policing activities from the inclusion of coral reefs in MPAs has proven to be effective, and a number of successful examples have been seen within the Asia-Pacific region.

Figure.8.4. Dynamites seized from a foreign vessel by RMI National Police. (Hideyuki Shiozawa)

8.2.7 Conservation of Coral Reefs

Coral transplant activities, a method for the protection and recovery of coral reefs, are being conducted in various locations worldwide. In response to the many issues surround the transplanting of corals, the Japan Coral Reef Society addressed ideological and technical problems in an academic journal article published in 2008. At present, recovery of disrupted coral reef ecosystems cannot be achieved solely by coral transplantation activities. The transplanting of corals must, in essence, be considered as a component of overall conservation measures for coral reefs. As erroneous transplant methods will lead to the danger of genetic disruption, transplant of corals to remote areas should be avoided. For instance, the transplantation of corals found in Okinawa to the seas of the Republic of Palau (and vice versa) is risky.

Currently, large population spurts in crown-of-thorns starfish have been spotted in several areas in northwest Pacific Ocean. Okinawa has also registered a similar increase in the numbers of such starfish and the species has also been observed in great quantities in the Republic of Palau. Extermination is said to be in progress. As previous cases seen worldwide indicate that random extermination is ineffective, it is recommended that selective extermination be concentrated only in important marine areas. Such marine areas may be considered as a type of MPAs. This approach, which has already been adopted in Okinawa, should be assessed in the Micronesia region in the future.

8.2.8 MPA Networks

1) Local Network

Optimal size is an important area of discussion concerning MPAs. Occasionally, debate surrounds the choice between establishing one large-scale MPA, or many smaller MPAs adding up to the same total land area. While further discussions regarding this topic shall be presented separately in this project report, it is first important to consider the key concept of “networks.”

The phrase “local network” utilized in this section refers to the network within a particular country. MPAs in the

Republic of Palau are managed by each respective state government. However, as it is natural for marine life to move freely between state borders, their protection and conservation hinges on the maintenance of healthy and effective MPAs found across Republic of Palau, a fact that also eventually links to the proper management and expansion of fishing catch.

Originally a concept known as the “ecological network” that began in Europe, stresses the objective of enhancing the well-being of all ecosystems in target areas not by concentrating protection efforts in a specific area but by adopting a wider perspective and establishing a connection between living spaces for the better protection of the lives of all living organisms. Ensuring the optimal allocation of green spaces in terrestrial areas guarantees the survival of living things. Movement of highly mobile species of fish in marine areas, together with the distribution of larvae of benthos such as crustaceans and shell fish, facilitates significant water mass change. While each MPA possesses unique environmental characteristics, their ability to constantly accept the entry of new marine life introduced from other water areas can be anticipated. It is therefore crucial not only to work towards the construction of an environmental situation that connects all MPAs, but also to heighten one’s awareness to such possibilities.

2) Global Network

It is important to locate the concept of a global network within a wider spectrum. According to Wood et al. (2008), as of December 2006, 4435 of the world’s MPAs were located within EEZ, accounting for a total combined land area of 2.35 million km^2. This is approximately equivalent to 0.65% of all oceans and 1.6% of total EEZ marine areas. The Aichi Target that was adopted during the CBD-COP 10 in 2010 in Nagoya pledged to turn 10% of the world’s oceans and coastal zones into conservation areas by the year 2020. Although this is a vital objective when considering the preservation of biodiversity and marine resources, the establishment of a network to this end is also an equally crucial theme for consideration.

In recent years, the notion of metapopulations has been actively discussed within the sphere of environmental biology. This theory aims to construct a model for large sustainable populations by collecting numerous populations of regional species and repeatedly conducting the process of increasing and decreasing population numbers. In order to ensure long-term survival, it is necessary to introduce mobility of living organisms between species populations found regionally and ensure mutual complementation in the maintenance of respective species populations. Survival of metapopulations is deeply linked to the size of each individual population and allocation of living environments.

Lobsters are a crucial marine resource distributed over a wide area that includes the coasts of Taiwan and areas close to Saitama Prefecture. Floating lobster larvae are known as phyllosoma, and larvae suspension may last up to two years, during which the larvae are carried by sea currents and distributed over a long distance. The maintenance and expansion of lobster populations are made possible by the continuity of optimal environmental conditions found in its migrating destination. As such, the establishment of MPAs in suitable locations and the creation of a mutual network are expected to contribute positively to the preservation of overall lobster populations.

Discussions surrounding the relationship between MPAs of the Republic of Palau and its neighboring countries that take into consideration the mobility of important marine species and life history traits of floating-stage larvae and juvenile fish, together with the construction of an effective network, are anticipated in the future.

8.3 Coral Reefs and Ecosystem Services of Mangroves in the Republic of Palau

8.3.1 What are Ecosystem Services?

Humankind benefits from a multitude of resources and processes that are supplied by natural ecosystems. Collectively, these benefits are known as ecosystem services. We gain immeasurably from the natural environment as we live, and our lives are made possible by utilizing the reserves of resources that have accumulated in the natural world. While this observation has been regarded as a general truth, it can also be said that there has been insufficient consolidation of scientifically-based arguments concerning this topic.

Such discussions are extremely important when considering the co-existence of humankind with nature. In the Republic of Palau, debate surrounding the co-existence of nature and humankind, as well as how abundant and healthy primeval natural landscapes and environments of Palau may be preserved for the future, often involves the key concept of ecosystem services.

The phrase “ecosystem services” was first coined by Ehrlich and Ehrlich (1981). In their discussions on ecosystem structures, the authors emphasized that a deep interconnection existed between living things and explained the types of benefits that the natural world has provided to the human race. Costanza (1997) further built upon such writings to publish a report titled “The Value of the World’s Ecosystem Services and Natural Capital,” which presented an assessment of nature based on many diverse perspectives. Costanza’s paper came to be used in various fields thereafter.

“Ecosystem function” is another phrase that is similar to “ecosystem services”. Since the concept of “ecosystem goods” was also in use, the definition of ecosystem function was clarified and taken to refer to the unique characteristics of natural habitats, as well as the various processes of biological and systematic attribute ecosystems, while ecosystem services and ecosystem goods refer to the benefits gained by people from such functions. This report addresses the various ecosystem services raised in past studies and research, and utilizes the following 17 ecosystem services (includes ecosystem goods). By taking into consideration the respective land areas occupied by various ecosystems in the world, this project report presents an estimate of the values possessed by each individual ecosystem service.

1) Regulation of elements contained in the atmosphere: Balance between carbon dioxide and oxygen, regulation of ozone levels that absorb ultraviolet rays, regulation of sulfur oxide concentrations.
2) Climate regulation: Regulation of temperatures across the globe, regulation of precipitation, regulation of greenhouse gases and the output of DMS (dimethyl sulfide) is a concrete example of how regional and global climate variability processes are regulated by biological activity.
3) Buffering of natural disasters: Degree of reactions of ecosystems to environmental change, as in the function of nature in cushioning the effects of storms, flooding, droughts etc. Buffering is mostly performed through plants and vegetation growth structure.
4) Regulation of water flows: Supply of water for agricultural purposes, transportation for the supply of water for industrial purposes.
5) Water supply: Storage of water supplied from water catchment areas (including groundwater).

6) Regulation of soil erosion: Prevention of soil erosion triggered by winds and surface water flow and storage of loose soil in lakes and wetlands.
7) Soil formation: Process of soil formation as seen from the weathering of rocks and accumulation of organic substances.
8) Nutrient cycling: As characterized by circulation of nitrogen fixation, nitrogen, phosphorus and nutrient salts.
9) Waste treatment: Treatment of waste water, regulation of pollution and detoxification by naturalization processes.
10) Transportation of pollen: Provision of animals, which plant pollen is transmitted with.
11) Regulation of populations of living things: Regulation of prey populations by keystone species or regulation of trophic levels through control of herbivorous populations by predators.
12) Provision of refugia: Provision of habitats and places for rearing of offspring for nomadic species, and provision of overwintering sites (the word “refugia” was originally derived from an area of relatively unaltered climate that is inhabited by plants and animals during a period of continental climatic change (as a glaciation) and remains as a center of relict forms from which a new dispersion and speciation may take place after climatic readjustment).
13) Provision of food supply: Provision of extractable materials to be used as food within gross primary production from fishing, hunting and gathering such as fish, crustaceans and fruit.
14) Provision of raw materials: Provision of extractable materials to be used as raw materials within gross primary production such as timber and fuel.
15) Genetic resources: Source of unique biological resources for areas such as pharmaceuticals, material science products, and virus resistance genes against plant pathogens and grain pests.
16) Provision of recreational spaces: Provision of opportunities for eco-tourism, sport fishing and outdoor leisure activities.
17) Provision of cultural values: Provision of opportunities for non-commercial purposes of ecosystems through aesthetic, artistic, educational, spiritual and scientific values.

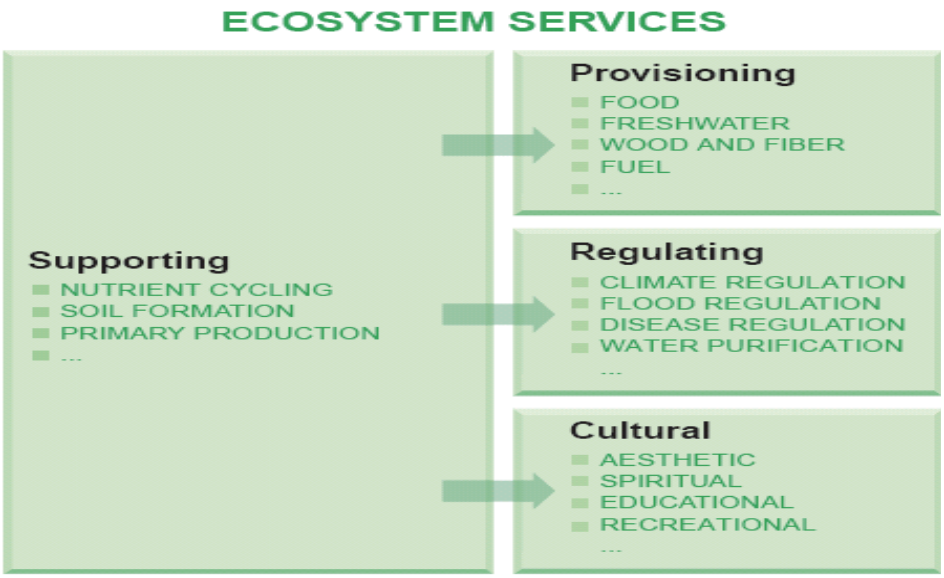


Figure.8.5. 4 ecosystem services proposed by a project for United Nations Millennium Ecosystem Assessment.

Collectively reviewed by 1,500 scientists worldwide from 2001, the project for the "United Nations Millennium Ecosystem Assessment" recommends consideration to be paid to the four following areas: ecosystem services, regulating services (services that regulate ecosystem environments), provisioning services (provision of marine resources etc.), cultural services (services that make cultural utilization possible) and supporting services, which are services that form the foundation of the above-mentioned services (providing a basis for regulating, provisioning and cultural services such as circulation of substances and soil formation) (see Figure 8.5). In 2006, the UNEP-WCMC (United Nations Environmental Programme-World Conservation Monitoring Centre) summarized the functions of coral reefs by consolidating issues concerning coral reefs and mangrove ecosystems. Through the organization of such scientific documentation and provision of scientific-based answers to basic foundational questions that deal with the importance of nature and the need for environmental conservation, new scientific developments, as well as contributions to environmental conservation and coastal management, can be anticipated.

8.3.2 Biodiversity and Ecosystem Services

There have been calls for attention to the importance of biodiversity for the preservation of ecosystem services. This section focuses on the relationship between ecosystem services and biodiversity while considering the significance of coral reefs.

Here, we investigate the ecosystem services of coral reefs and mangroves, which are of particular importance in the Republic of Palau. Such information shall be explained from a scientific perspective while the significance of coral reefs will be acknowledged from a scientific basis for the purpose of constructing theories for conservation and preservation.

1) Coral Reefs in the Republic of Palau

Information concerning coral reefs found within the Republic of Palau can be found in the report titled "Coral Reefs of Palau" compiled by PICRC and JICA in 2007. Apart from coral reefs, the report provides detailed accounts on seagrass beds and mangrove ecosystems, and also carries a bibliographical list of marine science literature published about the Republic of Palau, making the report an extremely valuable resource.

There is almost 2,000km^2 of coral reefs in Palau, a country made up of several islands. Palau's coral reefs are found in diverse forms and may be generally divided into four categories – vast lagoons, atolls, fringing reefs and barrier reefs. The PICRC-JICA report states that 215 types of hermatypic corals of 58 genera have been found in Palau. In general, more species of hermatypic corals, fish and sea algae inhabit the seas of Palau as compared to other Micronesian countries, and the level of biodiversity is high. The report states that Palau has suffered lesser damage to its coral reefs because it is not located in the trajectory of typhoons.

It must be mentioned however, that recently Palau's coral reefs have suffered from a number of disturbances. In particular, soil runoffs from land development projects, invasion of foreign species, grounding of ships onto reefs, and overfishing of marine resources have become enormous problems.

In order to address these issues, it is crucial to acknowledge the value of coral reefs, as well as to devise and implement specific solutions for their protection.

The Australian Institute of Marine Science routinely reports on the conditions of coral reefs found worldwide.

While massive coral bleaching that took place globally in 1998 is commonly known, a report released by the Australian institute in 2002 stated that 31% of corals found in Palau were destroyed as an effect of the coral bleaching phenomenon that had taken place.

2) Ecosystems of Coral Reefs

According to estimates found within the article by Costanza et. al (1998) mentioned in an earlier section, coastal zones are a particularly valuable form of ecosystems (the value of coral reefs is placed at $6,075/ha/yr）. In this paper, the topic of coral reefs is divided in the following three broad categories – role of coral reefs with regards to humankind, functions of coral reef ecosystems, types of ecosystem services received by humankind from such functions are regarded according to the categories put forth by the United Nations Millennium Ecosystem Assessment, while considering actual coral reef situations in the Republic of Palau.

① Generation of Complicated Landforms and Spaces

The Republic of Palau is an island country that floats in a sea of coral reefs. It is therefore not an over-statement to say that all activities undertaken in this region are related to coral reefs to a certain extent.

Coral reefs are living organisms that accumulate calcium carbonate such as hermatypic corals, calcareous algae and foraminifers. As coral reefs create a foundation upon which biological life begins, understanding the formation process of such a foundation and its structure is of most utmost significance to the types of human activities that utilize coral reefs.

Reefs are formed around the island of Palau, minimizing the effects of waves for the creation of a placid environment that is conducive for the accumulation of stone and other fine particles within the reef area. In addition, corals generate a three-dimension structure with branches that interconnect in a complicated manner to create a multitude of spaces which small living organisms are separated with. Seagrass beds in quiet lagoons are also home to diverse living beings such as fish and crustaceans. Coral reefs enhance and maintain biodiversity through the formation of such complicated landforms.

Calcium carbonate produced by living organisms is sometimes eroded by animals as part of their feeding activities. This is known as bioerosion and is one of the most significant characteristics of coral reefs. Blocks of *Porites tenuis* variations, which are feeding marks left by types of parrotfish, can frequently be observed. As parrotfish species nibble on corals and their bones, their droppings contain a high level of coral skeletal remains. Areas with large populations of parrotfish species often have extremely high levels of sand particle production. There has been research that state that one parrotfish produces several kilograms of sand articles in a year (Bellwood, 1995a, b ; 1996). Ecosystem services or functions from bioerosion lead to the production of sand particles, which are responsible for the creation of beautiful beaches and sandy sea bottoms, while also providing living habitats for organisms that are unable to live on rocks.

Living creatures that store coral and calcium carbonate in their bodies contribute to sand production when they die. The shells of foraminifers, and bivalve and univalve crustaceans are also important sources of sand. In Okinawa, there are beaches that are entirely covered with carcasses of foraminifers. Amongst these, "*Hoshi-zuna no Hama*" (Star Sand Beach) in Iriomote Island as well as the beaches of Taketomi Island have become important tourist attractions.

Among plants types, too, there are some like *Halimeda opuntia* f.*cordata* and calcareous gland that store calcium carbonate in their biological systems. While such fragments can be observed washed up on beaches, these are believed to turn into white sand particles with time. White sand beaches are derived from many of such organisms. It can therefore be said that the beauty of coral reefs found in the Republic of Palau are formed by the bioerosion activities of fishes and other marine life, which contribute to the construction of the background behind such beautiful scenery.

There are areas of coral reefs that are covered by seagrass beds. By creating environments that are clearly different from those dominated by coral reefs, habitats for distinctive types of living creatures are formed, leading to elevated biodiversity in general.

② Biogeochemical cycle and Purification Functions

Feeding activities of animals reduce the amount of organic materials found in the environment. Organic matter stored in the bodies of living organisms are transformed and processed for vital actions before being eventually passed out in a different form. Organic matter consumed through breathing activities and the passing out of inorganic substances as part of vital actions, are also assessed as reductions to the overall level of organic material in the environment. It is clear that from these phenomena that living things are involved in environmental fate centered on organic matter.

Such functions have been debated widely from the past in the area of tidal flat ecosystems. Water purification functions of 140ha of vast tidal flats known as *Sanbanze* that emerge at low tide in Tokyo Bay by benthos is estimated to be 575 tons annually, while COD purification levels are thought to be 335 tons a year. This compares to sanitation capabilities for sewage output of approximately 130,000 people. In addition, similar theories have been applied to the case of Seto Inland Sea and Ariake Sea. As coral reefs are found in transparent waters, making it difficult to directly ascertain the feeding activities of benthos and their effects, transparent waters can be considered as proof of normal and healthy feeding activities of benthos. However, such processes have yet to be sufficiently elucidated through scientific analysis.

In the Republic of Palau, overfishing of sea cucumbers has become a problem. Sea cucumbers are a species that may be easily observed in coral reefs and perform a crucial role within coral reef ecosystems. Sea cucumbers normally feed on sand and mud at the bottom of the sea, absorbing the attached organic matter for nutrition. There has been research on two types of sea cucumbers that feed on sedimentation (Tsuchiya, 2008). Examination of digestive tract contents of *Holothuria leucospilota* and *Holothuria atra*, two species of sea cucumber commonly found in Okinawa's coral reefs revealed levels of organic matter that were higher than surrounding sedimentation, suggesting that these two types of sea cucumbers select and feed on particles that contain larger amounts of organic matter.

Further investigations were carried out using analytical data concerning the food sources and fatty acid compositions of sea cucumbers. Such analysis is possible because the structure of fatty acids formed by a particular living organism is preserved and stored even when it is transferred to another living creature of a higher trophic level through the food chain. For example, as aerobic bacteria possess a unique fatty acid structure, sea cucumbers can be said to feed on aerobic bacteria if high levels of aerobic bacteria's fatty acid structures are found in their biological systems.

Upon examination of fatty acid structures in *Holothuria leucospilota*, it was found that their main sources of food are mostly derived from bacteria and diatom. In addition, these sea cucumbers were also found to feed on multi-cellular algae and dinoflagellates. Of particular significance is evidence of traces of food sources derived from the vascular plant *Holothuria atra*, which suggests a connection between these sea cucumbers and other ecosystems. In general, main sources of food for sea cucumbers are derived mostly from bacteria, multi-cellular algae and dinoflagellates.

Such analysis outcomes were meaningful when compared against sea cucumber populations in the Republic of Palau. There are more than 20 species of sea cucumbers of sizeable populations, and there is a possibility that the fishing industry exerts a great impact on coral reef environments upon considering that some of these sea cucumbers are utilized as marine products (with large landing catches). However, research needs to be performed as there is currently no consolidation of scientific data concerning this topic.

③ Functions as breakwater

Considering that Palau is composed of islands surrounded on all sides by coral reefs, it can easily be seen that coral reefs function as a breakwater. It has been reported that impact of the tsunami in the aftermath of the Sumatra-Andaman earthquake in December 2004 was weakened by the presence of coral reefs. While the above observation may be problematic in consideration of massive tsunamis such as the one that struck Eastern Japan in March 2011, reef lines of coral reefs in Palau and Okinawa are located at a distance from shorelines, making them possible buffers through their function in weakening the impact of strong waves.

Such breakwaters take an extremely long time to form, which makes it easier to understand their importance. Due to global warming, the rate of sea level rise is taking place faster than the rate of growth of coral reefs, triggering the effect of shrinking land areas of islands in the Pacific Ocean and the imminent danger of being submerged in seawater. It would indeed be a pressing problem if the natural environments of these islands were to be affected by global warming and other phenomena that are caused by human activities.

With placid ocean environments brought about by the breakwater function of coral reefs, sedimentation of sand particles within the lagoon increases, leading to a possible promotion of seagrass growth. Seagrass is found in great abundance in the lagoons in the Republic of Palau and they are thought to be connected to the existence of mangroves and landform characteristics. By creating varied environments inside coral reefs, seagrass beds are linked to the increase in biodiversity of coral reefs as a whole.

④ Maintaining of Co-existence Structures for Different Living Organisms（Maintenance of Biodiversity）

The various living creatures that inhabit coral reefs share mutual interconnections in co-existence. It is also clear that biodiversity is necessary for coral reefs to maintain their function as a fishing site. This is because the types of fish that are utilized for consumption purposes require large intakes of feed. Connection through the food chain means that crucial sources of marine products are supported by high levels of biodiversity. When compared with the number of people in Okinawa, it can be seen that the Republic of Palau has a significantly smaller population size. As larger populations lead to higher levels of expectations for the fishing industry (anticipation of bigger catches), there may be the presence of debates that are at variance with environmental conservation. Regardless of differences in population size however, there is a need to consider the sustainable use of coral reefs. As such, it is

necessary to conduct discussions on MPAs which take into consideration such functions.

Coral reefs provide living spaces for its inhabitant species with regards to spawning, raising of young and feeding grounds, while functioning to transmit diverse genetic information to the next generation. Three-dimensional structures created by hermatypic corals, as well seagrass beds found in lagoons, perform a crucial role in maintaining and expanding the above functions. The existence of complicated living environments and the presence of living organisms of different habitats that use them result in the creation of diverse coral reef communities. Numerous spaces formed in individual *ramiform corals* create little houses that serve to segregate small living organisms, drawing attention for their role in adding to further diversification of coral reefs.

