Community Consultations on Marine and Terrestrial Resource Uses

submitted by

Palau Conservation Society

as information for

Palau's National Biodiversity Strategy and Action Plan

March 2003

Table of Contents

Acknowledgements

We would like to thank the Chiefs and Governors of all the states who offered their help on these consultations in their states. We would also like to thank David Hinchley of The Nature Conservancy for helping us develop the methodology. We would like to thank the Office of Environmental Response and Coordination (OERC) for funding the work. Finally, we would like to give special thanks to all of the people throughout Palau who generously offered their time, thoughts and knowledge about Palau's natural resources during the community consultations.

The PCS NBSAP Team

Interviewers and recorders:
Henson Deltang
Bernie T. Keldermans
Tino Kloulchad
Jason Kuartei
Althea Malsol
Charlene Mersai
Ilebrang Olkeriil
Linda Pedro
Yalap P. Yalap

Interns:
Ebil Matsutaro
Erbai Matsutaro

Report compiled and edited by:
Elizabeth Matthews

Introduction

The overall objective of the community consultations is to gather basic key information on resource uses in Palau. One of the most direct means of collecting that information is to ask the resource users themselves. They are the people who have first-hand knowledge of the local uses and current state of many of the terrestrial and marine resources in the country.

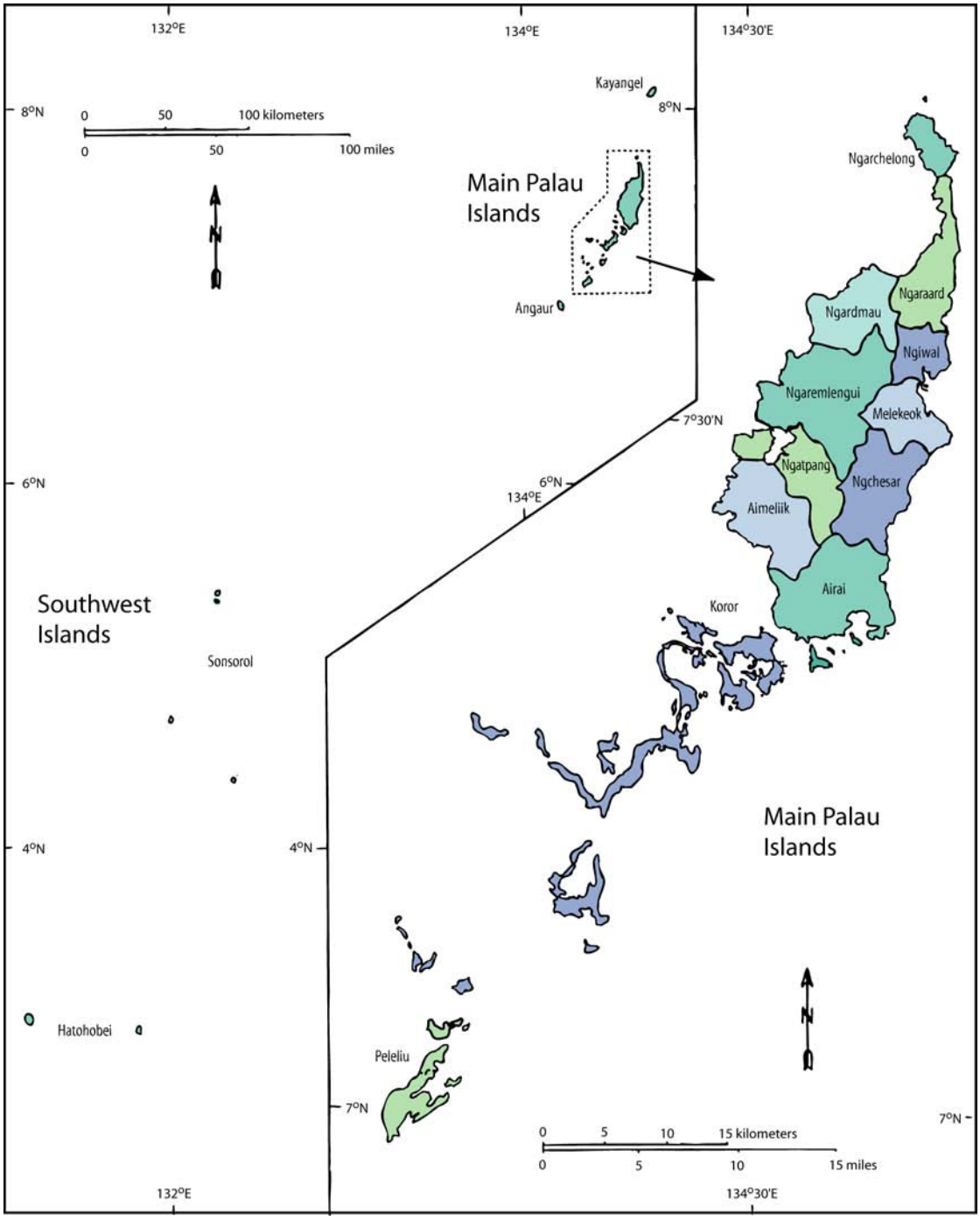
The information collected through the community consultations includes:
- the extent to which resources are being utilized in each state
- sustainability of current resource use patterns
- distribution of benefits from resource use within the community
- identification of unused or underused resources that could be tapped for future use
- identification of information gaps