Many types of fish inhabit seagrass beds using them in a variety of forms. With the movement of fish, material substances are transferred to different ecosystems, triggering new interaction with other living organisms in new fields and bringing about influences to substance cycle systems. In addition, it also brings about complex inter-species relationships and situations where indirect influences are exerted over the activities of other living organisms. It is thus important to conduct research into the network of MPAs from this perspective.

There has been research conducted on schools of fish inhabiting seagrass beds found in Amami Island, Okinawa Island, Yaeyama Isalnds (Ishigaki and Iriomote) of the Ryukyu Archiplego. Along with observations on utilization patterns of seagrass beds, the study found that fish species use a variety of ecosystems (Nakamura and Tsuchiya, 2008). There are some species of wrasses inhabiting seagrass beds. *Cigar wrasse* (Amami, Okinawa, Yaeyama Islands), *three-ribbon wrasse* (Yaeyama Islands, Okinawa), *thereespot wrasse* (Okinawa) and *Apogon ishigakiensis* (Yeyama Islands), are among species spotted regularly. There are also numerous species using seagrass beds as temporary habitats. *Longspine emperor* (Amami), *spangled emperor* (Amami, Okinawa, Yaeyama Islands), *black spot emperor* (Okinawa, Yeayama Islands), *longface emperor* (Okinawa, Yeayama Islands) and other *lethrinidae* are among such species. Bicolor goatfish (Amami, Okinawa, Yeayama Islands), *Indian goatfish* (Amami, Okinawa, Yaeyama Islands) or *blackstriped goatfish* (Yaeyama Islands) are among goatfish species passing through the seagrass beds of the Ryukyus frequently. Despite a difference in location from the islands of Amami to Iriomote, the utilization forms of seagrass beds are similar for fish of the same taxonomy groups. It can be said that the diversity seen in fish species are maintained by the existence of diverse coastal ecosystems. It would thus be desirable if more light is shed on each of the types of natural phenomena that are taking place in the coral reefs of the Republic of Palau.

Chicken grunts utilize coral reefs as a resting place in the day and feed on algae found in seagrass beds at night. They contribute to nutrient salt cycling as their droppings provide a source of nutrition that helps with coral growth and heightens the level of productivity of algae. Such functions are made possible by the maintenance of structures found within coral reefs that allow for the inhabitation of many different living organisms in each respective living environment, which protects conditions for co-existence and preserves species biodiversity.

Diverse landscapes and heterogeneity of environments serve to elevate the degree of diversity seen in species of living organisms. While more time is required in order for sufficient elucidation of such inter-relationships, analysis of maintenance functions of structures that enable the co-existence of diverse living creatures is a vital theme that will serve to provide the scientific basis to further understand ecosystem functions and services.

Column Ecosystem Services of Seagrass Beds

Generally speaking, seagrass beds form a part of the coral reef ecosystem. While ecosystem services of seagrass beds are explained in this current section under “Ecosystem Services of Coral Reefs”, In order to ensure a fuller understanding, details of the functions performed by seagrass beds will be given further attention here.

1. Fishing Industry Field:

In fields found in Okinawa, active fishing operations carried out in the vicinity of seagrass beds involve the fishing of *sukugarasu* (rabbit fish juvenile) and breeding of *mozuku* (*nemacystus*). The fishing of rabbit fish juvenile that enter lagoons (*inoh*) in large numbers around the 1st of June on the lunar calendar is a seasonal tradition in Okinawa. Fields in Palau are an important inhabitation field for sea cucumbers. In addition, seagrass beds in these fields also fulfill vital functions for spawning by squid species and growth of fry and other young fish.

2. Biodiversity Maintenance Field

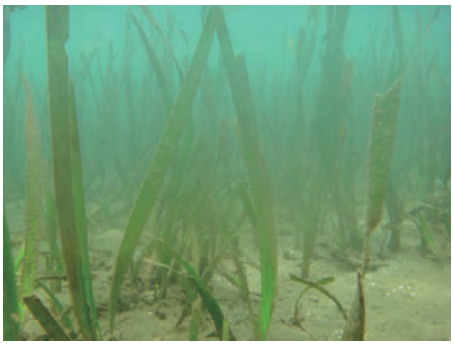
Seagrass beds are a shelter for diverse types of plant and animal life. The growth of seagrass allows for the survival of many small animals, as well as the enhancement of biodiversity. Micro-algae that live on seagrass leaves are also an important source of food.

3. Environment Purification Functions

Seagrass beds accumulate fine particles easily, which leads to a richness in organic matter. However, the project team did not find many eutrophied seagrass beds. This is thought to be attributed to the absorption of nutrient salts and organic matter by plants and animals, which aid in the purification of the environment and maintain certain conditions in seagrass beds. Sea cucumbers play a large role with regards to this function.

4. Landscape Functions and Tourism Resources

Seagrass beds and surrounding tidal flats serves as a field for shellfish gathering and other beach leisure activities. While seagrass beds are not commonly utilized as a direct tourist resource, the project team was able to spot tourist boats anchored at marine areas with seagrass beds in Palau. This indicates that the connection between humankind and seagrass beds is significant even from the perspective of tourism.



Seagrass beds
(Hideyuki Shiozawa)

⑤ Ecosystem Services as Field for the Provision of Goods such as Fish

【Fishing Industry Field】

The total land area of coral reefs accounts for less 0.5% of the area of oceans and seas in the world. However, the turnover rate of coral reef fish is high, leading to a high level of productivity utilized to support the lives of humankind (Choat and Robertson, 2002). According to Russ (1991), coral reefs produce an estimated 0.2 to 40 tons of fish per square kilometer in a year, although this may depend on the definitions of coral reefs and reef fish. In other research, it has been approximated that fishing catch from 1 km^2 of coral reefs is sufficient to support the needs of 300 people (Jenning and Polunin, 1996). While such estimates are expected to differ according to the proportion of coral reefs across provinces and regions, by considering values for the latter we may assume that it is possible for coral reefs found in the Republic of Palau（2,000km^2） to support the lives of 600,000 people.

Amongst more than 100 countries that possess coral reefs, many are currently poised to witness growths to their populations. In the near future, the importance of coral reefs as a crucial source of marine resources is anticipated to increase. Taking into consideration export quantities, this suggests that meeting our continued anticipations of larger catches of food resources from coral reefs is expected to become problematic. It is thus crucial that discussions on ensuring stable fishing catches into the future and the maintenance of ideal conditions for fishing industries are carried out together with the immediate formulation and implementation of corresponding policies.

It requires little mention that fishing resources are renewable. However, without stable supply the function of resources to renew themselves will be lost. The case of Okinawa serves as an extremely useful example. Since reversion to Japanese rule in 1972, the dietary habits of Okinawans experienced major changes that triggered over-fishing in sea urchins and a resultant sharp decline in their populations. Research also points to the relationship between development and changes in the environment (Tsuchiya, 2006; Tsuchiya, 2007). According to accounts by an acquaintance of the project team, since 1972 fishermen have harvested sea urchins from the ocean daily, but they began encountering problems when there was no longer any sea urchins left to harvest a few years later. As demand for sea urchins has remained high, Okinawa's Center for Marine Stock Enhancement has worked to boost breeding capabilities in order to meet demand.

Over-fishing results in population decline, leading to requests for larger fishing catches from fishermen, which triggers fluctuations in price. It is evident that such a vicious cycle not only destroys ecosystems, but creates negative effects on people's lives. It is thus vital that efforts are made to maintain balance.

While there is limited statistical data on fishing catches in the Republic of Palau, data across a five-year period from 2002 has been made public (2006 Statistical Yearbook, Republic of Palau, Bureau of Budget and Planning, Ministry of Finance) (Fig. 8.6). By looking at the chart data it can be seen that fishing catch for 2005 was significantly lower compared to those of other years. While team members attempted to investigate reasons to account for this with a number of organizations, they were unable to derive any clear explanations. The same condition can also be seen from the chart depicting total catch revenue ($) (Fig. 8.7).

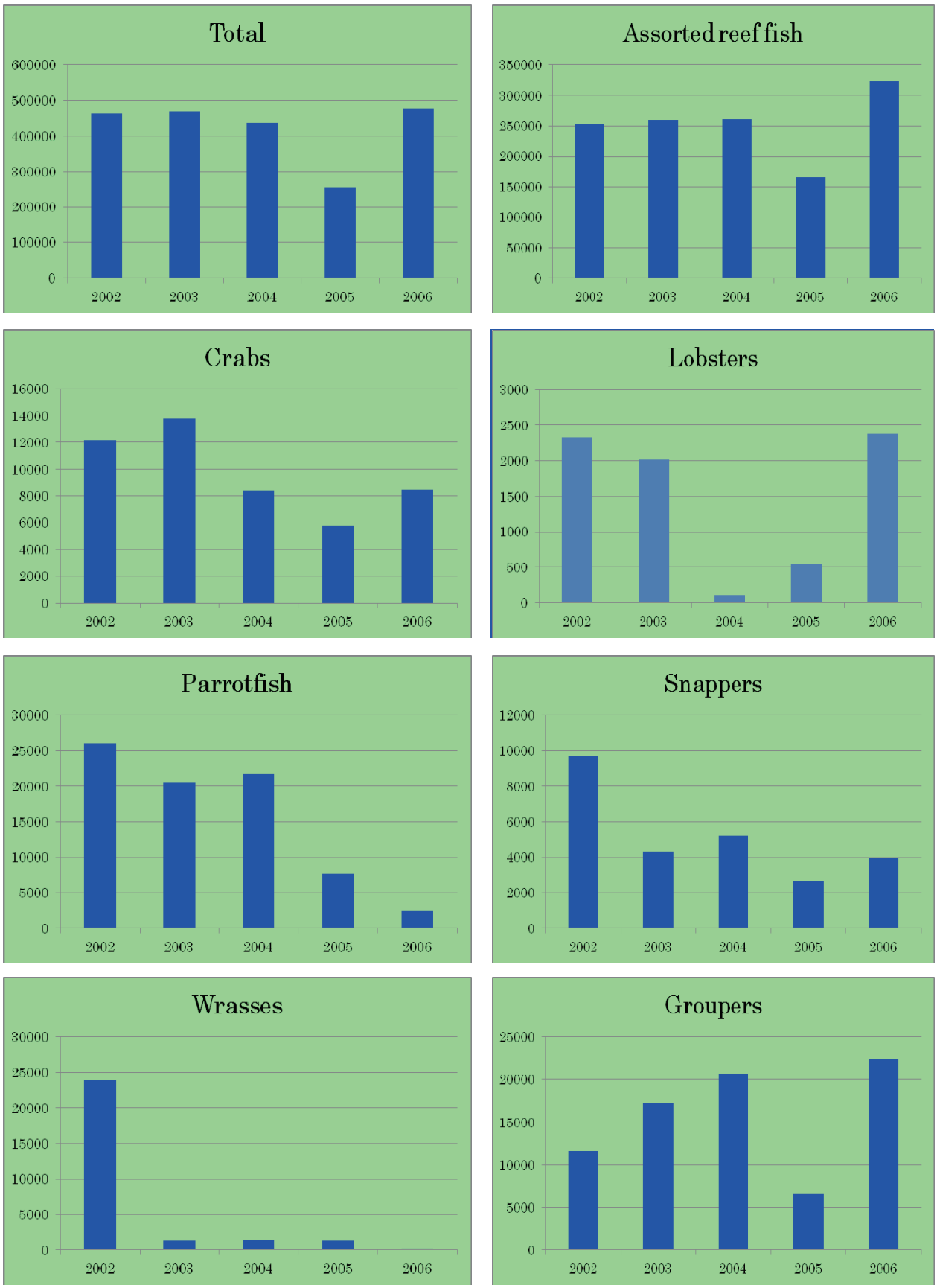


Figure.8.6. Transition of catch in coral reefs in the Republic of Palau. (Based on 2006 Statistical Yearbook)

Characteristic transitions can also be seen from statistics for different fish species. In 2002, there were large catches of wrasses but this decreased sharply over the ensuing years. Apart from wrasses, catches for snappers and crabs also registered similar trends, although declines were of a smaller degree compared to that of wrasses. On the other hand, lobsters yielded extremely small catches in 2004 and 2005, while those of parrot fish have registered steady declines every year.

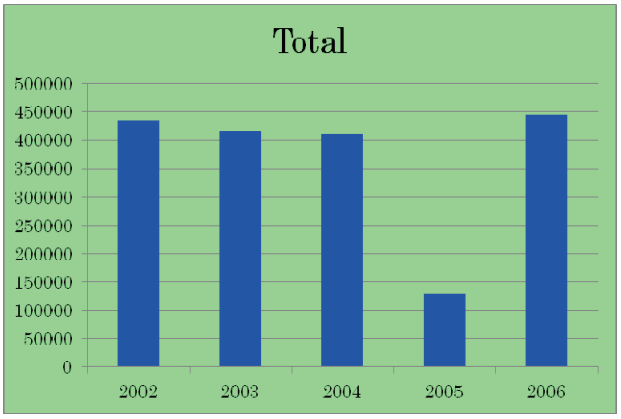


Figure.8.7. Transition of total catch in coral reefs in the Republic of Palau. (Based on 2006 Statistical Yearbook)

The crucial task ahead is the analysis of such data for the formulation of measures that can be applied to the management of coastal zones. To the best of the project team's knowledge, statistics beyond year 2006 remains unprocessed. As such, there is a need to continue collecting and consolidating accurate information.

Recently, a paper concerning the MPAs in the Republic of Fiji was released (Clements et al., 2012). Research in this paper involved measuring the size (weight) of groupers and other marine catch found in MPAs where fishing has been banned for more than 4 years, as well as in surrounding fishing grounds. Upon comparison, findings for fish and marine catch in MPAs showed distinctly higher values. However, in places where fishing bans had been lifted four months prior to research, the difference in findings were less clear when compared against those for fish and marine catch found in fishing grounds. According to these research outcomes, the effectiveness of MPAs is evident. The MPAs of Kenya are the subject of the most detailed scientific information to be consolidated on the topic of Protected Areas. Research has been conducted on the biological characteristics of MPAs over the past 30 years, and recent investigations have compared species compositions and diversity of fishes found in waters of both protected and non-protected areas (McClanahan et al., 2010).

It is anticipated that consolidation and analysis of data concerning the fishing industry, together with research on the effective utilization of MPAs and sustainable use of coastal zones may be further developed in the Republic of Palau.

【Supply of Local Souvenirs and Decorative Items】

Coral reefs are home to many types of living creatures that are utilized as material for decorative items. Such conditions can be easily perceived if one recalls the familiar sight of rows of seashells collected from coral reefs and other decorative items that made from coral shells in souvenir shops found in Okinawa, the Republic of Palau, Southeast Asia and other Pacific islands. Even in northern Japan where coral reefs are not found, one may find coral skeletons and other tropical shells that appear to have been collected from coral reefs in the souvenir shops of tourist spots in Hokkaido and Tohoku.

It is evident that the use of shells to make necklaces and other decorative items exerts a devastating impact on natural populations. As this serves as an obstacle to the long-time sustainability of stable supplies of marine species used for such purposes, it is time for concrete efforts to be taken before it becomes too late to reverse the damage against certain species which may not withstand such detrimental effects.

【Provision of Ornamental Fish】

Fishing catches of ornamental fish cannot be exempt from consideration. In Hong Kong, trading of ornamental fish is a crucial industry that saw more than 30,000 tons of fish being traded annually in the mid 1990s. Considering that trading of coral reef fish is estimated to be 50,000 tons a year, the sheer size of Hong Kong's trading volume for ornamental fish becomes evident. Ornamental fish imported into Hong Kong are mainly re-exported to China, and functions as a vital source of support for the economy (Sadovy and Vincent, 2002). However, in recent years trading of ornamental fish in Hong Kong is said to have decreased by half.

While ornamental fish are beautiful and may serve to enhance our lives by making it more interesting for a brief period of time, long-term considerations point to the need for efforts to ensure that expansion in the demand for ornamental fish does not lead to depletion of supply in resources. Methods where ornamental fish are captured by immobilization through the use of cyanogen compounds also cause detrimental effects to other types of fish.

【Provision of Medicine】

Substances beneficial to human health are extracted from living organisms in coral reefs. In coral reefs, there are species which have evolved to store chemical substances (biologically active agents) in their bodies in order to survive in the wild. Such chemical substances have contributed to developments in science and medicine and have garnered attention for their medicinal properties or use as research reagents. Such functions have been made possible because of the benefits received from diverse coral reef life.

Cone snails are an important component of coral reefs and have contributed ecologically to the understanding of co-existence mechanisms for many species (Kohn, 1959 etc.). Cone snails feed with the use of harpoon-shaped radulas that inject nerve toxins into prey. The immobilized prey is then eventually consumed as feed. Geography cones in particular contain high levels of poison and are known to fatally wound humans. Toxins of cone snails have been frequently researched and are synthesized by analgesic drugs. In addition, sponge species have also been frequently utilized in the research of biologically-active agents through the extraction of substances that react specifically to protein.

【Gathering of Construction Materials】

Limestone is easily cut and is used as building materials. One can easily observe the use of limestone that has been derived from coral reefs in the construction of traditional houses in Okinawa. Cement is also extracted from old elevated coral reefs. These are non-sustainable uses to which utmost caution should be paid.

⑥ Spiritual, Social and Cultural Values

【Healing and Calming Services】

The most important function of nature is its beauty. It is not uncommon that people feel infinitesimally small in the presence of the greatness of nature. Many calls have been made for people to treat nature with more respect. Plant and animal life that are reduced to living in narrow areas of sea remaining in urbanized spaces teach us about the wonder and strength of life and nature, and provide people with a sense of calmness.

Coral reefs are beautiful regardless of where they are viewed. When one travels to Okinawa by airplane, it is

hard not to be impressed by the vast sight of coral reefs sparkling in the emerald green oceans. On flights over Australia's Great Barrier Reef, pilots make announcements telling passengers to look out of their windows for views of the Reef. Massive coral reefs floating in oceans appear mysterious and may seem to draw people into their immensity. Indeed, looking at forests of colorful coral and countless fish while diving or snorkeling is an eye-opening experience. By strolling along coral reef shorelines at low tide, encountering blue duskytail damselfish swimming in tide pools, seeing many other types of corals and looking at their movements, one can certainly forget the passage of time.

【Provision of Fields for Tourism】

The beauty of nature is vital to the establishment of the tourism industry. Diving shops can only continue to be in business because of the presence of healthy coral reefs and the ability to view corals and colorful fish at all times. This is the same for tour companies that organize coral reefs tours on tour boats.

In recent years, eco-tourism has become popular, functioning as a source of revenue as well as contributing to the conservation of natural environments. However, it cannot be denied that incorrect forms of eco-tourism can upset the natural balance and lead to problems. As such, it is important to consider the nature of the different types of eco-tourism as well as their participant capacities.

When compared to figures for 2002, tourist numbers in the Republic of Palau are on the increase (fig. 8.8). Tourist visits in the year 2010 was said to be 90,000. Diving in coral reefs remains a central tourist activity, and many tourists have come to Palau to enjoy coral reef landscapes. Diving locations are distributed almost all over Palau (Fig. 8.9), although some spots have more divers than others. Careful measures that ensure co-existence with nature are thus necessary.

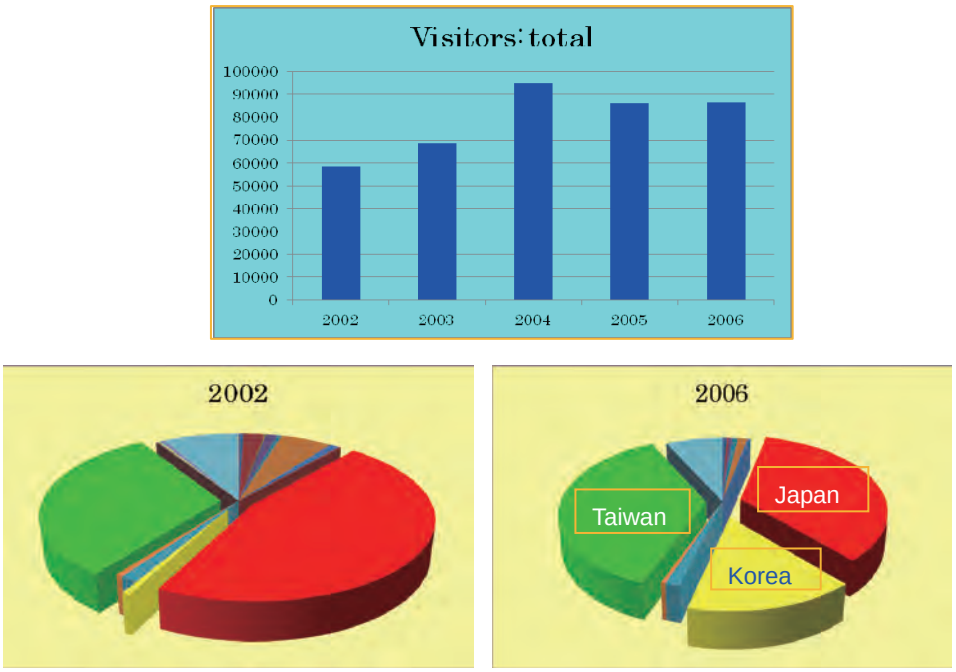


Figure.8.8. Transition of visitors to the Republic of Palau. (Based on PVA's data)

Figure.8.9. Diving spots in the Republic of Palau (indicated with red). Almost all regions off Palau are used for diving (PVA).

In Okinawa, much debate has surrounded ways to increase the number of tourists visiting the prefecture. In 2007, 5.9 million people visited Okinawa and moves to increase tourist figures to 100 million have been carried out since then. The Republic of Palau has a land area of 487 km^2 and a population of 21,000. In comparison, Okinawa has 4.6 times the land area of Palau (2,276 km^2) and a population of 1.4 million people, which corresponds to 67 times of that of Palau's. In considering environmental capacities, it is evident that Okinawa has a bigger resident population and hosts a larger number of tourists as compared to Palau. While comparisons between Okinawa and Palau should take into consideration differences in the degree of nature and the size of their oceans, it is hoped that approaches for the future may be formulated while bearing in mind their respective conditions at present.

It is therefore vital to first understand that the tourism industry will not be possible without the existence of healthy natural environment and the need to endeavor towards environmental conservation. Of late, discussions on how tourism and nature may co-exist have begun taking place in Okinawa, and attention should to be paid on the ways in which such discussions are turned into practical measures for implementation. It is hoped that such debates will be useful to environmental conservation efforts in the Republic of Palau.

【Provision of Fields for Traditional Rituals and Ceremonies】

Coral reefs areas are a site of many traditional events. *Hamauri*, which takes place on the 3rd of the third month of the lunar calendar, is originally an anthropological ritual derived from tradition. However, in the present day it is more often interpreted as a day for the gathering of clams and other leisure activities at the beach. From the past, people have gathered clams from rocky shores and consumed them for food. This balance between nature and human life is now upset and needs to be restored.

Apart from food resources, people have come to utilize living organisms in coral reefs in a variety of ways in their lives. In Okinawa, the practice of hanging chiragra spider conch shells from the eaves from houses to ward off evil is still seen today. Large shells are used as weights for fishing nets while great green turban shells are a material for mother-of-pearl inlays in traditional Ryukyu lacquer ware. There are also toys and decorative accessories such as necklaces that are made from resources found in coral reefs. In the past, there were also rituals where the dead were buried along with shells. As the nature of children's games changes with time, one wonders if the loneliness that one feels is simply nostalgia, or anxiety that comes from what is being taken away from nature.

At present, the project team is unable to ascertain information on the link between traditional rituals and the coral reefs in the Republic of Palau. However, due to the presence of legends surrounding the sea, it can be seen that the people of Palau have clearly shares a deep relationship with coral reefs. More effort needs to be made to consolidate further information on traditional rituals and ceremonies of Palau.

⑦ Provision of Fields for Education and Research

The need for environmental education is growing ever more important. Coral reefs and their diverse communities of living organisms provide the ideal environment as a field for children of all school levels and ages to learn about the fun and wonder of nature.

Many observation tours of coral reefs have been organized in Okinawa and images of children enjoying themselves at such events have been seen in newspapers and other media. Whether it is the observation of coral reefs at low tide while strolling along the beach or snorkeling, the ways in which one may learn about coral reefs are varied. Coral reefs are truly a field for lifelong education. In order to show how fascinating the living activities of organisms in coral reefs truly are, researchers and specialists must further promote research and strive to provide more information on the topic.

PICRC has devoted its efforts into environmental education, and has done so through activities such as creating teaching materials and producing posters and calendars. PICRC's endeavors in establishing aquariums are also of significant importance, as these serve to introduce the marine life of Palau's oceans to the numerous visitors who visit the aquariums each day.

⑧ Provision of Information on Changes in the Environment

【Information Provision Services on Changes to Global Environment】

Of late, the phenomenon of coral bleaching is growing serious. Coral bleaching is the coming off of the symbiotic substance *zooxanthellae*, revealing the white skeletons of corals. This phenomenon occurs when corals

are exposed to unnatural environmental conditions (high temperatures, low sodium content etc.). In particular, coral bleaching that took place on a global scale in 1998 was exceptionally damaging. While subsequent coral bleaches were of different scales, these occurrences remained frequent. In 2007, extensive coral bleaching took place once again.

At present, monitoring activities are in process in various locations around the world. The phenomenon of bleaching appears to repeat itself, leading to devastating impacts on corals as a result. Coral reefs in the Republic of Palau are not an exception.

【Rising Sea Levels Accompanied by Changes in Global Environment】

Changes in climate and water temperatures over the past 50-100 years have been recorded in various locations worldwide. In Okinawa, data from meteorological observatories in Naha and Ishigaki Island have reflected similar temperature trends (refer to Hasegawa et. al., 1999 for information on rise in water temperatures). Data from both locations exhibit that water temperatures have risen by approximately 1℃ over the past 100 years, pointing to an increase in the temperature of seawater. It is of no coincidence that similar patterns of rising seawater temperatures have been charted in different locations across the globe. There is no doubt that this has been due to the influence of global warming. In other words, the phenomenon of coral bleaching serves as an index for environmental changes seen across the globe.

【Information Provision Services on Ancient Climates】

Information stored in the skeletons of corals can be utilized to uncover environmental changes in the past. Particularly, analytical research on water temperatures of ocean environments, changes in sodium levels and the presence of flooding is currently in progress.

The arrival of James Cook to Australia in 1770 signaled the start of full-scale immigration of English people. Thereafter, large changes were said to have occurred in the environment, and such transitions are recorded in the corals of the Great Barrier Reef. McCulloch et al. (2003) analyzed barium-calcium proportions (Ba/Ca ratio) recorded in a specific skeleton of hermatypic corals that have lived for 300 to 400 years according to specific time eras. Findings not only proved a direct correlation with volumes of seawater inflow into rivers, but also showed that proportional ratios measured in the 20th century were of considerably higher values than those measured in the 18th century. By taking note of the special characteristic of barium in which amounts that are absorbed by fine particles are desorbed in low-sodium environments, analysis suggests that of late, there have been growing amounts of substances flowing into the sea from rivers. This is thought to be an effect of land development.

It is anticipated that highly significant outcomes can be gleaned by taking into consideration the history of the Republic of Palau in such studies.

⑨ Provision of Fields for Reclamation

Coral reefs function as a site for land reclamation activities. This form of utilization is destructive and non-sustainable. Coral reefs and coastal zones have been reclaimed to fulfill various purposes in support of human lives, and discussions involving this process have deepened due to calls to assess the environmental functions that

have been lost as a result of detrimental effects of reclamation. This is a topic that will surface in times of population increase or during the pursuit of ease and convenience by humankind. As such, the Republic of Palau is no exception to the possibility of such debates.

8.3.3 Ecosystem Services of Mangroves

1) Ecosystem Services of Mangroves

The ecosystems of mangroves are thought to provide the following services to humankind.

a. Mangroves grow mainly in estuarine regions, an environment inclined towards the accumulation of various types of substances that flow from rivers. Mangroves therefore function as warehouse for the storage of high quantities of organic matter and nutrients.
b. Source of organic matter supply: Large amounts of leaves from plants fall into mangroves and eventually break down and function to provide organic matter to surrounding tidal flats and coastal areas. This becomes feed for small animals and serves as an important food source for coastal living organisms.
c. Environmental purification functions: Mangroves and tidal flats are home to immense numbers of crabs and cone snails. When these animals feed on food, they reduce the amount of organic matter in tidal flats through their ability to purify their own living environments.
d. During high tide, one may observe the sight of small fish swimming in from the sea to forage for food amongst the roots of mangroves. Mangroves are an especially important source of shelter for young fry juvenile that live in coral reefs.
e. Frontal tidal flats are also used as breeding grounds for algae. These areas also share a deep connection with the lives of people by functioning as the site for marine leisure activities such as clam gathering.
f. Mangroves provide living habitats to birds, insects and other animal species.

Figure.8.10. Cooked mangrove and land crabs (right). Mangrove crabs belong to the *scylla* genus, which there are 4 species of, and study on their taxonomy is in progress. The species bred in the Republic of Palau is called *Scylla serrata*. (Prof. Makoto Tsuchiya)

g. Mangroves function as a field for food resources. The most vital species in the case of the Republic of Palau is the mangrove crab (Fig. 8.10, left) and attempts at crab breeding are currently in progress. Land crabs are also served frequently at meals (Fig. 8.10, right). While unseen in Palau, *Thalassina anomala* are sold commonly in

the markets of countries and territories in the Pacific Ocean region.

h. Mangroves are an extremely important field for environmental education. As a result of being widely used in a variety of academic research, fascinating discoveries have been made, bearing the possibilities of new academic progress and improvements to human life.

i. Mangroves are valuable in their use as fields for recreation, such as eco-tourism and kayaking (Fig. 8.11).

Figure.8.11. Tourist enjoying kayaking
(Prof. Makoto Tsuchiya)

2) Mangroves of the Republic of Palau

Much of Palau's coastline is surrounded by mangroves (Fig. 8.12). In the case of Babeldaob Island, mangroves are found along 80% of its coastline, while the remaining 20% is covered with beaches and reefs. Babedaob Island has 4,025 ha of mangroves, which accounts for 9% of all mangroves in Palau. Koror Island, Malakal Island and Arakabesang Island have a total of 205 ha of mangroves while Peleliu Island has 435ha.

On Babeldaob Island, mangrove forests are distributed over several hundred meters between river banks to inlands that are located 1 km upstream from estuaries. Along the sea, *Sonneratia alba* and *Rhizophora mucronata* are common, while *R. mucronata* and *R. apiculata* dominate estuarine regions. *Xylocarpus granatum* can be observed as one moves further inland (upstream). *Nypa fruticans* can be found along river banks.

The characteristic of mangroves in the Republic of Palau is how their brace and arboreal roots grow to form complex structures that possibly limit the extent of utilization of mangrove areas by humans. Palau's mangroves are also said to be an extremely conducive habitat for salt-water crocodiles. Indeed, there are tourists who have been lured on mangroves tours because they were told that they may be able to spot salt-water crocodiles.

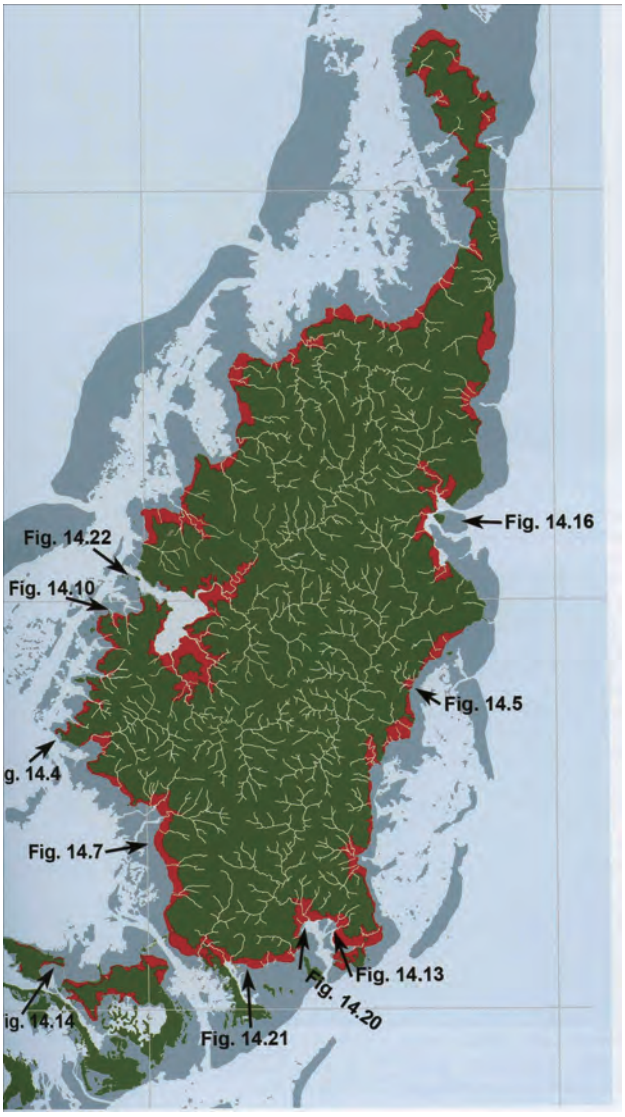


Figure.8.12. Babaldaob Island is surrounded by mangroves (painted red). (Marine Environment of Palau, Colin 2009)

Fallen leaves from mangroves flow directly outwards to estuarine regions and marine areas, providing living organisms with an important source of organic matter (food resource). Organic particles broken down from fallen leaves accumulate in areas surrounding mangroves and exterior tidal flats, serving as a form of support for the lives of living creatures inhabiting those areas.

During low tide, a variety of bird species rest their wings and carry out feeding activities on tidal flats that extend in front of mangrove forests. The feeding of crabs and shellfish by bird species serve to reduce the amount of organic matter found in tidal flats. In addition, birds deposit organic matter taken from other tidal flats in the form of droppings. Such biological processes cannot be ignored in the event that large populations of bird species are present. Quantitative research on the topic has just been initiated and detailed information has yet to be adequately consolidated.

The sight of diverse types of birds inhabiting tidal flats is one that naturally calming to the heart. The utilization of tidal flats by birds is not random; there are species of birds that utilize shorelines and water edges, others that feed by placing their feet slightly into the water, types of birds that move collectively in flocks and yet others that live alone. While tidal flats may seem uniform, they should be understood as a collection of many different environments that are utilized by various types of living organisms.

8.3.4 Global Environments and Mangroves

It is crucial to consider how mangrove plants are related to the future of global environments when conducting discussions on coastal management. The lower portion of mangrove plants below the stem as well as the brace roots that support them, together with respiratory roots that jut out onto tidal flats, are submerged under water during high tide and exposed during times of low tide. Generally, such areas are known as intertidal zones. As an effect of global warming and rising sea levels, the position of intertidal zones shifts (rises). One can naturally anticipate that such changes will cause an influence over living organisms inhabiting intertidal zones.

As a result of rising sea levels, rises in intertidal zones along with its gradual shift inland will prompt the need for similar transitions by mangrove plants, which will move in search of more favorable environments. The balance between the respective speeds of the rise in sea levels and the movement of mangroves (speeds with which viviparous seeds are implanted further inland to generate plants, or the shifting of distribution areas through the generation of new mangrove plants and communities by the extension of roots and stems further inland by landside plants) remains a source of concern. Negative effects will appear in the event of slow speed of mangrove growth or in case of presence of obstacles blocking the mangrove transition.

It has been said that mangroves are slowly moving inland, although this shift is occurring in very small degrees. Reasons that account for this are the accumulation of rock and sand sedimentation from upstream regions and nesting activities of *Thalassina anomala* (Fig. 8.13). *Thalassina anomala* live underground, but as a result of their burrowing and habitat extension activities, their nest mounds often protrude outwards through holes found beneath the earth (Fig. 8.13, right). Occasionally, giant mounds of more than 1 meter in height can be observed, suggesting that these areas will eventually be transformed into land. In fact, the photographs in the figures indicate that land plants are already growing on top of the mounds made by *Thalassina anomala*. In such cases, there is a need for mangroves to move outwards to the sea.

A difference in the balance between the speeds of land formation and rise of sea levels will affect the future well-being of mangrove ecosystems, although such developments may not be easily forecasted.

Figure.8.13. Mounds formed by *Thalassina anomala* found in the mangrove forest in Ngiwali. New portions of mud are ejected through the hole on top (indicated by the arrow), which means that the *Thalassina anomala* are active in the inside. (Prof. Makoto Tsuchiya)

8.3.5 Correlations of Ecosystems

Early observations of coral reefs and mangroves found in the Republic of Palau begged the question of the types of influences that the existence of vast mangroves had on coral reefs. As seen from Fig. 8.12, a large portion of shorelines are surrounded by mangroves that stretch inland to river mouths and regions up to 1 km upstream. Taking this into consideration, it can be seen that massive quantities of fallen leaves affect the quality of surrounding waters and bottom sediments while generating a relationship with the life activities of living organisms that inhabit river mouths and coastal zones.

In half-closed river mouth environments such as the ones seen in three of the project team's survey sites (Section 6.3 of Chapter 6), fine particles and organic matter that flow down from terrestrial areas and mangroves accumulate to create unique environments that exert a possible influence over biota.

Golbuu et. al., 2003 investigated sediment behavior in half-closed environments of river mouths in the Ngerikiil River in Airai State (which served as a survey site for this project) (see Fig. 6.39). While watersheds in this area maintained comparatively good environmental conditions up until the 1970s, construction of the International Airport in 1978 and 1982, together with lowland agriculture that was particularly popular in the 1990s, aggravated soil runoffs (Fig. 8.14), causing sea bottoms in estuarine regions and coastal zones to be enveloped with fine sediment, and affecting the well-being of coral reefs. In addition, the clearing of forests that intensified after 1997 triggered soil runoffs that were said to have reduced visibility in river waters to near zero. Golbuu et. al., (2011) established six observation points between the river mouth and the area close to the outer peripheries of coral reefs to measure a variety of environmental conditions and survey the state of accumulation of fine particles. Due to short river distance, at times of precipitation fine particles that flow out from rivers are transported to river mouths

and coastal zones within a matter of 12 hours. Taking into account the shape of the bay, this research concluded that only 2% of sediment particles that flow out to estuarine regions are transported to outer seas while the majority remains within the bay, contributing continuously to the accumulation of sedimentation. The amount of sedimentation that gets accumulated was estimated to reach 20,000 tons in a year. Research findings also pointed to the fact that freshwater flows on the surface and out beyond the bay area within five days.

Figure.8.14. Red soil runoff during rain.
(Prof. Makoto Tsuchiya)

In Golbuu et. al., (2011), sedimentation process of fine particles and turbidity dynamics of watersheds in four terrestrial areas of differing degrees of development on Babeldaob Island (Diongradid Bay, Ngermeduu Bay, Ngerdorch Bay, Ngerikiil Bay) were researched. It was found that sedimentation of fine particles for every 1 km^2ranged between 29.7 to 216 tons annually, with areas of higher levels of development exhibiting more quantities of sedimentation. Similar findings have also been presented in research by Victor et. al., 2004.

With regards to coral reefs, an example that allows for the ostensible understanding of the link between terrestrial areas and coastal zones is the death of corals from sediment particle outflow. There has also been examples of research which report that outflow of sediment particles have had an effect on living organisms in coral reefs found in the Republic of Palau (Fabricius et. al., 2007). During time periods when effects of sedimentation outflow were observed in coral reefs, the quantity of accumulated microscopic particles was found to be 39.6mg/cm/day, while the extent of effects on coral reefs was reported as being dependent on the type and species of living organism.

8.4 State of Watershed Management Based on Sustainable Land-Use

8.4.1 Perspectives Adopted for Consideration

The presence of healthy ecosystems as a precursor to the establishment of healthy economies and societies is a universal awareness. All countries of the world are heralding the “Age of the Environment” by making the transition to economical and social systems that are based on ecosystems. As such, even with regards to the structure of the Palau Integrated MPA Model, integrative research needs to be conducted on the overall protection of watersheds based on the construction of sustainable MPA models that regard marine and terrestrial areas as a single set. Upon taking into account various examples across the globe, it has been proven that development of terrestrial areas has a certain extent of influence on marine areas. Therefore, the correlation between terrestrial areas and coastal zones that was discussed in the previous section is of significant importance. Marine areas must be considered together with terrestrial areas in order for it to be adequately protected. In addition to marine areas, watersheds (which include terrestrial areas) should also function as the unit of consideration. At present, Protected Areas have been established in 28% of coastal marine areas and 2% of terrestrial areas in the Republic of Palau. As

the percentage of Protected Areas in terrestrial areas remains low, its further expansion remains as a task for the future.

In order to expand the amount of Protected Areas in terrestrial regions, it is vital to guarantee collateral for lands. For the purpose of passing on a sustainable country and local regions to future generations, important areas must be singled out for environmental conservation. National and state governments must purchase said lands and maintain public ownership, and establish Protected Areas (regulating land use). Measures should also be implemented to manage commercial ownership of lands (through the National Trust etc.) and set out blueprints obviating non-sustainable development of land.

The establishment of Protected Areas leads to the imposition of controls over ways of conduct and activities that may require endurance on the part of the present generation for the sake of generations in future. However, from the perspective of ensuring environmental education for the people of Palau, it may be useful to utilize the principle of teaching by negative example. The Republic of Palau may learn how environmental conservation leads to sustainable development for the country in the long run by looking at numerous examples found in Japan that exhibit the damages of unrestrained development. At the same time, proposing policies that ensure a balance between environmental conservation and the development of regional economies is also a good way of promoting the further establishment of Protected Areas.

8.4.2 Organization of Tasks and Agendas

1) Prerequisite Information

In order to implement sustainable methods of managing watersheds that include coastal zones, there are a number of prerequisites that have to be met. Here, these qualifications are summarized into the following three conditions:

- The need for the formation of a network of Protected Areas containing both terrestrial and marine areas has been confirmed for the case of the Republic of Palau.
- Financial funding mechanisms for the purpose of conservation initiatives are already established in the Republic of Palau.
- The Republic of Palau has completed its selection of MPAs and is now in the process of implementing actual establishment of designated MPAs. The establishment of new MPAs is not being sought for the moment.

2) Perspectives for Future Tasks

The following perspectives are important when progressing with tasks for the future:

- The Republic of Palau has succeeded in securing sources of funding. Issues with regards to this aspect still remain for other countries and jurisdictions in the Micronesia region.
- How the Republic of Palau may serve as a successful case study of the Protected Area model to be applied to other countries and jurisdictions in the Micronesia region remains an issue for the future.
- However, even within the Micronesia region, conditions for the Republic of Palau and countries such as RMI are different. As such, whether the model of Palau can be applied fully to other territories requires further consideration.

Volcanoes in the Republic of Palau are dormant, and in its surroundings, there are barrier reef type coral reefs that have formed deep lagoons, as well as a portion of fringing reef type coral reefs. In contrast, the RMI and other territories mainly have atoll type coral reefs. Other nations and territories also do not have landforms like the Republic of Palau, which is composed of mountains and rivers. They also possess no clearly defined watersheds and landform environments are also significantly different from that of Palau's. In particular, at the Majuro Atoll, environmental problems that are different from those seen in the Republic of Palau such as polluted waters (human sewage etc.) within lagoons, receding shorelines due to rising sea levels, reduction of agricultural lands due to shrinking freshwater lens and salination of well water are exacerbating. As such, there is a need to consider if Palau's terrestrial area-inclusive model is fully applicable to the respective situations faced by different countries and jurisdictions in the Micronesia region. While this project report puts forward the "Palau Integrated Coastal Management MPA model," it is hoped that applicability to other regions is undertaken upon the consideration of the target region's specific environmental and local conditions.

3) Integrated Conservation of Ecosystems

When considering Palau's coastal management techniques together with the establishment of MPAs, it is vital to conduct discussions that include deliberation on terrestrial areas for the assessment and implementation of integrated management policies. It is anticipated that discussions on early measures will be conducted while paying attention to the following issues:

- The establishment of Protected Areas for terrestrial areas has been delayed in the Republic of Palau. There is a need for integrated management plans that take watersheds into consideration.
- Policies to guarantee collateral for land (such as the National Trust etc.) are necessary as part of public-private cooperative methods for the establishment of Protected Areas.
- Measures to alleviate the shortage of urban city planners and other specialists to segregate areas for development and conservation purposes.