For the purposes of this study, resources were defined as those general categories of flora, fauna or non-living substances that are utilized by local people for food, medicine or raw materials. In Palau, the most important resources are marine fish and invertebrates, coral reefs, mangroves, trees, wild plants, freshwater fish and invertebrates, fresh water, and farmed crops. Habitats that are important for these resources are the outer and inner lagoonal reefs, lagoons, seagrass beds, mud flats, mangroves, upland forests, swamp forests, savannas, atolls, beaches, rocky shores, and taro patches. Other resources that are used in Palau, but more on a commercial scale are gravel, rocks and sand.

Methods

Community consultations were conducted by teams of researchers from the Palau Conservation Society in 14 of Palau's 16 states. Southwest islanders (Hatohobei and Sonsorol states) were interviewed in Koror, where most now live. A total of 357 people were interviewed between June and October 2002 for this study. Trial interviews were conducted in Aimeliik and Ngaraard states. After these interviews, the team slightly revised its approach to information gathering.

The research team attempted to keep the style of the interviews relatively informal, so no pre-printed questionnaires were used. In general, although there was slight variation in the interviewing process from state to state, the consultations were conducted as follows:
- Key resource users in each state were identified through key informant interviews with knowledgeable people from the community. Such key informants were usually the governor or traditional chiefs.
- These resource users were interviewed at home, if possible.
- If those pre-identified people were not at home, interviews were conducted house-to-house. Care was taken to ensure a cross-section of people of different ages and gender. After those people were interviewed, they were then asked who else in the community was an active user of key local resources.



In each state, the research team attempted to interview a cross-section of people. This cross-section included men and women of young, middle and older ages. These people could be considered more generalist in their resource use activities. Once representatives of each of these groups were interviewed, specialists in particular resource uses were sought. For instance, storyboard carvers, medicinal plant collectors, and weavers were considered specialists.

TABLE 1. Number of people interviewed by state.			
State	Male	Female	Total
Aimeliik	12	6	18
Airai	8	9	17
Angaur	5	10	15
Hatohobei	7	9	16
Kayangel	13	8	21
Koror	22	22	44
Melekeok	4	10	14
Ngaraard	20	5	25
Ngarchelong	23	14	37
Ngardmau	9	7	16
Ngaremlengui	7	10	17
Ngatpang	10	5	15
Ngchesar	11	4	15
Ngiwal	11	12	23
Peleliu	12	11	23
Sonsorol	19	22	41
TOTAL	193	164	357

State visits ranged from 2 to 5 days, depending on the state, the number of interviewers available and the quality of the individual interviews as they progressed. Interviews were conducted in Palauan. The interview team usually consisted of 2 or 3 people, although occasionally a team was a single person. If there was more than one person on a team, one person acted as interviewer and one person as recorder. The interviewers followed a general set of questions based on the objectives of the study, however not all people were asked all questions. Generally, the interviewers tried to find as complete an answer as possible to all the objective questions over the course of the interviews in the state. A state was considered "finished" when the team felt the objective questions listed above were answered as well as they could be in the time allotted.

Topographic maps were referred to during each interview, and informants were encouraged to locate key resource use areas on the maps.

The notes from each of the individual interviews were compiled into a summary for each state in English. These state summaries are presented in this report. The original notes from the interviews (in Palauan) are on file at the Palau Conservation Society office.

METHODOLOGICAL ISSUES

Three main difficulties were encountered over the course of this study. They are listed here for future reference. They relate to methodological issues that may have affected the quality of the information collected.

The first issue relates to the difficulty associated with collecting information about certain activities. For instance, most Palauans know that hunting pigeons is illegal. However, they also know that the practice continues. Most people did not feel comfortable talking about such activities. People also did not want to talk about medicinal plants. There is a belief in Palau that the medicinal properties of plants will disappear if they are spoken about.

Secondly, the topographic maps were difficult for many people to read. Only those people who really knew the resources and were still actively using them were comfortable with the maps. Older people and many of the women were not comfortable placing sites on the maps. Often the site names used locally and those printed on the topographic maps were very different. At times the research teams, who were not familiar with all of the states that they conducted the interviews in, could not easily identify where on the map people were referring. This difficulty could perhaps have been minimized if a person from the state office had been recruited to help with site identification and to help place sites on the maps during the interviews.

Finally, time was always an issue. This study would have been greatly enhanced if more time was available to interview people in each state. Palauans are very dependent upon their natural resources and have a great deal of knowledge about those resources. Individual interviews with knowledgeable people often lasted two hours or more. Given the limited time and the nationwide scope, this study provides an overview of some of the major resource uses and issues by state. Follow-up interviews for additional clarification were often not possible given the time constraints. This study highlights some of the areas that villagers say are problematic (such as localized resource depletion and sedimentation), but it does not attempt to be quantitative or definitive. Occasionally, no one in a state mentioned a resource or issue (for instance, dredging) that is widely known to occur in that state. As a result, that resource or issue does not appear in the state summary. There are many reasons why something was not mentioned during the interviews. It should be kept in mind that such omissions could, and probably did occur. At the same time, much rich information about each state was obtained. This study is a broad brush picture of some of the major resource uses and issues as seen by some of Palau's residents.