For the purpose of protecting terrestrial areas, national and state governments may utilize methods as nationalizing land ownership (establishment of publicly-owned lands), setting up of Protected Areas and allocation of rights to land to commercial entities (through the National Trust etc.). However, the most suitable method must be selected based upon the understanding and consolidating of information on local legal systems and various other official procedures (*In addition, plans for the utilization of Protected Areas must be aligned with conservation and preservation measures that take into account actual regional conditions).

8.4.3 Determining Problem Areas and Researching Watersheds

1) Tasks within Model Site

Findings from surveys conducted at the project's three model sites (refer to Chapter 6) were reviewed together with the process of identifying problem areas. Task contents are as follows:

- Mapping of information concerning natural conditions: Obtaining of cartographic information, ascertaining vegetation, water systems, watersheds, etc.
- Mapping of information concerning social conditions: Obtaining of cartographic information, ascertaining land

utilization such as roads and residential communities.

- Site survey (ascertaining general conditions by car and boat): Identification of agricultural land and man-made structures beforehand to ascertain conditions surrounding land use. Surveys were carried out by paying particular attention to wild birds, which are a major species of wildlife within terrestrial ecosystems.
- Information from both natural and social conditional aspects, especially information on the location and regulations of Protected Areas, as well as legal systems concerning regulations on development (environmental assessments etc.) will be used to carry out present data analysis. Assessment of the following items is desirable:

2) Summary of the Integrated Ecosystem Conservation Model

Important steps in this process include selection and identification of crucial areas within watersheds, setting of zoning plans that determine core and buffer zones, formulation of plans that serve to conserve and preserve Protected Areas while deciding their management and utilization. Models should be set as examples but specific operations must be carried out at the same time. It is also anticipated that large numbers of relevant personnel can engage in discussions to propose desirable policies for environmental preservation and land utilization programs, as well as countermeasures for surface soil runoffs, and ultimately put these plans into practice. (Fig. 8.15).

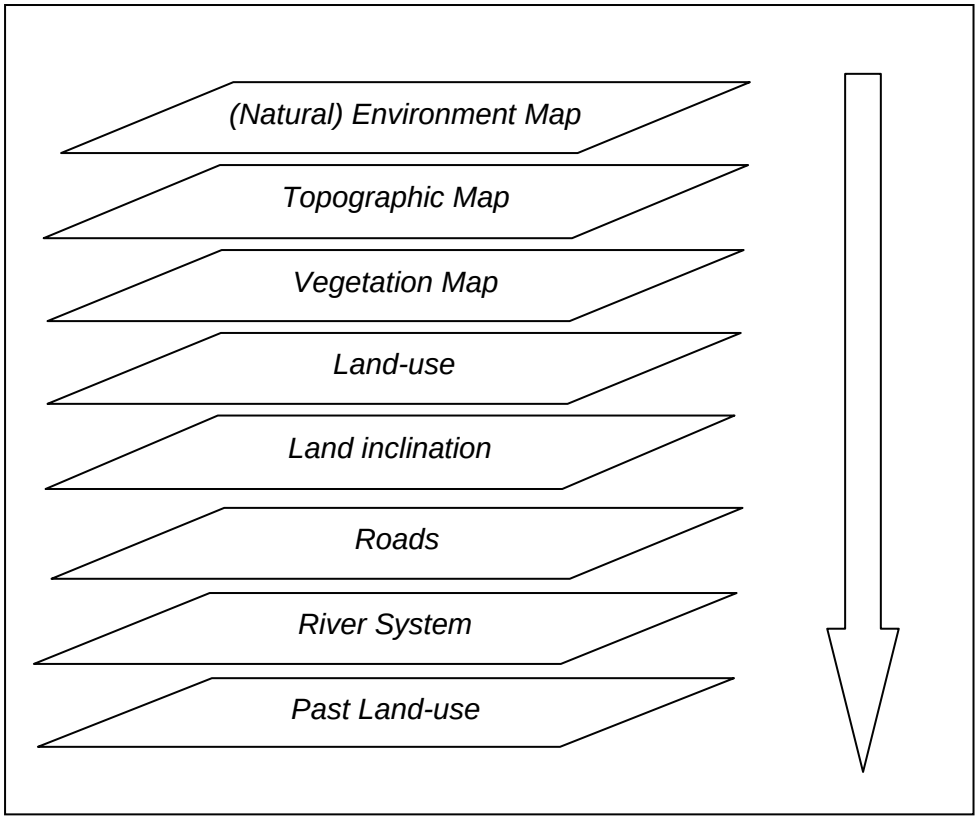


Figure.8.15. Sustainable Land Use with GIS Data. (Ecosystem Conservation Society-Japan)
In order to determine regional environmental conditions, existing data and information such as vegetation maps and shifts in land utilization conditions in the past and present were collected and superimposed with the Natural Environment Map. Through this process, various forms of regional information are consolidated into materials that may be utilized for regional analysis and assessment of plans for the establishment of conservation areas and sustainable utilization of land.

3) Land-Use Plans and Watershed Management

The Republic of Palau is an oceanic nation made up of 550 islands large and small. It has a population of approximately 20,000 people, 70% of whom resides in the former capital state of Koror. In 2006, the capital of Palau was moved to Melekeok State in Babeldaob Island, Palau's largest island. Using funds provided by its former ruling nation, the United States, Palau hired a Korean construction firm to construct an almost complete loop road known as Compact Road on Babeldaob Island. In recent years, natural and social environments have been undergoing transition.

In review, while it is unknown how much unspoiled and rich natural ecosystems and biodiversity existed on Babeldaob Island in the past, the three model sites selected as survey locations for this project each have terrestrial areas that are covered by tropical forests and extensive mangrove growth in estuarine regions. In coastal zones, model sites were observed to have abundant seagrass beds, which are the main source of food for dugongs, and also extensive coral reefs with large numbers of colorful tropical fish. However, it becomes a source of extreme concern when the types of future effects that will impact the environment as a result of the building of Compact Road, whose construction required the clearing of forests and reclamation of reefs, and the progress of further roadside development, are considered. While concrete outcomes could not be determined due to the short time frame of the survey, various areas of the project team's main survey site of Babeldaob Island were observed to serve as habitats for a diverse range of forest, grassland and waterline bird species, as well as an abundance of indigenous species and many types of migratory birds as a result of Palau's status as an island nation. However, population sizes were small, suggesting a certain extent of influence from man-made land utilization (development of agricultural land and construction of Compact Road). Further attention needs to be paid to findings from continuing research by Dr. Alan Olsen of BNM and Mr. Milang Eberdong, both of whom kindly lent their assistance to this project's surveys in Palau.

Amongst Micronesian countries, the Republic of Palau levies international travelers with a 15 USD departure tax known as the Green Fee, the proceeds of which are allocated as funds for environmental conservation initiatives. Palau can be said to be a first-world country in terms of environmental policies; funds from the Green fee are channeled to the respective state government for utilization in conservation efforts for 30% of coastal marine areas and 20% of terrestrial areas that have been designated as Protected Areas. While conducting the project, the team members had the opportunity of having dinner with the Speaker of the House of Delegates of the National Congress of Palau. Asked about the most urging problem in Palau, the Speaker replied that it was the issue how to activate the Palauan economy. The project team hopes that proposals for sustainable development, as well as concrete projects to further those ends continue to be implemented in the future.

8.4.4 Towards Sustainable Land-Use

As the world is on the cusp of heralding the age of environmentalism, the global trend has been to pursue sustainable development for the creation of a sustainable society. In addition, there is also a global consensus on how healthy ecosystems are necessary for the establishment of a healthy society. In other words, the idea that sustainable development in the Republic of Palau serves to preserve and rebuild healthy ecosystems has become an important theme. Ideally, there is a need for the national government to acquire 60% of total national land area, of

which at least 50% should be placed under public ownership for the purpose of protecting natural ecosystems. In order to achieve this, the project team, with the cooperation of the national government of Palau and other state governments, is working towards the materialization of future projects to practically assess effective methods of preserving lands one watershed at a time.

With regards to approaches to managing watersheds that are derived from sustainable land use, thoughts from the UNESCO Program on Man and the Biosphere (MAB program) will be presented and utilized as explanation in this section.

- Core areas consisting of large masses of untouched nature should be preserved and passed on to future generations by designating them as strictly “No Take” and “No Entry” Protected Areas.
- Utilization regulations and limits for buffer zones must be set and all activities that obstruct environmental protection must be banned. Buffer zones for the regeneration of nature should be established and in its surroundings, land utilization spaces similar to the concept of *satoyama* that is based on traditional lifestyles should be preserved as transition zones that maintain and improve the various functions of natural ecosystems and ecosystem services.
- Buffer zones in respective core areas must allocate spaces by taking into consideration landform characteristics such as rivers, shorelines and mountain ridge lines. Ecological networks that make it possible for the transition of animals with large migration distances must also be constructed.
- With regards to land utilization for urban areas, usage purposes should be centralized and made more compact. Lessons from Palau’s past, when there was great respect for traditional culture, closely-knit communities and humble lifestyles, should be taken as an example. Values that are placed upon the richness of the heart are believed to be the key to achieving the creation of a sustainable society.

Column What do Palauans think?

The project team members had the chance to brainstorm with Mr. Joseph Aitaro, the director of the Bureau of PAN, Ministry of Natural Resources, Environment and Tourism. Mr. Aitaro grasps best the current situation in the Republic of Palau and was kind enough to share his views with the team members.

Q. What are the issues that Palau is currently facing?

A. It is necessary to clarify what important natural resources are located where, and what is the economic value of Palau's nature.

Q. What are your views on the "sustainable development" in Palau?

A. It is important in order to form a nation based on a sustainable society. Therefore, it is necessary for the communities to realize the value of nature.

Q. What do you think about the small number of the terrestrial protected areas?

A. Approximately 6.5% to 6.7% of Babeldaob Island is designated as terrestrial protected areas. There are 10 communities (states) on the island, and as much as it is necessary to draw up plans for the proper use of land for each of these communities, I don't think this process is advancing in a satisfactory manner.

Q. What is necessary for the proper land use of terrestrial areas?

A. It is important to define and clarify the value of natural heritage. Moreover, due to the unclear situation, disputes over land ownership between the government and private citizens are common. By clarifying the land value not from the social, but the environmental perspective, spontaneous development can be avoided.

Q. What does the Republic of Palau expect from Japan?

A. We would appreciate (attempts on) putting into practice methods of sustainable ecotourism, using the pilot project to conduct the assessment of the concrete economic value of natural resources. Further, establishing terrestrial and marine protected areas one by one, so that they could serve as yet another model, would also be appreciated.

Q. Do Palauans already realize and practice it?

A. The national government and businesses profiting directly from the tourism industry in Koror State realize this, but this is not the case in other regions. Palau is an island country rich in nature and culture, I would regret to see it turn into a place like Guam, Saipan or Hawaii, where people come to shop to.

8.5 Social Realities and Hopes Concerning MPAs in the Republic of Palau

8.5.1 Social Backgrounds

1) Co-Governance in Palau Concerning Assistance for MPAs – Nation Building in Palau and Post-Colonial Cooperation

One of the strongest impressions that the project team gained from its surveys of MPAs in the Republic of Palau is the presence of robust co-governance. Co-governance refers to the powers of governance held by citizens themselves, and represents local communities, government administrative units in and outside of regions, private corporations, educational institutions, NPOs and NGOs as well as international organizations coming together in a consolidation of collaborative effort.

Within the Republic of Palau, there was favorable public sentiment during the start-up phase of the Green Fee against the backdrop of steady inflow of financial aid. While there was a degree of variance to the level of spontaneity, the presence of public agreement and action was clearly palpable. A high-quality and regulated implementation mechanism was established by a network of socially-related capital consisting of relevant government personnel, members of regional management, as well as NGOs.

Such collaborative structures serve as points of reference not only for other Pacific island countries, but are also useful in discussions surrounding measures to ensure a balance between the environment, marine industries and tourism also in case of Japan. However, it is pertinent to note that mechanisms seen in Palau are structurally different from those found in the Micronesia region and Japan. If similar outcomes were to be anticipated, it would be problematic to simply import existing methods and organizational development know-how in expectation of comparable results. It is therefore crucial to first understand the background of social structures within Palau.

While the significance of the Micronesia Challenge Initiative, an ambitious plan targeted at the entire Micronesia region, should not be denied, expectations of ripple effects from such an initiative requires not only efforts to ensure applicability, but also the need for an awareness and understanding of biodiversity.

Spread effects from policies to maintain ideal marine environments and ensure sustainable quality of marine, environmental and tourism resources led to fundamental improvements to the level of marine and environmental policies within the Micronesia region. Through the creation of socially-related capital, it also generated spiral effects in the form of a model of co-governance that completely fused with the structure of existing traditional societies and gave rise to a new sense of national and regional pride. In order to further enhance the successes witnessed in Palau, an integrated and specific investigation into possibilities for added support that involves an accurate understanding of Palau's social structures, together with a review of the elements that ensured success for the nation's environmental policies, is necessary along with rectification of existing problems large or small.

The following five points are crucial for consideration (including a presentation of hypothetical problems):

① Elements within Palau's social and cultural background conducive for co-governance

One reason to account for the success of the co-governance model seen in Palau is its historical background. More specifically, the social nature of Palau before the Japanese Mandate Era and the accumulation of influences

from the period of Japanese rule should be given particular consideration. Elements to aid our understanding can also be found within Palau's traditional culture.

【Bull】

The controlled system of taboos known as "Bull" needs to be considered because it functions as an important background.

Bull is a complex structure of rituals and practices of chiefs, local communities and clans. It has been said that the nature of MPAs from a general expanded interpretation is in itself the very extension of the system of *Bull*. However, systems of the past were limited to certain periods and subjects, and carried great gravity because the basis of the economy, upon which people's lives depended, was wholly reliant on the biological productivity of marine and terrestrial areas.

【Palauan Money and the Elevated Social Status of Women】

Palauan money is the symbol of the matriarchal system of society and represents a system of responsibility borne by families on the male side for rites of passage for women such as births and deaths (Palauan money is not a form of currency but rather decorative stones used as necklaces. Each stone is believed to contain stories that are passed from generation to generation, and these stories are thought to possess value).

In particular, marriages, the birth of one's first child and funerals are of significant importance, and women would wear Palauan money inherited during important rituals and ceremonies. The social movement and ostentatiousness of Palauan money serves as a symbol of a family's social status and represents political power within a matrilineal system of society. Palauan money is also used to signify succession of new males to the position of chief and is utilized in reconciliatory negotiations for problems that occur between different villages.

The elevated position of women, accompanied with respect for their rights, suggest that women are more able to assume positions of authority within the realm of environmental education and come forward as pro-environmental practitioners. In fact, it can be said that the high level of understanding displayed by women to MPAs, together with the large number of females involved in NGOs, NPOs and government administration as well as their strong commitment, have greatly helped to set the right directions for the model of co-governance seen in Palau.

Palauan money is similar to the Rai stones in the FSM state of Yap in serving as indicators of social status within villages and functioning as ceremonial items of offer during rites and rituals. Palauan money is also used during private ceremonies and as items that identify the types of personal relationships and status structures within a single family.

Figure.8.16. Palauan Money (Etpison Museum). (Prof. Shunsuke Nagashima)

【Economic Rights and Responsibility】

Men of the same family are entrusted with the responsibility of providing economically for their family members and awareness of such a responsibility brings forth a sense of diligence and industriousness. Men who are unable to provide money, ceremonial items or special foods during rituals commemorating rites of passage for women are considered as bringing shame to their families. To prevent this, men without adequate economic abilities are supported by their sisters and other families on the female side. (Conversely, men who have been deceived and shamed by women are stripped of their political powers.)

Palauans are known as “Jews of Micronesia” because of their image as hardworking, conscientious workers with financial capabilities (seen as possessing the gift of business). The diligence of Palauans was demonstrated in the form of strong academic desire and assiduousness during the Japan Mandate Era, and still continues into the present day.

In light of such social and cultural backgrounds, monetary incentives can be seen as a useful tool in the tackling of environmental problems. Such a function works within a structure of providing support for one’s village and family, and is a role that is separate from one that involves the exchange of money within a system of commercial production. It thus follows that personal and economical activity-based utilization of MPAs in the Republic of Palau is limitative and restraining, and serves as an incentive in the form of the receipt of money by local communities.

In other regions such as the FSM state of Chuuk, monetary incentives concerning the economic activities and benefits arising from a family’s possessed lands are useful on both a personal and familial basis. In contrast, the perspective of preserving local communities is particularly important in the case of the Republic of Palau, and the presence of a social background that points to the existence of a socially-restrictive system governing the use of resources of common lands should not be overlooked.

Figure. 8.17. Example of a funeral.
Funerals are usually attended by about 500 relatives and kin, and may function as a transfer of social status (succession of position of chief for men, transfer of social status, Palauan money and cash for women). Amounts of money to be paid by relatives are accurately calculated and the total amount paid by each family is announced publicly. (There is also indirect participation through overseas remittance of money.)　Proceedings of funerals are conducted in a methodical fashion. (Prof. Shunsuke Nagashima)

Figure. 8.18. At funerals, relatives from the male side present offerings of cash and food (ingredients), which are prepared by women. This dichotomy of giving and preparation reinforces family relationships and friendships while constructing inter-personal relationships (particularly power relationships of persons of authority).
(Prof. Shunsuke Nagashima)

② Post-colonial cooperation

Post-colonial cooperation is Palau's fundamental economical structure and functions as the motivating factor behind MPAs.

The economical system of the Republic of Palau is similar to those seen in FSM and RMI, and remains unchanged as an economy based on MIRAB (Migration, Remittance, Aid, Bureaucracy). As the socioeconomic structure of dependence on Compact money within the Republic of Palau is not as strongly prescribed as the situations in FSM and RMI, Palau's economy has been supported by its position as an export base for marine products such as tuna and its reputation as a center for diving blue tourism.

The above serves as motivation for the establishment of MPAs on two levels.

High quality natural marine environments characterized by beautiful and serene coral reefs are attractive destinations for sports and recreation, leading to increased foreign earnings of MPAs that function as tourist sites. Such success serves as feedback to increase desire for the further establishment of additional MPAs.

③ Human Resources within the Republic of Palau

One of the reasons to account for enhanced co-governance is the system of higher education in the United States and the lifelong involvement of US Peace Corps personnel permanently stationed in Palau.

There are many qualified people in Palau who pursue tertiary degrees in universities located in Guam, Hawaii and the United States mainland after completing high school and junior college in Palau. In addition, there are many young American volunteer Peace Corps members in their 20s who come in assistance of Palau's national development and eventually settle in the country at the end of their assignments, marrying members of the local community. It is not uncommon for these ex-Peace Corps members to join NGOs and private organizations as an extension of their past activities and experiences. As such, the bureaucratic practice of hiring expatriates is rarely seen in Palau.

④ Political Leadership, Foreign Assistance and Autonomous Sources of Finance

In Palau, political leadership, foreign assistance and newly formed autonomous sources of finance are conditions that have begun to support co-governance within the country.

The Micronesia Challenge Initiative was a universal declaration announced to the world by the President of Palau. Within this framework, the levy of an environment utilization fee (the Green Fee) can even be regarded as a

proactive, counterproposal at a time when the world is facing problems brought about by global warming. Under such conditions, coral reef regions and countries may be expected to assume a victim mentality and issue public statements that underscore their positions as countries that require protection and assistance. However, Palau's declaration was a counterstrategy that emphasized oceanic and environmental quality, as well as its right to progress and advancement. A reflection of the PPP (Polluter Pay Principle), a principle that stresses the need for beneficiaries to bear responsibility, the declaration received glowing assessments for its positive and forward-looking agenda.

⑤ Environmental management and spontaneous powers of governance

Through the actual research of many relevant personnel members concerned with MPAs in the Republic of Palau, one forms the impression that MPAs exist ostensibly within local communities. Although a relatively new keyword, it is gaining acceptance as a source of pride for local residents. In addition, that sources of conflict and friction have yet to surface amongst the various stakeholders is of deep significance. Although there exist people who engage in petty acts of transgression, there do not appear to be incidences of protest or anti-MPA movements even when such acts are apprehended by patrol forces.

Citizen awareness with high levels of governability (spontaneous powers of governance) and the cooperative forces of social capital that support it, result in the generation of a regulated and natural system of co-governance. One of the most representative examples is the comparatively low output of waste from Palau as compared to those of other neighboring countries.

Palau's waste disposal facilities (waste dumping sites) incorporate the Fukuoka method that was introduced by the Japanese government a number of years ago. This method involves the pumping of air beneath cover soil to remove odor and aid in the breaking down of waste. In October 2011, a deposit system for canned drinks was introduced with the assistance of JICA, which helped to prevent the littering of empty aluminum cans. Litter was also rarely seen in mangrove forests and coastal zones, and there was also little floating matter found in lagoon waters.

Figure. 8.19. Waste disposal facility in city of Koror State (Prof. Shunsuke Nagashima)

In contrast, a significant amount of floating matter was observed inside atoll reefs found in the FSM state of Chuuk. Much of this waste consisted of daily items that can easily be segregated for proper disposal. In addition, waste appears to build up in uninhabited islands where large traces of human inhabitation can be seen. On Picnic Island that is situated next to the state capital, larger accumulations of waste can be seen during weekends.

Within the Republic of Palau, the background behind successful waste disposal management can be attributed to the high level of awareness amongst regional residents and citizens towards the effective use of technical assistance.

This may fundamentally be linked to Palauans' national character, which is inclined towards the maintenance of transparent ocean waters and oceanic diversity.

Figure. 8.20. Post-colonial and island MPA cooperation (1)
During the President's inauguration ceremony in 1981, influences of Japanese rule stood out in areas of industrial and cultural development. (Prof. Shunsuke Nagashima)

Figure. 8.21. Post-colonial and island MPA cooperation (2)
The ceremony that commemorated Palau's independence in 1994 saw Japanese style toasting and active participation by Japanese citizens (from the Embassy of Japan in Malaysia) (Prof. Shunsuke Nagashima)

Figure. 8.22. Post-colonial and island MPA cooperation (3)
Taiwan participated in the 1994 ceremony commemorating Palau's independence. Korea also took part in the building assistance for the National Capitol Building = Presence of post-colonial cooperation
(Prof. Shunsuke Nagashima)

8.5.2 Comparison of MPAs in the FSM States of Yap and Chuuk

1) Regulation of MPAs and Private Ownership in Chuuk State

While the establishment of MPAs has begun in FSM, this process takes on separate characteristics for different states. In a survey conducted in Chuuk State in August 2011, maps indicating clear demarcations for MPAs could not be found. Even through observation of detailed maps, one could only determine imprecise core MPA areas and the location of its surrounding outer zones. According to the interviewed personnel in charge of MPAs, information on locations of MPAs is “not meant to be publicized. Defining areas that are part of MPAs and those that are not will lead to the problem of fishermen trespassing into privately held lands within designated MPAs. (However, specific maps may be given after official procedures for application are taken and a non-disclosure agreement is reached.)” This problem involves the daily fishing activities performed by women in lagoons, which is a unique practice found only in Chuuk. In Chuuk, it is traditional for women to engage in fishing in the shallow seas, and this occasionally leads to health problems (cases of cholera etc.).

Traditional MPAs still exist, and areas owned by families (clans) are governed by systems of land use and taboos. However, while environmental stability is maintained by fishing limits (harpoon fishing is the main type of fishing activity), awareness concerning rights to personal ownership are growing along with widening usage for commercial purposes, leading to swift changes to social conditions. For example, women harvest marine resources by diving or fishing at the shores of small islands, and sea cucumbers are processed on uninhabited islands. Daily fishing activities are carried out by men outside of small islands and also uninhabited islands, after which daily catch is packed with ice purchased from the state capital and shipped out the following morning. Compared to Chuuk State, the level of commercial fishing activities in the Republic of Palau has significantly lesser vitality.

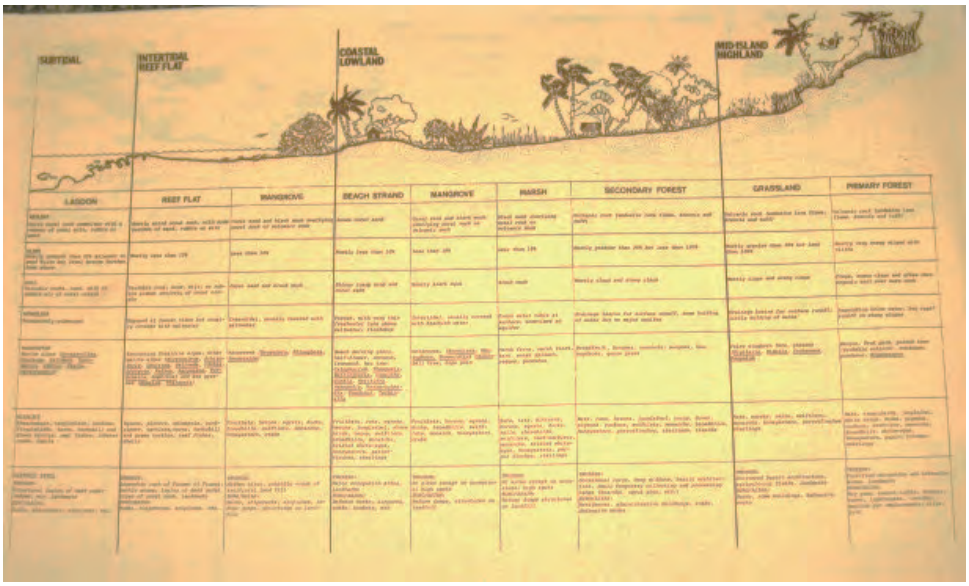


Figure. 8.23. Example of ownership and utilization from ridge to reef in Chuuk State
Land utilization map made by Chuuk (Udot) trust government. Exercise of individual rights over possession and utilization differ from island to island, but such areas commonly extend more than 200m from shorelines (regulations are limited concerning fishing activities inside lagoons by women).

2) MPAs in Yap State

In recent years, MPAs have begun to be formed at a rapid pace through the cooperation of communities (corresponding to states in the Republic of Palau) and adjacent lands, while an extremely limited number of state-level (corresponding to nation in the Republic of Palau) MPAs are starting to be established in the outskirts of

community MPAs. Yap State only has one person in charge of MPAs, and research and reports are conducted by Palau International Coral Reef Center (PICRC), which is based in the Republic of Palau.

Upon visiting Kadai Village (even among the closed communities of Yap State, Kadai was the village that began charging admission fees to showcase traditional dance and is famous for the beautiful Stone Path), the project team was able to confirm the installation of nighttime underwater illumination in six locations (which were explained as having been installed for the purpose of monitoring no-fishing zones after dark, but in actuality appear to function more as fish collecting lamps) that was carried out under sponsorship of the EU. In addition, monitoring floats were also set up along waterways (where traditional and other general fishing activities are allowed). This installed equipment was located along the front of a tourist beach that provided excellent vistas of the sunset and views of tour boats and kayaks. MPAs extend from this point to a location several kilometers to the northeast, but there have been rumors of the acquisition of a beach by foreign Chinese capital, and reclamation for the construction of an offshore pier is already in progress. The tense relationship between tourism, environmental protection and securing of marine resources is rapidly showing signs of exacerbation.

Figure.8.24. Remains of a stone currency mining site at Rock Island in the coastal region of Airai State. Stone mined here was exported to Yap. When land ownership changes take place in Yap, stone money is offered together with actual cash to conclude the transaction. Such practices are seen even until today.
(Prof. Shunsuke Nagashima)

Environmental management problems faced by Yap State that are concerned with the utilization of seas include strong demands by the tourist industry and vested interests (annual utilization fees are paid to villages) with regards to areas such as manta ray waterways. Manta ray bays are world-level tourist attractions that function collectively as a pillar of the Yap economy. Conversely however, MPAs in Yap State seem to be managed free from contradictions and appear to have been established as a way of providing support to the tourist industry. MPAs seen in Yap can serve as a suitable model and point of reference.

Originally, land ownership in Yap State extended from “ridge to reef” under a strong traditional system of control by chieftain leadership (in Chuuk State, a clan’s sphere of authority extended to an area located at a certain distance from reef centers). At present however, unused and abandoned mountainsides are on the increase, while tourist related demands are expanding on the ocean side. There are also plans to acquire lands that traditionally function as water sources for the construction of a golf course. The structure of conflict between groups led by community chiefs (pro-development) and those headed by members of society with a keen awareness of environmental conservation is becoming more pronounced.

At present, MPAs that revolve around such tense relationships do not exist in the Republic of Palau. However, tensions will ensue once tourism development (construction of golf courses in particular) gets underway. The situation in Yap State should function as a valuable lesson through which the importance of the issue of “ridge to reef” should be re-considered. Japan can be said to be facing common challenges as well, since much attention has been focused on the inter-connection between forests, rivers and seas, as well as problems facing watersheds, and also *satochi*, *satoyama* and *satoumi* in recent years. As the Republic of Palau may face the possibility of problems related to the development of tourism in the future, it is necessary to create rules to govern the consideration and prevention of such issues.

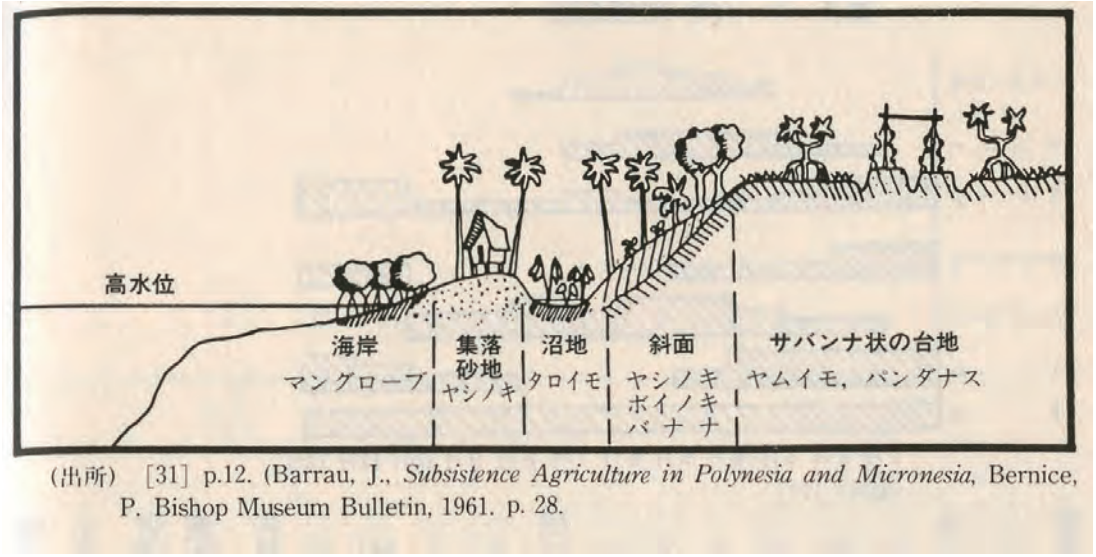


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Figure. 8.25. Example of ownership and utilization from ridge to reef in Yap State
Land ownership together with resource and environmental management, extend from ridge to coral reef interiors, in other words, across the entire area from upstream to downstream water catchment areas and into the sea. While sequential environmental management of terrestrial and marine areas is possible, undersea coast MPAs (cases of permission given to exceptional fishing rights in waterways) are the only areas subject to regulation at present.

3) Differences in establishment environments for MPAs between the Republic of Palau and in other Micronesian countries and jurisdictions

In earlier sections, Palau's society and the characteristics of MPAs found within the country were discussed with regards to the model of co-governance. In FSM and RMI, there is a limited number of NGOs geared towards environmental conservation. The powers of private-sector broadcasting, education, publication and printing are also weak. The same can be said for environmental research, as well as research and practicum facilities in junior colleges and other tertiary educational institutions.

Taking into consideration such differences in social environments, the introduction of the case study of Palau, in particular the background to its success (international assistance and formation of intermediary organizations) and its systems of management, is anticipated to be valuable in promoting the further establishment of MPAs in FSM and RMI.

8.5.3 MPAs in the War in the Pacific National Historical Park in Guam

Based on the Micronesia Challenge Initiative, the network for the protection of terrestrial areas and marine resources has spread to Guam and CNMI. In August 2011, the project team was given a tour by staff of the University of Guam of the Headquarters on Skinner's Plaza at the War in the Pacific National Historical Park in Guam (established on August 18th, 1978), which serves as practical site for the implementation of environmental protection measures.

The most satisfying and heartening discovery of the team's visit was the systematic organization of fundamental information concerning the historical park, although this could be due in part to the credentials and qualities of the personnel in charge. Team members also formed an empathic connection with the facility's commitment to expand the network of MPAs in the Micronesia region through the fostering of cooperation amongst various Protected

Areas found in other countries and regions. Shared information, literature, workshop materials and other related books were impeccably organized, and overall conditions were truly worthy as those of the MPA headquarters of Guam. While exhibition space was limited, there were materials linking Guam's situation to developments concerning MPAs in the Republic of Palau, as well as information on other different and enlightening examples found in other regions.

One of the approaches undertaken by Guam has been the establishment of the "Global Community Day." This is a program aimed at inculcating self-awareness as global citizens through activities such as volunteer clean-ups, beach cleaning and other environmental beautification campaigns. In addition to clean-ups by Girl Scouts and their families, there are also activities such as the painting of walls and walkways found within the War in the Pacific National Historical Park.

From January 2005, monitoring of sea turtles was initiated as part of hands-on activities by citizens for environmental conservation. Cooperation for such activities was sought from the respective coastal communities. Guam's approach in systemically accumulating results from environmental activities targeted at the entire island is one that may possibly be implemented in the Republic of Palau.

One of the most interesting activities seen in Guam was summer camps hosted by an organization known as "Reef Rangers". Camps are held in two sessions from 20th to 24th of June, and between 27th June and 1st July, and activities include learning from coral reefs, games and snorkeling. Further, initiatives by the Conservation Corps are held prior to the summer camps from 13-17 June to coach camp instructors on teaching methods and environmental conservation. The summer camps were organized after teenagers were invited to participate in exploration of marine resources of Guam.

Guam's approaches are different from those seen in the Republic of Palau and FSM, where the relationship between the nation, region, NOGs and residents is denoted by a top-down, vertical system of communication. Residents and schools are not identified as targets, instead the methods utilized in Guam facilitates spontaneous desire in individual residents and children through the process of questioning, which also fulfills the function of nurturing awareness of residents as "citizens." Such approaches are also worked into social education, the outcome of which is the further enhancement of overall awareness to environmental conservation.

In addition, Guam's juxtaposition of wars and MPAs is also unique. As Japan features dominantly in such themes, much of these materials serves as a form of reflection on past events and should be passed on to younger generations of the Japanese.

Caves, coasts, coral reefs and hilltops that were destroyed by imperial Japanese troops still remain in their tenuous condition to the present day. Caution has been raised about the danger of unexploded ordnance in locations where caves had been utilized as ammunitions chambers. This also applies to troops from the United States, as hills were scaled back for the construction of military bases. There are also exhibition materials on how wetlands in Saga Bay were permanently lost due to development of roads for military transport. At present, terrestrial and marine areas surrounding US military bases are under conservation after being designated as managed territories, and the historical park serves as a brilliant example as a Protected Area.

Figure.8.26. Activities for marine conservation in Guam. (Prof. Shunsuke Nagashima)

Guam, with its state of over-development, has differentiated itself from other Micronesian countries with its reputation for being the “pavilion of the ocean.” Gradually, past approaches of billing Micronesia as “the place to visit before it is lost to modernization” have given way to the inevitable acceptance of economic development in FSM and the Republic of Palau.

As a result of over-development in Guam, in addition to its large land area, problems of land and water sedimentation are serious and there is a pressing need to consider solutions to complex environmental damage by man-made causes. Urgent issues to consider include hydraulic power and sewage problems, recreational and improper uses of the environment, declining populations of wildlife and securing of shelters for wild animals, environmental damage caused by entry of off-road vehicles, pollution and damage caused by waste matter and materials, damage sustained by coral reefs due to over-populations of crown-of-thorns starfish, over-development, over-fishing, as well as climate change. As the Republic of Palau may come to experience similar issues in the future, the approach of the Micronesia Challenge Initiative in learning from the negative situations faced by Guam could serve as an effective method.

The project team also discovered the use of intriguing phrases as a form of historical experimentation, such as

“Chamorro’s stewardship” and “entrusted responsibility of the Japanese.” These phrases serve to address issues within the management of watersheds that include water cycles and pollution, debris and waste accumulation under management of watersheds, and calls for watershed management to consider filtering water that flows into marine areas.

Use of the phrase “calm before the storm” in relation to the concept of Chamorro has been observed. Although there have been no references made in relation to the Japanese, the Japanese are unmistakably the ones who brought the “storm” to Guam.

8.5.4 Possible Contributions of Education-Related Facilities as Social Capital

A signboard indicating assistance from the government of Taiwan (R.O.C.) for the MPA support project known as “Marine Sanctuary Project: Parrot Fish/Sea Cucumber” stands at a pier within an MPA in Ngaremlengui State.

Figure.8.27. A board of the support from the Taiwan ROC government.
(Prof. Shunsuke Nagashima)

In the vicinity is Palau Community College’s (PCC) PCC-Cooperative Research and Extension Multi Species Hatchery, which was established in 2010 with assistance received from the US Department of Agriculture (DOA). Breeding R&D programs by PCC’s Cooperative Research & Extension Department that were previously held at BMR’s facilities have now been relocated to these new premises. Research specialists from the Philippines work closely with local staff to facilitate transfer of technology, and conduct hatching and breeding of mangrove crabs and shellfish.

Such facilities are not direct government departments. It is crucial that they are undertaken and accepted as junior college and university bodies. This is significant in order to promote public benefit and technical advancement for the future, as well as boost marine resources found in MPAs.

Contributions of Japan during the Japan Mandate Era include introducing public school education, promotion of public health, as well as the experience of the rewards of diligence. The maxim of effort for success, and the experience of growth remain unforgotten in the minds of Palauans. At a time when the percentage of Japanese people in Palau accounted for some 70% of the total population of Palau, Japanese worked tirelessly alongside the people of Palau, guiding them through the learning of technology and skills and sharing the fruits of their common labor. Interaction with such human traits forms the basis of today’s pro-Japanese society of Palau. In addition, the conscientiousness of the Palauans and their high capacity and inclination towards intellectual learning can also be remotely traced to the influence of the Japanese presence in Palau.

Amongst the achievements of numerous projects undertaken by OFCF, favorable appraisals were given to the *uminchu* (fishermen) of Okinawa and fishermen from Hachijo Island, who maintained good relations with Palau by learning the local language, establishing contact with local residents with respect as fellow islanders, developing friendships by treating them as equals, as well as conducting a variety of other activities. Be it the sharing of techniques for fishing in the Pacific or the deepening of understanding towards coral reef environments, the relationships forged amongst these fishermen and the people of Palau signified shared common sensibilities as

fellow islanders, keen human ties and the spirit of cooperation towards a common goal. Such social capital in the form of relationships was also felt between the Filipino specialists and local staff members.

Social capital is a concept used within realms such as sociology, political science, economics and business management, and is based on the idea that active mutual collaboration among humans will lead to enhanced efficacies of society as a whole. The concept of social capital places an emphasis on social structures such as relationships of trust, norms and networks.

Relationships of trust between people and social networks refer not to vertical structures of rigid top-down human relationships, but rather hints at qualities of meritocracy and horizontal relationships between people. This includes trust, acquaintanceships and other social relationships and intermediate social groups (social groups found between the individual and society, such as local communities and volunteer organizations). In the United States, social capital became a concept of focus in the 1990s along with reflection upon social developments such as a decline of local communities and extreme individualism. Micronesian countries are intrinsically societies with deep attachments to social strata, and relationships with kin and local communities. The strengthening and deepening of bonds between people will form foundations of trust and lead to the development of technology.

To state the truth at the risk of being misunderstood, the Pacific island region as a whole suffers from both a present and historical lack of technology for the operation, troubleshooting and maintenance of machinery. Implementation of structured initiatives to address such problems is not progressing well. Within the Republic of Palau, a large portion of such work is left in the hands of specialists from the Philippines. As such, what is truly lacking in Palau is not advanced technology, but rather the slow and gradual introduction of tasks and challenges that will enable economic successes to be enjoyed amongst people, and the aspiration towards growth and improvement.

MPAs represent the environment and are a form of resource, and function as a tangible and easily understandable goal for national-level projects. In order for such objectives to be met, more effort needs to be made in secondary schools and technical colleges, as well as in educational curriculums, in order to introduce content that will instill future ambition and hope for growth. For that, the initiatives of PCC, which serve as an entry point to tertiary education institutions, should be assessed with a high degree of favorability.

Figure.8.28. Facilities of the PCC Multi-Species Hatchery. (Prof. Shunsuke Nagashima)

8.5.5 Environmental Education Concerning MPAs, Research Bodies and Japan's Involvement

While the high level of governance and thoroughness of publicity with regards to MPAs in the Republic of Palau are noteworthy, the following points should be taken into account in order to ensure sustainability and direction for future development.

1) Activity Funds for Public-Private Environment-Related Organizations

Considering Palau's population size, the cooperation seen between pubic and private environmental groups is highly substantial. However, the securing of funds for future activities, together with ensuring sufficient manpower, remain as critical issues.

While financial assistance under the Compact of Free Association with US (COFA) guarantees a certain degree of stability to received funds, this money is not dedicated to infrastructural improvements and environmental conservation, but is also allocated to civil servants and governmental organizations and therefore not meant as operation funds for privately-run groups. It thus follows that the Micronesia Challenge Initiative, with its potential for global dissemination of information and persuasion, is the next best strategy. It appears that the most persuasive approach to this initiative would be to have the Republic of Palau function as the base of operations and central authority for the entire Micronesia region.

Figure.8.29. Key personnel involved in public and private environmental organizations in Palau 1
Left: Meeting of Palau Environment Consortium Assembly (meeting of representatives of various environmental organizations) Center: Dr. Ann Kitalong, Belau National Museum (extreme left) Right: Anu Gupta, PCS (right)
(Prof. Shunsuke Nagashima)

Figure.8.30. Key personnel involved in public and private environmental organizations in Palau 2
Left: Mandy Eptison, Center: Mr. David Orrukem, BMR (far back) Right: Mr. Nakatani, JICA specialist (third from left) with a JICA volunteer (right) (Prof. Shunsuke Nagashima)

In addition to building for itself a strong central nexus, the caliber of publications, international cooperation and public administration personnel in the Republic of Palau has begun to surpass those seen in FSM and RMI in terms of quantity, quality and range. Research case studies from organizations such as PICRC are also on the rise. However, Palau has yet to reach a stage where it is able to dispatch and deploy technical specialists or take the lead in developing survey, instruction and application of research to neighboring countries and jurisdictions with differing regional conditions. The only exception is visual media, as Palau's broadcasting capabilities and cooperative dissemination of information can function as a mobile tool for the deepening of cooperation amongst regions.

For example, Oceania Television (OTV), originally a domestic broadcaster within the Republic of Palau, has begun to widen its broadcasting network to FSM and RMI with the advent of digital broadcasting, which has enabled it to reach audiences beyond the shores of Palau. Among OTV's program broadcasts are programs that are helmed by government personnel who expound the values and cultural background behind the establishment of MPAs.

Cooperation based on diversity will be enhanced if countries began consolidating information on a variety of case studies and research examples. Improved cooperation as a collective region will not only serve to allow for better understanding from other countries and international organizations, but also enable the promotion of "high quality utilization."

Recognition by external parties will also help to diversify funding sources for both public and private environmental organizations.

Figure. 8.31. Oceania Television's (OTV) studio and visual materials
From top left: Mr. Olkeriil Kazuo, OTV Marketing Director (seated front), Mr. Jeff Barabe, OTV President (second from right)
(Prof. Shunsuke Nagashima)

2) Enhancement and Promulgation of Science Education for Environmental Education

When considering MPAs, it is necessary to regard the relationship between marine and terrestrial areas, and think about terrestrial vegetation, while also promoting the development of such awareness in research.

In discussions with the Honorable Rehuher-Marugg, Minister of Community and Cultural Affairs, upon mention of the discovery of a new species of pandanus (*Pandanus doitoensis*) in Kita-Daito Island that resembles an existing species found in Palau (based on pre-war sources), which suggests the significance of intra-species exchange, the minister expressed the following. "Pandanus is an important part of Palau's tradition and daily life, and is widely used in the making of mats and artwork. It is my desire to see the establishment of an integrated museum that will include the classification of land plants. Since information concerning the sea has been greatly boosted by PICRC, the next challenge is information concerning land. The research and facility enhancement

functions of having a natural science museum are a crucial component of national policy.”

The establishment of research bases dedicated to terrestrial areas is helpful in creating links towards the development of consolidated management of MPAs that include terrestrial areas. It also bears future potential and the ability of appeal to external parties. Most importantly, this will serve as a hub for the nurturing and boosting of local researchers. The Indonesian Institute of Science (LIPI) serves as a good reference point in this regard.

As the first step to the realization of the goal above, researcher development programs at the Watershed Research Center and research facilities on traditional culture such as the Center for Promotion of Local Crafts can be incorporated as part of national policies on support for planned training of natural science curators. As a secondary step, networks with surrounding regions can be formed. Lastly, the conversion of natural history archives on terrestrial areas to research institutes or museums may be considered.

Figure. 8.32. Left: Ms. Rehuher-Marugg, Minister of Community and Cultural Affairs (second from the right) Center: Ms. Rehuher-Marugg explaining utilization of traditional lands and coastal zones, Right: *Pandanus hosimidan*, the new species of pandanus that is the object of anticipation concerning connections with Palau. (second from right)
(Prof. Shunsuke Nagashima)

The humble-looking Art and Tides Calendar issued by PICRC is also a notable development. Themes are set as learning content and objectives for children, who submit their drawings to the art contest organized as part of the calendar project, and winning artworks are selected for publication.

In 2011, a contest that was targeted at elementary, junior high and high school students was held based on the theme of “Living Organisms of Aquatic Plants”. With UNESCO taking the lead, the Palau Conservation Society (PCS) extended sponsorship to the event along with 14 other organizations. Calendars are sold mainly to tourists in Palau.

Figure. 8.33. The Arts and Tides Calendar (Prof. Shunsuke Nagashima)

3) Establishing Connections with Society and Methods for Promulgation

This involves the issue of overcoming the problem of current restrictions on science education. Academic

curriculums must address the issues of waste disposal, public health and also the problem of maintaining balance between sustainable life and economic affluence. How this can be achieved remains a challenge for the future.

Island territories provide the ideal environment for learning about the history of natural environments that are involved in human life. Island environments are an attractive research target because of their clearly defined territorial borders, the existence of the important theme of inter-relationships between terrestrial and marine areas, the possibility of comprehensive experiential research, as well as the ability to ostensibly ascertain outcomes and impact of pilot programs.

Uncovering the sequential connection between land, mountains and the coast, together with historical trajectories of co-existence with nature, are also highly significant. In addition to taking the example of Guam as a point of reference, the approach of weaving storytelling into educational programs could also be a method of boosting tourism and green tourism in which new values and increased employment may be developed. More than focusing on the resulting damages of development activities, the actions of consumers that cause environmental burdens to be augmented must also be revised. In particular, waste disposal management and optimal utilization of high quality environmental resources are necessary. Indeed, the wise use of nature and natural resources has come to be expected of producers and people engaging in agriculture. In 1998, the International Small Islands Studies Association (ISISA) undertook the Island Biodiversity declaration, of which ethno-biodiversity, which emphasizes respect towards local wisdom and time-treasured processes, served as a central concept. It is thus important for a region's social characteristics, culture and possibility for sustainability to be accurately reflected.

Figure. 8.34. In the Republic of Palau and other Pacific island nations with available land, taro is traditionally an important crop that serves as a main staple diet. (Prof. Shunsuke Nagashima)

With regards to the possibility of sustainability, the measure that needs to be taken up with urgency in the Republic of Palau and other small island nations in the Pacific is subsistence sustainability. The regional characteristic of eternal viability has given way to a decline in self-sustainability due to market-oriented economic reform, globalization and a way of thinking where high value is accorded to imported goods. Deterioration of self-sustainability also means a decline in the level of care put into *satochi* and other communal lands. The level of pollution impacted on downstream areas is limited when land is properly tended to and cared for.

In contrast, the productivity of regions that have a competitive edge remains significantly low. There is a need to revolutionize knowledge, effort and technologies, and carry out marketing for these areas. Without the opportunity of such transformations, there will be no viable future for the islands. In addition, there is also a need to think about the way to assess the present situation where islands are at the brink of facing a crisis of survival due to effects of global warming and ocean transgression. While it is vital to maintain a balance between the consolidation of

terrestrial and marine areas into MPAs with the wise economic use of natural resources, it is necessary to overcome the current sluggish pace of introducing reforms.

4) Understanding and Development of MPAs for the Nurturing of Global Citizenship

The need for an interconnection between civic education and environmental education is linked to ideas surrounding the responsibility towards consumer education. For example, the difficulties of reconciliation with existing hunting rights (however small or limited to a few specific persons) even under comprehensive regulations for the protection of dugongs is similar to the issue of whaling seen in Japan, where discussions are apt to be restricted to the realm of food and dietary culture. While time may help to resolve problems concerning user awareness and aid in the decrease in utilization by specified persons, there is a need to introduce measures that are more fundamental and more effective than the existing love-for-nature campaigns. It is crucial to advance towards establishing a connection with education that imbues a stronger sense of self awareness of global citizenry by espousing the rights and responsibilities of people as consumers. This will also serve as a breakthrough of limits to the narrow definitions of environmental education.

As part of the rights of consumers, people have the claim on enjoying stable and good quality environments as well as receiving of consumer education. On the other hand, responsibilities of consumers include the duty to consider and critically assess (not the act of criticizing, but a form of thinking that recognizes differences) the impact of one's actions on society through associated accountabilities of responsible action, engagement in actions of solidarity and consideration for the environment. Ultimately, this refers to the nurturing of a community that possesses accountability for the effects resulting from the actions of each individual within the group.

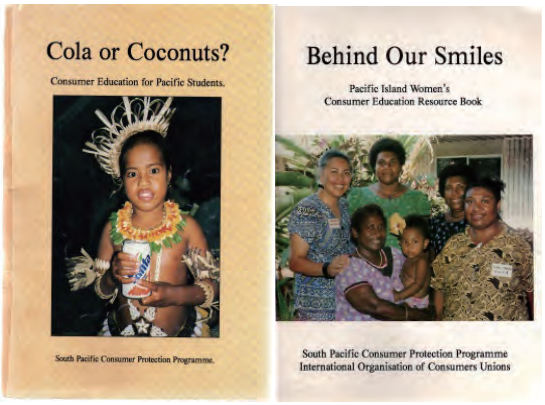


Figure. 8.35. "Cola or Coconuts?" and "Behind Our Smiles" (Prof. Shunsuke Nagashima)

In the Republic of Kiribati, materials for consumer education titled "Cola or Coconuts? - Consumer Education for Pacific Students, South Pacific Consumer Protection Program" (Consumers International Support Project) have been translated into the local language. In addition, a resource book for women's activities named "Behind Our Smiles" has also been produced.

Addressing environmental problems rests on a foundation of sharing struggle and burden, as well as an accumulation of outcomes from practical and cooperative forms of action. Compatibility between environmental and consumer education, or with education concerning sustainable development, serves to guarantee future possibilities for the people of Pacific island nations. As part of local involvement with the environment based upon responsible action, it is hoped that more practical and empirical examples of success within MPAs can be seen in the future.

In place of atolls, the Republic of Palau provides an environment where the utilization of lands, mountains and coasts as a sequential space in the form of *satoshima* (island used by residents) can be easily seen. As such, when future strategies are in place for a coordinated system between the realization of consumer responsibility and the existence of a practical national environment movement that includes terrestrial areas, the Republic of Palau, already a country focused on environmental policies, will become more attractive due to its reputation as an island of world-class environmental standards.

5) Japan’s Involvement

Policy awareness surrounding the aforementioned measures is expected to be the subject of active and varied discussions.

As a perception of the times, moves towards a reconstruction of post-colonial relationships are anticipated as part of preparations for the 100th anniversary of Japan-Micronesia relations in the year 2014. Specifically, attention should be paid to Palau, a major nation in terms of environmental policies which served as the location for the South Sea Mandate Office during the Japan Mandate Era. The environment, which is one of the pillars (tourism, environment and marine resources) for future nation-building and development in Palau, remains as a realm in which the involvement of Japan as a large island country is being called into question. As such, it appears that the rebuilding of a future-oriented relationship between Japan and Palau will be likely.

Figure. 8.36. Historical ties between Palau and Japan
Left: The number of Japanese immigrants to Palau was 15,000 in 1938, which accounted for 70% of the overall population, indicating the special status of the region even within the history of Japan-Palau ties.
Center: Palau’s tropical biological research center established in 1935 and operated with funds from the Japan Society for the Promotion of Science (JSPS). The center was closed in 1943 due to the war, but research contributions on corals, fish, annelids, luminescent organisms, shellfish and seaweed, together with information on their habitats, have been conducted. Research findings were consolidated into some 150 volumes of “Southern Sea Science” and other titles, and would have an 80-year history if such materials still remain.
Right: A drawing by elementary school children envisioning the future of a healthy environment, although this is not directly related to Japan. (Prof. Shunsuke Nagashima)

8.5.6 Blue Carbon Tourism and MPAs

The foundation for external assessment for appraising easily verifiable effects of the establishment of MPAs is based on direct and indirect outcomes on tourism and fishing. The Rock Islands Southern Lagoon of Koror State and mining remains of Yap stone money have been nominated by the national government of Palau for registration in the UNESCO World Heritage List.

Jellyfish Lake in RISL is renowned worldwide and functions as the experimental site for a balance between environmental conservation and cautious utilization based upon a set of unique regulations. It is of continuing importance to impose numerical limits on the extent of entry by visitors.

In Palau, the conflict between fishermen and divers so often seen in the case of Japan is not an obvious problem. The project team witnessed many divers observing coral reefs inside of MPAs and also in areas surrounding MPAs. While the large numbers and sheer diversity of fish species were surprising, there were cases where fish were lured into the waters by intentional feeding. Such acts lead to negative effects in the long-term due to pollution from an increase of organic matter. Voluntary regulation amongst diving operators in the surrounding areas has come to be

required.

In the Shimizu River of the former Shimizu village in Ngchesar State (710 hectares, 115 plots, permitted number of households 96), a Jungle River Cruise service has been organized by private tour operators in wide waterways found outside of MPAs. The landscape is a typical for mangroves seen elsewhere, but fulfills conditions as a suitable site for tourism. The tour is popular with visitors as wild salt-water crocodiles are made to jump for pieces of chicken hung from rods (although some environmentalists are worried that this practice creates a negative impact on the inherent nature of salt-water crocodiles). The tour also includes demonstrations on how mangrove crabs are caught and showcases marine areas where watersheds may be observed. This cruise is notable as a learning tour for visitors although repeat participants may require more comprehensive content.

Dense foliage is found at the back of all mangroves, creating the image of a jungle. With the assistance of suitable guides and the opportunity to view diverse types of plant life up close, Palau is filled with destinations that will serve as excellent locations for learning-based forms of tourism. When combined with the importance of marine area management and learning effectiveness, it is possible to gain revenue from highly value-added guiding tours and tourism. Open-cutting of waterways and local craft production may also be combined for further effect. The presentation of a new genre of blue carbon tourism that involves careful and thoughtful regeneration of *satakata* (lagoon) forests is a highly feasible approach.

Figure. 8.37. Contents of the Jungle River Cruise (Prof. Shunsuke Nagashima)

8.5.7 Remote Islands Promotion and MPAs

Mr. Haruo Remeliik, the inaugural President of Palau who assumed office in 1981, was a native of Peleliu Island whose grave is located at the flag stand of the plaza of the state government building. A bust sculpture of Mr. Remekiil also stands in front of BNM, signifying his important and symbolic status in Palau.

The mother of President Kuniwo Nakamura, who was in power during the ceremony commemorating Palau's independence as a republic and served two terms as the President for a total of eight years, also hails from Peleliu Island. His brother, Toshio Nakamura, was a member of the Micronesia Constitution Council that was established in 1973 by the Congress of Micronesia, and also served as the seventh council leader of the Palau Legislative Council in 1980. Another sibling, Mr. Marumo Nakamura, became the first Chief Justice of the Palau Supreme Court in 1981 (after serving as assistant judge at the TTPI Supreme Court from 1977 to 1981). The above example is one of many that point to the existence of a treasure trove of talent in the offshore islands of Palau. Shallow seagrass beds located in northern Peleliu Island between uninhabited islands have been designated as the Teluleu Conservation Area. The area serves as a breeding site for rabbit fish and provides supplies of seagrass, which is a

staple diet for dugongs.

Although Peleliu Island is an offshore island, its location at the southern tip of a lagoon within which Koror State's Rock Islands are found, allows accessibility by speedboat in approximately two hours. The north of Peleliu is a lagoon with gentle sea currents while open oceans are found in the south.

Angaur Island was a former mining site for phosphate rock. During the German Occupation Era, mining and land exploitation took place, and such activities continued for the next 50 years during the TTPI era. The prolonged mining of phosphate rock has laid waste to mining lands, and residents of Angaur Island have been relocated to the south of the island. Similar conditions can also be seen in the Republic of Nauru, Banaba Island of the Republic of Kiribati, as well as the previous Japanese territory of Fais Island in the FSM state of Yap. Angaur Island has produced a long line of talent, amongst which are a number of MPA representatives.

Located in open oceans, the stretch of sea between Angaur Island and Peleliu Island is a world-class diving spot. While occasional accidents take place, the site is a favorite destination for repeat visits by intermediate divers and above.

Located further southwest is Sonsorol State, home to a population of 100 people (Palau Census 2005) and four atolls, of which three are inhabited. Total land area is 3 km^2 and altitude is a few meters above sea level. A widespread famine took place here in 1911, which prompted the German Government to relocate then residents to Ngerekebesang Island. The island is inhabited by large populations of coconut crabs and blue sea turtles.

Hatohobei Island, located at the southernmost tip of the Republic of Palau close to Indonesia, is composed of Helen Reef and Tobi Island. Altogether, 44 people live on a combined land area of 0.6 km^2 （Palau Census 2005). Tobi Island was the site of bonito and sea cucumber fishing during the Japan Mandate Era, and also saw the mining of phosphate rock. Helen Reef is an MPA that is famous as a vast breeding site for seabirds.

The ancestors of the states of Sonsorol and Hatohobei were of people who came from a remote island in FSM and spoke a language that was different from the Palauan language, whose request to move to Palau due to a natural disaster (such as a typhoon) was acknowledged by the Paramount Chief of the Republic of Palau. At present, most residents of these two regions live in Koror State and have formed communities there.

Due to shared territorial borders with the Philippines in the west and Indonesia in the south, southwest islands of the Republic of Palau that include Sonsorol and Hatohobei are marine areas with rampant illegal fishing operations within the EEZ. While their conditions as remote isolated islands enhance their value as a protection area for biodiversity and rare plant and animal life, discussions concerning the implementation of high-quality utilization worthy of such value and the bearing of resulting management costs remain highly limited.

According to explanations by Hatohobei State-elect Honorable Delegate Andrew, Hatohobei and Sonsorol are vulnerable to changes in climate, and damage sustained from past natural disasters have led to poor and needy lifestyles of island residents. For areas of such world-class value, it may be effective for its marine areas, islands and coral reefs to be collectively designated as a special ocean conservation and biodiversity protection zone for implementation of wise use by cruising boats. Once regular visitors can be secured, production industries for souvenir items (crafts from plant materials, decorative shell items and tropical fruit juice) may be anticipated.

8.6 Initiatives and the Importance of Adaptation Toward Climate Change in the Micronesia Region

8.6.1 Effects of Climate Change

According to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC-AR4), the linear trend of warming for global average temperatures over the past 100 years (1906-2005) has reached 0.74ºC due to man-made emissions of greenhouse-effect gases and the pace of such increase is mounting. Global average surface temperatures in the South Pacific region have risen by 0.6 - 1.0ºC since 1910.

In addition, such temperature increases have been accompanied by an all-round rise in sea levels, with sea levels increasing by 3.1mm annually since 1993.

IPCC-AR4 estimates that global temperatures will increase by a speed of 0.2ºC each decade over the next 20 years. By the end of this century, global average surface temperatures are believed to rise by at least 1.8ºC and reach a maximum rate of increase of 4ºC.

On the other hand, sea levels are expected to rise by 0.20 - 0.59m by the end of this century.

Table 8-3. Predicted rises in global average air temperature and sea level elevation at the end of centuries (Intergovernmental Panel on Climate Change, Fourth Annual Report)

Case	Temperature change (°C at 2090-2099 relative to 1980-1999)[a, d]		Sea level rise (m at 2090-2099 relative to 1980-1999)
	Best estimate	*Likely* range	Model-based range excluding future rapid dynamical changes in ice flow
Constant year 2000 concentrations[b]	0.6	0.3 – 0.9	Not available
B1 scenario	1.8	1.1 – 2.9	0.18 – 0.38
A1T scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2 scenario	2.4	1.4 – 3.8	0.20 – 0.43
A1B scenario	2.8	1.7 – 4.4	0.21 – 0.48
A2 scenario	3.4	2.0 – 5.4	0.23 – 0.51
A1FI scenario	4.0	2.4 – 6.4	0.26 – 0.59

Notes:

a) Temperatures are assessed best estimates and likely uncertainty ranges from a hierarchy of models of varying complexity as well as observational constraints.

b) Year 2000 constant composition is derived from Atmosphere-Ocean General Circulation Models (AOGCMs) only.

c) All scenarios above are six SRES marker scenarios. Approximate CO_2-eq concentrations corresponding to the computed radiative forcing due to anthropogenic GHGs and aerosols in 2100 (see p. 823 of the Working Group I TAR) for the SRES B1, AIT, B2, A1B, A2 and A1FI illustrative marker scenarios are about 600, 700, 800, 850, 1250 and 1550ppm, respectively.

d) Temperature changes are expressed as the difference from the period 1980-1999. To express the change relative to the period 1850-1899 add 0.5°C.

Climate changes brought about by global warming may trigger a host of effects in global environments and societies. In particular, transitions including shifts in the distribution of habitats for plant and animal life, changes to agricultural seasons, reduced populations of specific plant and animal species, premature flowering of plants and variation in the emergence patterns of insects are anticipated to cause an impact on the Micronesia region.

Effects of climate change that are directly concerned with content presented in this project report can be anticipated according to two different simulations. If global average surface temperatures rise by approximately 2ºC, “most coral reefs will exhibit signs of coral bleaching (negative impact on coral reef ecosystems) and destruction from flooding and rainstorms will also be exacerbated (negative impact on coastal zones).” Global average surface

temperature increases of more than 2ºC will lead to “widespread extinction of corals (negative impact on coral reef ecosystems), a sharp rise in the proportion of the population affected by floods and other natural disasters (negative impact on coastal zones), as well as the disappearance of wetlands (negative impact on coastal zones).”

In addition, “absorption of man-made emissions of carbon dioxide have caused the acidification of oceans to accelerate, causing pH levels in oceans to fall by an average of 0.1” (IPCC-AR4). As such, it is feared that future increase of carbon dioxide levels in the atmosphere may lead to further acidification of oceans. It is estimated that pH levels in oceans will fall 0.14 - 0.35 in the 21st century, triggering the possibility of a negative impact on living organisms that depend on coral reef ecosystems for survival.

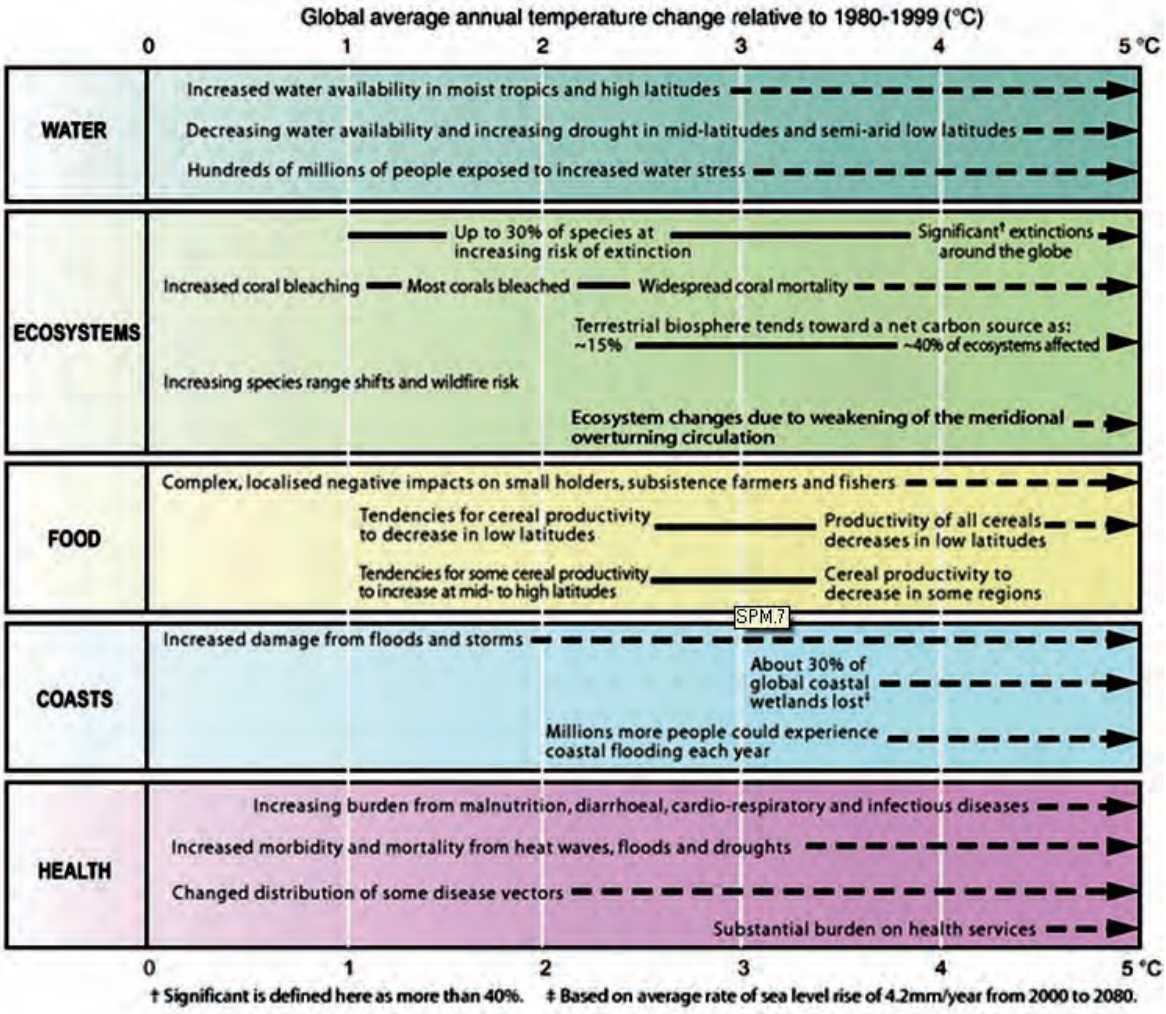


Figure.8.38. Predicted influence due to the change in the global average temperature between 1980 and 1990 (Intergovernmental Panel on Climate Change, Fourth Annual Report)

Particularly, it is important to consider the impact caused by a rise in sea levels on small island states (SIS). Exacerbation of effects such as flooding, high tides from heavy storms, beach erosion and other dangers to coastal zones will threaten core infrastructure, residential zones and other facilities that are crucial to supporting the survival of island societies. In addition, deteriorating conditions of coastlines such as beach erosion and coral bleaching will cause an impact on the region’s resources. Complex stress factors will also increase the burden exerted on mangrove ecosystems and accelerate salt damage to soil, including those of wetlands.

8.6.2 The Vulnerability of Palau to Climate Change

According to “The Second National Report” that was submitted by the Republic of Palau to the Secretariat of United Nations Framework Convention on Climate Change (UNFCCC) in 2003, the above-mentioned effects of climate change are anticipated for Palau in the future, but the salient impact of other negative consequences are already being seen. Typhoons and the El Nino effect have become particularly ostensible in recent years:

- Widespread erosion of beaches and coastlines
- Coral bleaching
- Sustained changes in climate patterns
- Reduced productivity for agriculture (salt damage from rising sea levels have affected taro and yam crops) and fishing
- Impact of coastline erosion on roads, bridges, foreshores and agricultural plantations along coastlines (effects of coastline erosion have also been observed on islands with an absence of improper coastal development)
- Drying up of sources of drinking and agricultural water due to severe droughts
- Frequency and spread of diseases carried by mosquitoes

The following are areas and industrial sectors that are highly vulnerable to climate changes as assessed by the Republic of Palau. Specifically, the impact on taro farmers, mangroves, water resources (especially the Ngerikiil watershed in Airai State) and public health environments (diseases spread by insects) have also been listed as serious effects of climate change:

- Coastal zones such as lagoons, coral reefs and marine ecosystems
- Coastal fishery
- Water sources (Freshwater)
- Agriculture, forestry
- Tourism
- Hygiene, sanitation and public health
- Communities
- Infrastructure

By state, Koror, home to two-thirds of the national population and is the center of Palau’s tourism industry, which is the main source of support for the country’s economy, and Peleliu, where the direct impact on mangroves is expected to be extensive, are two particular states in Palau where damage from effects of climate change are feared to be the worst. If climate change worsens, consequences of the resulting rise in sea levels will be seen directly in the mangrove forests in Peleliu State. Fish, invertebrate organisms and reptiles (salt-water crocodiles) living in the mangroves will be affected, while local residents will likely suffer from an ensuing influence on timber supply, degree of effectiveness to preventive measures for coastline erosion and historical cultural assets that serve as a form of tourism resource. As arable land in Peleliu State is limited to those found in narrow lowlands along the coastline, further salt damage sustained by soil may lead to negative effects on stable supply of food resources in Palau.

Areas of particular concern to this current project are super high tides, rising sea levels and rising sea temperatures caused by climate change.

High tides are usually observed in the Republic of Palau annually in September and October. Once every few years, extensive water damage to taro crops, which are the main staple diet for Palauans, and seawater inflow due to flooding will be sustained, but such occurrences have become more frequent in recent years and are accompanied by longer, extended periods of high tides. Seawater flooding will cause 75-100% of taro crops to wither and repercussions of such events are grave. In addition, sustained high tides will cause effects on freshwater areas, thereby affecting sources of water for consumption and agriculture, in addition to triggering insufficient drainage of sewage and used agricultural water.

Other than super high tides, a rise in sea levels is extremely threatening to a country like Palau, where only one-quarter of all national land is located at an altitude of 10m above sea level. As Palau has concentrated most of its infrastructural networks and residential areas in low-lying areas, the extent of damage from high tides and rising sea levels sustained to its society and economy is anticipated to be of devastating proportions.

In addition, an upward shift of approximately 3ºC in the temperatures of sea water was observed in the late 1990s. Such changes in seawater temperatures will lead to coral bleaching, which in turn affects Palau's marine and coastal ecosystem. In addition, negatively impacting on the industries and livelihoods of people that depend on ecosystem services on survival. At present, coral reefs in the Republic of Palau are in danger of suffering from serious effects (bleaching) of an increase in seawater temperatures that has been brought about in recent years by climate change, and such consequences are also feared for the future.

8.6.3 Potential of MPAs in Relation to Climate Change Adaptation

With regards to the vulnerability to climate change seen in the Republic of Palau (and in most cases the Micronesia region as a whole), the Palau National Report has made recommendations for the following adaptation plans:

- Countermeasures for agriculture: introduction of drought-resistant crop and plant varieties to areas susceptible to the risk to drought, implementation of measures for soil and water source protection, promotion of intercropping and diversity in cultivation variety, strengthening of irrigation facilities, prevention of invasive alien species (boosting of quarantine), securing and stabilizing food provision supply through policies that suppress consumption of imported foodstuff
- Preservation of coastal environments: Preservation and regeneration of foreshores and mangroves, construction of breakwaters (limited to areas of high concentration of people and infrastructure due to high costs), management of inflow of sewage and drainage water into seas through countermeasures for environmental pollution (sewage), relocation of residents from high-risk areas
- Conservation of marine ecosystems: Monitoring and implementation of law enforcement
- Conservation of biodiversity: as low-cost adaptation plans for high vulnerability risks of indeterminate factors of climate change will be undertaken, conservation of biodiversity in both terrestrial and marine areas is desirable
- Countermeasures for water sources: boosting of management and maintenance of existing supply systems for water sources, introduction of system where beneficiaries are made to bear the burden, water catchment

using buildings and roads

- Sanitation and Public Health: Education and enlightenment of citizens to diseases, extermination of breeding grounds for mosquitoes
- Buildings: Installation of resistance to typhoons and heat, as well as heat shields from point of construction
- Formulation of integrated policies: Planning of policies that include the above-mentioned measures, development of capabilities, citizen education and enlightenment for actualization

Small island nations like the Republic of Palau, as well as developing countries with dispersed populations and infrastructure that are concentrated in coastal areas, require adaptation measures that are effective against climate change. It is preferred that measures mentioned above are not adjusted and implemented individually, but are rather carried out collectively under an overarching project or policy. The Palau-type MPAs showcased in this project stress management techniques that ensure connectivity from marine to terrestrial areas, a balance between conservation and sustainable use, networking and the participation of local communities. These qualities are also extremely effective from the viewpoint of strategies for climate change and will function as methods to efficiently implement and introduce adaptation countermeasures.

With regards to planning and managing Palau-type MPAs, it is crucial to not only consider the respective geographical locations of each MPA, but also fully assess factors for climate change (in particular vulnerability and adaptation needs) so as to work them into management approaches for MPAs.

8.6.4 Latent Potential of Blue Carbon

Carbon dioxide absorbed and secured by marine and coastal ecosystems is known as “blue carbon.” In recent years, the concept of blue carbon as a policy to ease the effects of climate change (emission reduction policy) has been garnering attention within UFCCC. Primarily, the concept refers to carbon dioxide absorbed and secured by mangroves, seagrass beds and coastal wetlands. It has been said that the amount of carbon dioxide absorbed and secured by such ecosystems can reach a maximum quantity 50 times greater than that by terrestrial ecosystems (forests) of the same land area (source: Pidgeon, Emily, “Carbon Sequestration by Coastal Marine Ecosystems: Important Missing Sinks and Sources,” 2012).

The preservation of marine and coastal ecosystems that include absorption and securing resources is an immediate, low-cost policy for easing the effects of climate change without the need to depend on the development of new technology. In addition, conservation of biodiversity, sustainability of ecosystem services, protection of livelihoods and securing of stable food resources serve to strengthen adaptation strategies against climate change and the bringing about of a society with diverse benefits.

However, rules and structures corresponding to those for emission reduction mechanisms which target forests and land utilization such as forestation CDM (Clean Development Mechanism) and REDD+ (Reducing Emissions from Deforestation and Degradation in Developing Countries) have yet to be developed for blue carbon.

In the future, as discussions are advanced within the next international framework run under the supervision of UNFCCC (upcoming initiative frameworks will be determined through approval of signatory countries by 2015), it is anticipated that the positioning of blue carbon will be determined along with the development of rules and mechanisms for implementation. The incorporation of studies, plans and empirical findings considering blue carbon

as an international framework into Palau-type MPAs holds great significance for the Republic of Palau and the rest of the Micronesia region. If blue carbon comes to be recognized by the international society as an effective method of easing climate change that can be practically implemented, plans for sustainable funding that are aimed at ensuring continued maintenance of the MPA network shall receive a significant boost.

Chapter 9 Palau Integrated Marine Protected Area Model

9.1 Introduction

The MPA model put forth in this chapter serves as a source of reference providing ideas for the establishing of new MPAs and the improvement of existing MPAs not only in the Republic of Palau, but also the rest of the Micronesian countries. In such an event, consideration must be given for the following characteristics shared commonly by coastal zones in the Micronesia region to allow assessments to be carried out from a broad set of perspectives.

- Composed of small islands and islets, surrounded by coral reefs
- Mangroves are distributed in estuarine regions
- Susceptible to influence from terrestrial areas
- Coral reefs are distributed in seas surrounding urban areas with high concentrations of population (or there is a possibility of such situations occurring in the near future)

As mentioned earlier in this project report, although definitions and ways of thinking for MPAs are varied, in general MPAs are established for the following reasons: 1) in order to preserve natural environments in their ideal states, and 2) to ensure the possibility of sustained use of marine resources. In particular, biodiversity serves as the keyword for discussions concerning the former, although debates concerned with specific biological species have also been conducted.

For territories such as the Micronesian countries where populations are comparatively smaller and effects of human activities are more limited compared to those seen in other countries such as Japan, there is a possibility of constructing ideal (or close to ideal) MPAs that take into account a variety of conditions.

In line with hopes for stronger marine conservation efforts in Micronesian countries and the achievement of co-existence of man and nature, this project hereby proposes the Palau Integrated Marine Protected Area Model, which is composed of the following two main elements:

- Ensuring the possibility of sustainable resources in coastal zones while maintaining ideal conditions for biodiversity and ecosystems.
- Intended for an integrated three-component system made up of land, rivers and coastal zones that accounts for the effects of excess nutrient salt and sediment inflow from terrestrial areas on coastal ecosystems.

9.2 Dominant Areas of Management

9.2.1 Co-Management

In general, MPAs within the Micronesia region are suited to a system of co-management that shares the rights and responsibilities of maintaining MPAs amongst the national and local governments (state governments and municipalities), as well as local communities. This is to allow for efficient monitoring and law enforcement, which are vital for maintaining the effectiveness of MPAs. In remote and isolated island territories of the Micronesia

region, a top-down structure of maintenance by the government will not only lead to higher costs, but also affect the productivity of policing and law enforcement activities. On the other, community-based management is limited in terms of capacity and would require assistance by the national government.

9.2.2 Cooperation among the National Government, Local Governments, Communities and NGOs

MPAs found in the Republic of Palau are co-managed through cooperation between state governments and local communities. The national government provides structural, technical and financial assistance, while lending support to matters concerning policing and law enforcement. As the country owns a limited number of patrol boats, patrolling is left mainly in the hands of local communities. The mooring of guard houses within MPAs has also proved to be effective, and guards hired by the state government conduct night patrols from the guard house. Patrol guards are chosen from within the local community and are helpful in generating employment. There are many instances in the Republic of Palau where MPAs have been established through cooperation between local communities and environmental NGOs. As such, the roles performed by NGOs are also significant.

9.3 Conservation and Utilization

9.3.1 Balance between Conservation of Ecosystems and the Sustainable Use of Resources

At present, many MPAs of diverse variations have been established all over the world, although the MPA set up within the Great Barrier Reef in Australia is possibly the most famous. Utilization modes for offshore coral reefs that extend across a radius of 100 km in the Great Barrier Reef are determined and managed through zoning. On the other hand, the situation is characteristically different in the Micronesia region and Southeast Asia, where human life takes place close to coral reefs, and large populations of people rely on resources from coral reefs for their livelihood. As such management methods like those seen in the Great Barrier Reef are unsuitable for implementation, and development of establishment and managements technique for Micronesia-type MPAs is necessary.

If conservation of biodiversity is the main objective when setting up MPAs, then designated areas must be as large as possible. Bigger surface areas are needed in order to allow MPAs to exhibit ample spillover effects. In the case of Micronesia however, the establishment of overly large no-take zones in waterfront areas of fishing villages will affect people’s procurement of marine products.

In future, it is vital to assess the balance between the conservation of ecosystems and sustainable use, which takes into account people’s demands. Instead of assuming a confrontational stance towards the relationship between conservation of ecosystem and the fishing industry, it is important to possess the awareness that preservation of biodiversity and optimal realization of ecosystem services as set forth in Chapter 8 contributes to a sustainable fishing industry. A network of a number of relatively smaller no-take MPAs surrounded by a properly-managed buffer zone (multi-purpose utilization zone) could be presented as a concrete example of such an approach.

9.3.2 *Satoumi*

Recently, the concept known as "*satoumi*" in Japan has become a topic of frequent mention in discussions surrounding ocean policy. *Satoumi* refers to harmonious co-existence of nature and humankind towards coastal zones. As *satoumi* can also be said to be a concept governing the relationship between man and sea, it is different from MPAs, which is an approach that clearly defines boundaries found at sea. It is therefore fitting to think of MPAs as being one of the many tools that help to create *satoumi* that are rich in biodiversity. As the movement to create *satoumi* has also widened elsewhere in the world, it is hoped that development of more effective marine conservation theories can be achieved through the creation of *satoumi* in MPAs of the Micronesia region.

9.3.3 No-Take Zones and Seasonal No-Take Zones

The relationship between MPAs and the fishing industry can be regarded in the two main categories of no-take zones and seasonal no-take zones. Instead of imposing a blanket ban on fishing all-year round and establishing vast no-take zones of indefinite time periods, Palau-type MPAs should consider the implementation of a different system that allows for sustainable utilization by people. While it is difficult to set and stipulate durations for prohibitions on fishing, approaches where fishing of vital species is banned during breeding season in definable areas are currently enforced. It is important to note that this approach is not without its problems as there some species of fish and marine life may have extended periods of breeding.

In Okinawa, there have been successful examples of effective management outcomes from the establishment of conservation MPAs during spawning season for vital fish species and no-take MPAs that prohibit capture of juvenile fish. It can thus be seen that the setting up of limited period MPAs that do not last throughout the year are important and should be considered for implementation in the MPAs of the Micronesia region.

Amongst the Pacific island nations, there have been examples of traditional no-fishing zones set up in waterfront areas of villages. In the Republic of Fiji for example, there is an age-old tradition of designating marine areas as taboo regions where no fishing should take place 100 days to one year after the death of a chief (important members of local communities such as the village head). There is also a custom of using fish that has been taken from taboo regions in rituals held in mourning of the dead after a certain period of time. In addition, that these special no-take zones have exerted a positive influence on marine resources has also been transmitted as part of local knowledge.

9.3.4 MPA Network

In recent years, international targets for MPAs have focused on the construction of an MPA network over the mere increase in the number and land size of MPAs. MPA networks are groups of MPAs that effectively achieve biological goals that may be impossible for singular MPAs to accomplish on their own, and include networks aimed at the attainment of socio-economic benefits. In other words, such networks bear the dual functions of serving as biological (spatial) networks that preserve marine resources through the focus on movement of living organisms and genetic relationships, as well as operating as networks between people and information. Under such considerations, it can be seen that Palau is in the process of constructing networks of people and information

through establishment of the Protected Areas Network (PAN).

If MPAs with identical land areas were to be established, an emphasis on the creation of a network of managing multiple small MPAs makes it easier to gain the consent of local communities, increase the efficiency of MPAs and facilitate better policing. This approach is preferred over the designation of large no-take zones. In addition, the securing of multiple smaller living habitats in distant locations gives rise to biological effects related to species preservation. The existence of diverse environments is vital in order to secure multiple habitats for living organisms within a single MPA, even though the establishment of such vast areas is not an easy process. It is therefore desirable to consider the distribution of environments that are necessary for species preservation while establishing small MPAs and transferring living organisms between MPAs to create conditions where plant and animal life are able to survive in a variety of environments (so as to establish MPA networks). Such a structure makes it possible larva and juvenile organisms generated in a certain MPA to be distributed and established in other MPAs.

However, there are few MPA ecological networks at present that take into consideration the transfer of living organisms and genetic connectivity. This is because there is overwhelmingly limited information on the necessary process flows and biological constitutions of target species. For that reason, it is vital to consolidate scientific information for application to individual MPAs so as to enhance their effectiveness.

9.4 Effective MPAs

9.4.1 Factors that Influence Efficacy

It goes without saying that a high level of awareness amongst people is important for the enhancement of effectiveness of establishing MPAs. Such awareness is linked to the holding of ample discussions during the establishment process as well as continuous proper management and supervision post-establishment, which are factors that improve effectiveness.

There are four perspectives that are particularly important when assessing the reasons behind the efficacy of MPAs: 1) Have patrolling and policing been adequately carried out? 2) Is the MPA established in a suitable location? 3) Has sufficient land area been secured? 4) Has enough time (years) passed since establishment?

MPAs will not realize their full potential for effectiveness if rules that have been set are not observed. The fundamental element of MPA management is the thorough exercise of surveillance and policing activities. It would be more efficient for governments and local communities to cooperate for the carrying out of mutual surveillance and law enforcement.

Locations of MPAs must be determined upon ample consideration of the biology of target living organisms as well as the history of living patterns, such as their spawning areas (sources of larvae), breeding grounds for juveniles, and living habitats for adults. Information concerning such locations can frequently be obtained from experienced fishermen. As most juvenile sea life tend to remain in floatation mode during this period of their lives, information on water flows (ocean currents, tides and currents due to wind) is also important. In future, it is crucial to reflect on the distribution patterns of living organisms, genetic relationship between ectopic sites and connectivity of MPAs which pay attention to the characteristics of living histories of sea life before engaging in discussions and actual construction for MPA networks and determining their respective locations. This remains one

particular area where the contributions of natural science are the most necessary.

How large should MPAs be in order to ensure a balance between ecosystem preservation and the sustainable use of resources? Also, how much land area for MPAs is needed so as to increase the quantity and availability of target resources? In order to seek the answers to such questions, a considerable amount of scientific information is required. Optimal land areas are expected to change according to factors such as the types of ecosystems (coral reefs, mangroves, seagrass beds and tidal flats etc.) and biological constitutions of target species, socio-economic conditions of the region in question and actual circumstances surrounding the fishing industry. Concrete details concerning the philosophy and methodology for the Convention on Biodiversity has been summarized into the 12 fundamental principles of the ecosystem approach that was deliberated at the CBD-CPO5. The first principle in the approach states that “the objectives of management of land, water and living resources are a matter of societal choice”. Indigenous peoples and other local communities living on the land are important stakeholders and their rights and interests should be recognized. Both cultural and biological diversity are central components of the ecosystem approach, and management should take this into account. Land areas for MPAs should also be determined at the level of local society.

It is important to set temporal scales after the establishment of MPAs in order to ensure their optimal efficiency. In particular, effects of MPAs that have been set up to protect marine resources and conservation of coral spawning will only be tangible a few years after establishment. As such, guaranteeing long-term sustainability, realizing continuous monitoring and conducting necessary improvements and revisions are equally crucial steps that have to be performed in addition to the setting up of MPAs.

9.4.2 The Resilience of MPAs

Coastal ecosystems experience destabilization from a number of factors that range from over-fishing, climate change, excessive inflows of nutrient salts and sediment, as well as too much tourist-related activities. Instead of dealing with such inhibitory factors individually, it is more vital to come up with solutions that will enhance the overall resilience and resistance of MPAs against conditions that cause destabilization.

Resilience is also an important consideration when deliberating the preservation and regeneration of coral reefs. While countermeasures on a global level are necessary against phenomena such as mega bleaching, which is related to global warming and is one of the major factors that cause serious destabilization of coral reefs, local communities may work towards increasing the resilience of their coral reefs to such destruction as a countermeasure that is within their control. Such measures may include enhancing the health conditions of corals by taking steps against excessive inflows of nutrient salts and sediment into coral reef ecosystems. In addition, overall resilience of coral reefs can also be increased by paying attention to the network between coral reefs and MPAs and concentrating conservation efforts on supply sources of coral larvae. However, consideration of such concrete countermeasures remains insufficient.

9.4.3 MPAs Consisting of Mangroves and Seagrass Beds

Palau-type MPAs not only consist of Protected Areas for coral reefs but are also composed of MPAs for mangroves and seagrass beds. These MPAs protect crustaceans such as mangrove crabs and preserve important

species found in marine products such as various species of clams, in addition to preserving mangrove plants and seagrass. Such MPAs are also established with the purpose of protecting species that utilize mangroves and seagrass beds as “cradles” (adult fish utilize habitats that are found mainly in coral reefs). As these plants secure carbon dioxide, attention to the amounts of carbon dioxide absorbed by sea life will allow MPAs that have been established in mangroves and seagrass beds to be applied to countermeasures against rising levels of concentration of atmospheric carbon dioxide such as the Blue Carbon Project and be used in the protection of not only terrestrial ecosystems such as forests, but also in maintaining healthy marine ecosystems and biodiversity.

9.5 Spillover Effect

Spillover refers to the diffusion of eggs, larva, juvenile and adult sea life populations found within MPAs into surrounding marine areas.

Strictly speaking, the spillover effect can be divided into two categories – the spillover of juvenile and adult fish beyond MPA boundaries, and the outflow of larvae through spread and diffusion. If permanent no-take zones have been established for the purpose of increasing the supply of marine resources, it is important for such zones to also enhance spillover effect. As the imposition of permanent no-take zones leads fishermen to conduct fishing activities in areas outside of MPAs, the fishing of increased populations of marine product species beyond the borders for MPAs is the only way of ensuring sustained benefits.

9.6 Integrated Coastal Zone Management (ICZM)

9.6.1 Integrated Coastal Management (ICM)

MPAs found in the Republic of Palau are a crucial countermeasure against sediment and soil particle outflow from terrestrial areas (Golbuu et. al., 2003). In Ngiwal State, only watersheds were initially established as Protected Areas, but the addition of estuarine mangroves and coral reefs thereafter allowed for the carrying out of Integrated Coastal Management (ICM).

ICM refers to the consolidation of management measures for both marine and terrestrial regions such as rivers. In terms of public policy, this management principle also strives for the non-sectionalism and integration of government administration units such as those for national transport and infrastructure, agriculture, forestry and marine resources, environment and tourism.

9.6.2 Pollution by Red Soil Runoff

Pollution by red soil runoff, which is the outflow into marine areas of turbid water caused by runoff of red surface soil in times of precipitation that is derived from the development of terrestrial areas and agricultural activities, is a serious environmental problem in Okinawa. Amongst the small islands of the Micronesia region, many islands with tall mountains have red soil, and eventual pollution caused by soil found in coastal zones will

also be known as pollution by red soil runoff. In the course of this project, team members were able to confirm changes to the color of seawater that had been caused by outflow of red soil from coastlines on multiple occasions during their surveys conducted in Palau.

Pollution by red soil runoff affects coral reefs negatively. There are instances where corals die from being buried under copious amounts of red soil. Even in small quantities, constant soil runoff will place chronic stress on coral reefs, which excrete viscous fluids in an attempt to remove red soil that falls upon it. Once sea water becomes turbid from red soil inflows, zooxanthella, which co-exists with corals, will suffer from insufficient photosynthesis due to an absence of light. Large accumulations of red soil on sea beds will also prevent coral larvae from being implanted. Pollution from red soil runoff is a representative and necessary example of the countermeasures for the resolution of the problem areas plaguing terrestrial areas that have to be undertaken under management projects.

9.6.3 Monitoring of Pollution by Red Soil Runoff

The extent of pollution by red soil runoff can be ascertained through quantitative analysis of sea bed sediment. In comparison to the unstable concentration of red soil found in sea water, the concentrations of red soil in bottom sediment are comparatively more stable. However, such concentrations fluctuate due to red soil inflow from rainy seasons, as well as the raising and diffusion of red soil by typhoons and tidal currents caused by seasonal winds. Concentration levels that exert significant influence on the degree of health of coral reefs are not average annual values, but momentary maximum values. In the case of coral reefs, it has been reported that maximum values should be kept below 30kg/m^3 (Omija et. al., 2003).

There is a simple method that has been developed for measuring the quantity of micro particles found in sediment, which is known as SPSS (Content of Suspended Particles in Sea Sediment). As SPSS utilizes comparatively inexpensive equipment such as transparency meters for simple measurement, many training researchers from Micronesian countries visit Okinawa to master techniques for SPSS measurement. However, as many monitoring indices of Micronesia countries have yet to include SPSS, further promulgation is necessary. In addition, it is important not to neglect the carrying out of comparative investigation by identifying the origins of micro particles accumulated in costal zones together with methods for quantitative analysis so as to obtain more accurate information.

9.6.4 Measures Against Excess Inflow of Nutrient Salts

Coral reefs are also harmed by excess inflow of nutrient salts into marine areas. Dissolved amounts of mineral compounds such as nitrogen and phosphorus, which function as nutrition for phytoplankton, seagrass and algae, are known collectively as nutrient salts. In the coral reefs of Okinawa, an increase in the level of concentration of nutrient salts results in reduction of corals and suggests the inclination for augmented algae growth. Excessive nutrient salts will boost the amount of phytoplankton, cause seawater to become turbid and trigger active algae growth. As algae and corals share a competitive relationship in terms of habitat structures, expansion of algae growth is linked to lesser cover degrees and existing quantities of corals. For information on countermeasures for red soil runoff and excess nutrient salt inflow, the research report that introduces 33 examples of watershed policies currently undertaken in various parts of the world including Okinawa and the Republic of Palau serves as a good

form of reference (Wilkinson and Brodie, 2011).

9.6.5 Problems Concerning Suspended Particles and Countermeasures

Water turbidity caused by pollution through red soil runoff and excess nutrient salt inflow is a serious problem. In addition to affecting the process of photosynthesis by zooxanthella that co-exist with corals, seawater turbidity increases the difficulty of dive fishing and affects tourist activities such as diving and snorkeling, bringing significant consequences to ecosystem services. In order for MPAs to be used continuously for tourism purposes, the preservation of the transparency of sea water becomes a vital issue.

In addition to the measurement of the degree of turbidity and suspended sediment in water, analysis of water transparency levels has been developed as a new monitoring index to measure turbidity in shallow coral reefs. Methods of measurement are inexpensive and simple, making it effective for Micronesian countries. According to research conducted in Okinawa by Kinjo et. al. (2011), water transparency levels of more than 14m must be maintained in order to maintain a coral reef cover degree of 50%.

9.7 Acquisition of Maintenance Fees and Alternative Sources of Income

9.7.1 Stability of MPAs

Costs are entailed for the management and operation of MPAs. For the purpose of achieving sustained management and operation of MPAs, revenue may be increased through a growth in fishing catch brought about by the effects of establishing MPAs, or through an increase in revenue from other sources. Based on present conditions, utilization as sites for tourism activities is the most effective approach.

With regards to the co-management of MPAs, maintaining long-term sustainability is far more difficult than the initial establishment procedures and commencement of operations for MPAs. The possibility for sustainability is higher when the local communities are convinced of the effectiveness of MPAs. In order for MPA related activities to continue beyond the initial enthusiasm seen in early active discussions concerning establishment processes, it is important to objectively assess the efficacy of MPAs and continuously present positive outcomes as proof to local residents.

Other systems and policies are necessary for areas where MPAs are not anticipated to bring in revenue from tourism-related utilization. Under such considerations, the Green Fee that has been exercised in the Republic of Palau is effective in advancing MPA projects. The Green Fee is expected to be used efficiently for environmental preservation efforts within MPAs. It is therefore important for other Micronesian countries to consider the implementation of similar fee systems.

9.7.2 Measures for Alternative Sources of Income

Management of marine resources requires measures for alternative sources income. This is because fishing catches are reduced partially for fishermen during the early stages of resource management. However, as livelihood

needs for fishermen and their families still have to be met, there are many occasions where alternative income sources to replace primary earnings from fishing are necessary. Sources of replacement income may be gained from means such as increasing fishing catch through the utilization of breeding and migrating fish reefs, as well as promotion of eco-tours and so on.

9.8 Utilization of MPAs for Tourism

9.8.1 Utilization of MPAs and Fee Systems

Research by Oomori, et, al.（2011）of MPA management and operation structures in the Philippines proved that in many cases, the sustained management of MPAs earn money by making use of marine areas to attract divers. Utilization for tourism-related objectives provide a driving force for the commitment to ensure sustainability of MPAs and leads to reduced pressures on fishing catch. There is a need for MPAs in the Micronesia region to develop optimal systems for utilization as well as the imposition of fees.

9.8.2 Environmental Capacity

It is not necessarily a good thing for tourist numbers to be on a constant increase. A growing number of visitors pose a greater burden to coral reefs through excess sewage and nutrient salt inflow into the sea, which leads to repercussions for ecosystems. Overuse of coral reefs for tourism and by tourists also causes additional stress to corals. The presence of too many visitors who engage in diving and snorkeling bring damage to corals through actions such as fin kicks. For this reason, it is important to investigate environmental capacity that is related to the utilization of coral reefs.

9.9 Other Management Tools

MPAs are not a miracle drug for the resolution of problems concerning environmental preservation and resource conservation. More than imposing an exclusive ban on all fishing activities, MPAs that are geared towards the management of marine resources should look into a combination of management tools that brings together methods such as no-take seasons and size limitations. Amongst keywords for approaches to marine resource management are non-fishing periods, non-fishable sizes, no-take zone, regulations for fishing paraphernalia and methods, barriers to entry (licenses, fishing rights), fishing catch limits and so on. Management methods can be determined upon the foundation of biological information for the living organisms and species concerned. Needless to say, it is also necessary to fully account for not only biological conditions but also the actual situation surrounding the fishing villages and fishing industries involved. In other words, in addition to anticipating results from biologically determined methods of management, one must also be able to expect outcomes such as comparatively easier policing and the observation of regulations by fishermen.

9.10 Support by Scientists

It has already been mentioned that the consolidation of scientific information is necessary for the management and operation of MPAs. There are a number of points that should be considered when regarding the additional roles that should be performed by scientists.

Mutual roles of the national and local governments with regards to co-management of MPAs include effective establishment of MPAs, facilitation of a system for network construction, MPA establishment and operation, research studies, promulgation and enlightenment activities and financial assistance with regards to monitoring of MPAs and policing activities. Furthermore, co-management of MPAs requires the participation of many different stakeholders and a framework for decision making related to the establishment and operation of MPAs. A support system that renders assistance to the decision making process in a manner that is as scientific and rational as possible would also be necessary. Allowing stakeholders to choose from a variety of options presented by scientists is an effective approach.

In order to carry out decision making with regards to the establishment, management and operation of MPAs, the possession of Scientific Ecological Knowledge (SEK) is necessary. In addition to collecting such data, it is expected that scientists participate actively in discussions concerning the establishment, management and operation of MPAs. On the other hand, the assimilation and application of Traditional Ecological Knowledge (TEK) that has been corroborated with experiences transmitted to local communities will also ensure smooth management of MPAs. In addition to the natural sciences, fields such as society, culture and history may also participate in the process of establishing, managing and operating MPAs. This symbolizes the development of a new area of academic research.

9.11 Cultural Respect

In order for Micronesian countries to construct and expand effective MPAs, an MPA system with practical application of TEK that respects and harmonizes the culture that has been built up by people who share deep associations with the sea is vital. It is important to respect the ceremonies and rituals that have been conducted in and of the areas surrounding MPAs to be respected, and to cherish the relationship that is shared with nature.

9.12 Monitoring of MPAs

At present, the Palau International Coral Reef Center (PICRC) plays a central role in developing techniques for the monitoring of MPAs in Micronesian countries, while JICA is involved in projects that promulgate and support these new monitoring techniques. As part of this overall approach, investigations into monitoring indices for effective management of MPAs are underway. While information such as the populations of corals, fish and benthos are easily utilized as indices for the monitoring of MPAs, indices concerning the fishing industry are not included due to monitoring difficulties. However, such perspectives are crucial for MPAs that are focused on expanding the availability and sustainable use of marine resources.

Assessment of the effects of establishing MPAs must not only be based upon the enhanced biodiversity and fish populations within MPAs, but also an increase in the amount of fishing catch obtained by local communities. For this purpose, indices that are concerned with the fishing industry such as CPUE (Catch Per Unit Effort) must be incorporated to quantify benefits that are available to communities and serve as a form of information for improvements to the management and operation of MPAs.

9.13 Management Effectiveness Assessment

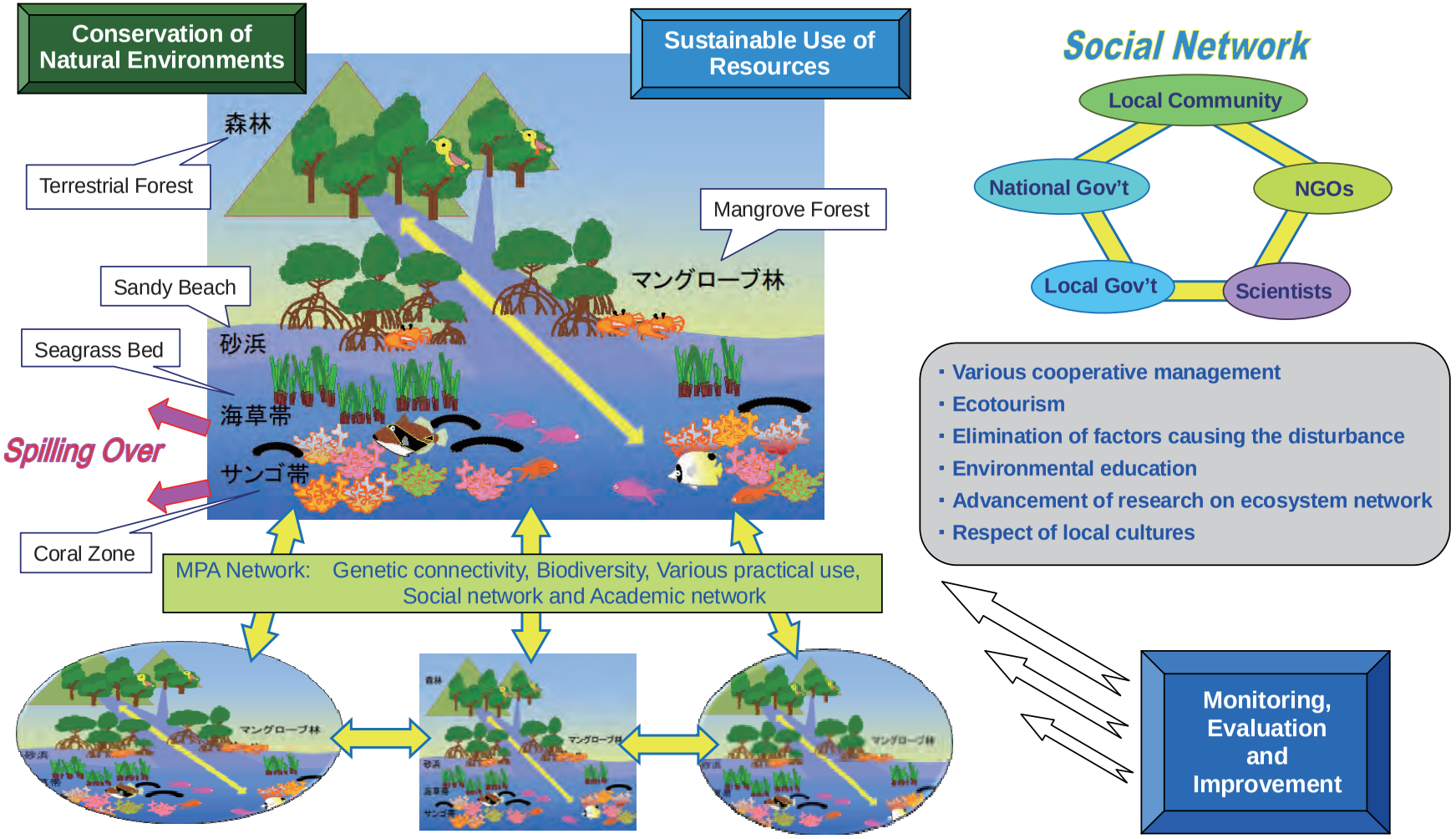
As far as possible, objective assessments of outcomes for MPAs must be conducted in addition to the implementation of necessary enhancements in order to ensure that MPAs are utilized in a sustainable way. The management effectiveness assessment system serves as a database and a tool for such a purpose. Application and necessary revisions to the Management Effectiveness Assessment Tool (MEAT) that has been implemented in the Philippines (see earlier chapter) may be a possible approach.

Concrete reasons for conducting management effectiveness assessments are 1) ability to present scientific and objective assessments to the national government, providers of financial aid and local communities, 2) ability to determine progress level of activities and order of priority and 3) ability to conduct adaptive management and necessary improvements.

Assessment of MPAs should be made in the form of self-appraisals. Effort should be made to avoid making management personnel of MPAs feel as if they are being assessed by external parties. This is to provide opportunities to encourage initiative in the participation of assessment systems. Rather than determining the good MPAs and the bad MPAs, the primary objective of assessments is mutual learning of ways to improve MPAs through the examination of examples found in other regions. It may also be appropriate to involve the participation of third party scientists in assessment bodies when conducting self-appraisal and objective assessments.

Palau Integrated Marine Protected Area Model

- Trinitarian model of terrestrial, river and coastal ecosystems -



Chapter 10 Summary and Challenges for the Future

With the purpose of contributing to the construction of a sustainable society that functions as a link between societies of the past and future, and designation of the Republic of Palau as a target for research, this project has presented a proposal for the Palau Integrated Marine Protected Area Model, which has been based upon investigation of present conservation efforts of natural environments in Palau from a variety of perspectives, as a first step towards contributing to environmental conservation in the Micronesia region for the future. Deliberating the concept of more effective MPAs in the geographic area of the Republic of Palau where many MPAs have already been established, the purpose is to make a concrete proposal by taking the ideas from multiple fields into consideration.

This integrated MPA model has been envisioned for the enhancement of efficacy for Protected Areas in Palau, which has already seen the establishment of numerous MPAs thus far. The model attempts to present a concrete proposal that takes into consideration ideas from a diverse range of fields.

During the data collection process where information was obtained through interviews with many relevant people in Palau, the project team endeavored to understand the thoughts of the local people. In the process of consolidating this report, project team members also asked themselves how they could contribute to the conservation of marine environments in the Republic of Palau and the Micronesia region.

At present, all states of the Republic of Palau have either designated certain area(s) as eco-parks or natural history museums. Bearing this awareness in mind, we have the responsibility of maintaining such richness of nature while proposing measures that make sustainable use possible, as well as seeing to the actual implementation of such approaches. It is also important that investigations are carried out with respect for cultural practices that have been nurtured over long periods of time and with anticipation for changes that may take place in the future. Establishment of integrated natural Protected Areas that include terrestrial areas, in addition to protecting natural environments while discussing possibilities that make sustainable use feasible, signal the start of such processes. Nature, which is being utilized for tourism purposes, possesses the ability to calm and heal. However, an excess of tourism activities will cause such properties to be lost. As such, balance between conservation and utilization should be considered.

It remains a fact that improper handling of natural environments may lead to irreversible outcomes. The regeneration of natural environments that have once been lost is an effort and cost intensive task whose immensity has been proven in so many past examples seen across the world. It is thus crucial to begin immediate dialogue and engage in action as soon as possible.

Examples from Okinawa have been introduced in many sections of this report. This is because situations that occur in places with large populations and a high level of pressure on nature that is derived from human activity such as Okinawa are thought to function as a good source of reference when thinking about environmental conservation and utilization of nature in the Republic of Palau. It is also hoped that such discussions serve to contribute to the construction of a good relationship between the Republic of Palau and Okinawa, as well as Japan, that is characterized by strong bonds of friendship.

An awareness of two vital issues were formed in the process of undertaking this project, the keywords of which are “connection between land and sea” and “network”.

With the establishment of MPAs, output of marine resources and species populations will increase as long as

optimal environments are maintained. However, it is important to pay close attention to the relationship shared with surrounding conditions as problems may arise if there is the presence of external pressure that imposes changes to the environments found within MPAs. Effects brought about by the influence of terrestrial areas is the most important factor. Active discussions concerning the protection of watersheds has been carried out in the Republic of Palau. The idea put forth within this project that it is crucial for terrestrial and coastal areas to be regarded as an inseparable system, is a concept that has been considerably promulgated. It remains important to make explanations of this idea on a scientific foundation possible so as to enable it to be easily understood by people.

Two types of networks have been presented under the Palau Integrated Marine Protected Area Model. The first is the network of people and organizations of diverse backgrounds that are involved in MPAs. It is of great significance to be aware of the importance of sharing information on the contents of individual MPAs, mutually understanding respective characteristics, building networks and exchanging opinions. This is because each MPA is expected to have its own unique characteristics. It is because of this heterogeneity that overall efficacy is enhanced and networking construction bears significance. With the integrated model, the national government, local governments, local communities and residents, NGOs and scientists assume a diverse network that is aimed at the overall management of Protected Areas. Various thoughts and ideas that are put forth through discussions are anticipated to be useful for environmental conservation and sustainable use of resources, so it is desirable to establish such sessions (tentative name: Palau Integrated Coastal Zone Management Committee) from early stages of MPA establishment. Such moves will no doubt spur the development of land-use policies (overall zoning of public land) that are grounded in perspectives based on the future and serve as a committee for the progress of crucial discussions that are linked to the future of the Republic of Palau.

Another type of network refers to the biological network of MPAs. Each MPA is home to specific environments with unique characteristics and species of plant and animal life. Living organisms that move from within MPAs to external areas become part of fishing catch for marine product industries, while other organisms begin new life upon moving to other MPAs. In the event that influence from human activities causes an impact on MPAs, the implementation of conservation and policies for the preservation of resources must be undertaken immediately from the above-mentioned perspective. To this end, early consolidation of life histories and other information of main biological species must contribute to the establishment of measures and their actual implementation. Such efforts for the securing of ecological networks are not only important for the protection of biological resources but are also a crucial contribution to the preservation of biological diversity.

At the same time, networks between the MPAs found in the Republic of Palau and those of nearby countries are also vital. Sea life move from place to place based on various processes in their life histories. For species that move over large physical distances, international cooperation in addition to measures by a single country are needed to ensure adequate protection. It is hoped that fundamental research that proves the importance of such cooperation from a scientific perspective is promoted.

In the course of advancing such activities, it is necessary to determine actual conditions through frequent monitoring and carry out review and revisions wherever necessary. For this purpose, the establishment and activities of a human network composed of relevant persons of various backgrounds are anticipated.

Understanding ecosystem services and assessing the value of ecosystems are important when MPA activities are in progress. Humankind receives a multitude of benefits from nature, and these benefits are known as

ecosystem services. Ecosystem services as also used a basis for forming judgments on the value of nature. Protected Areas are established upon the recognition of the value of nature contained within its boundaries. Of late, attempts are in progress to quantify the merits of nature in terms of monetary value. While such efforts have been grounded in economic value assessments that are closely associated to human activities, the ultimate presentation of effective conservation policies requires the carrying out of assessments from a variety of perspectives. In order to preserve the beautiful nature of Palau for future generations and contemplate the co-existence of man and nature, discussions that reflect the outcomes of value assessments of ecosystem services will become extremely important in future.

Climate change has impacted upon the natural environment and also our lives in many ways. Nature that is found in tropical regions is one of the most susceptible to the effects of climate change. It is therefore necessary to reconsider present environmental conditions from the perspective of global climate change and promote a variety of activities that reflect important information originating from the Republic of Palau and the rest of the Micronesia region so as to maximize such outcomes in environmental conservation policies and preserve the beauty of Planet Earth.

The development of talent and human resources is also an important and pressing issue to the crux of this project. It is crucial to make this a constant theme in various discussions to be conducted in future and prevent neglect of efforts to achieve this aim.

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