About the State Summaries

Sixteen state summaries were compiled from the notes taken during all of the interviews for each state. The identity of the informants has been kept confidential. The information is presented so as to answer the overall objectives stated above and has been grouped into the following sections:

- Extent of resource uses - this section includes a list of the primary resources mentioned during the interviews
- Changes in resource use patterns
- Threats to the resources
- Sustainability of resource uses
- Unused or underutilized resources - identified by the people interviewed
- Information gaps - identified by the people interviewed as well as by the researchers. Researchers noted information gaps when they could not find people in a state who know about particular resources or activities. This could have been because certain key people were not to

be found, or because the people interviewed knew nothing about those resources, or because no one in the community was knowledgeable about a particular resource anymore. These are areas for future enquiry and action.

At the end of the state summaries is an overall summary of the major findings of this study. The key resources used, issues and concerns related to the resources, sustainability of uses, and concerns and information gaps that were identified over the course of the community consultations are included in tabular form by state. A glossary of Palauan terms mentioned in the text follows on page 121.

Aimeliik

EXTENT OF RESOURCE USES

The population of Aimeliik in 2000 was 272. Eighteen people from the state were interviewed for this study. Four hamlets in Aimeliik are currently inhabited. The IPSECO power plant, is located in Ngchemiangel, Aimeliik. This in one of two power plants that supplies electricity to Babeldaob and Koror.

Main Natural Resources

- Marine fish
- Marine invertebrates
- Farm crops
- Forest trees
- Taro
- Medicinal plants
- Fresh water
- Mangroves
- Plants
- Birds and bats
- Lime (*aus*)
- Cultural site (Omabael)

FISH: Aimeliik has many rich marine fishing habitats. All kinds of reef fish are caught from Aimeliik's waters. Big fish such as *maml* (Napoleon wrasse) and *kemedukl* (bumphead parrotfish) can still be found. Reef fish are caught for big community activities that requires group fishing. *Melkesokl* (coral heads that rise in deep lagoon areas) are the best nighttime spearfishing places. Because there are many between of these habitats between Aimeliik and Koror, residents from Koror often fish at these *melkesokl* as well.

The whole lagoon in front of Aimeliik is a very good place to catch fish by line fishing. However, it is not a very safe place to fish because of the heavy speedboat and tugboat traffic. Even big container ships that travel to Koror pass near the Aimeliik reefs.

INVERTEBRATES: Aimeliik is well-known as a place to collect the swimming crab *kmai* (*Portunus pelagicus*). Other invertebrates that are collected from Aimeliik's reef flats are sea cucumbers (*molech*, *cheremrum*, *temetamel*, *bakelungal*, *irimd*, and *ngims*); bivalves (*kim*, *oruer*, *duduomel*, *delbekai*, and *kikoi*); lobster (*cherabrukl*); crabs (*rebotel* and *ksull*); and sea urchins (*ibuchel*). Corals are collected and used to make lime for chewing. They were also used to make white paint. Although traditional paints are not used very often today, when a *bai* was built in Aimeliik in the mid 1990s, the paints were made from local materials.

During trochus season, people from Aimeliik, whether they are living in Aimeliik or in other states, collect trochus at the designated areas on Aimeliik reef.

Women from Aimeliik collect mangrove clams (*ngduul*) and men trap crabs (*chemang*) from the mangroves.

FARM CROPS: Aimeliik is second only to Airai for farming and gardening. Several large farms are in the state. The Chinese Agriculture Technology Mission sells their produce at Agrifund, Malakal in Koror. The Mission helps local farmers by providing seeds and seedlings. They also donate fruits to Aimeliik Elementary School.

Not long ago, an Aimeliik women's group called Ngarayolt took over Subelek Farm which had been started by the prisoners some years ago. Recently, the first harvest of sweet potatoes was sold to Daewoo Company. Taro and tapioca crops are not yet ready for harvest.

The Palau Bureau of Agriculture has a station located at Nekken in Aimeliik. The station propagates trees that are available to anybody.

OISCA, a Japanese agricultural program, has recently been revived. Land is being cleared and the area is being cleaned.

In addition to these large agricultural projects, individual families tend one or more gardens (*sers*) to grow family food such as tapioca, sweet potatoes, taro, pumpkin, and a variety of vegetables.

TARO: Even though fewer women are still maintaining taro patches, the taro patches are still valued. There's a Palauan saying that was heard during the interviews in Aimeliik: "*Ngikel ngarengii a meklechel a meral redil*," that means, "those who have a taro patch are real women." Taro from taro patches have higher value in the customary exchange than taro from *sers* (dry land). Like pigeons (*belochel*), taro from *mesei* are considered "*ngarbab el telechull*" (food that is exchanged as a traditional obligation or favor).

Many swamps are planted with giant taro and left unattended until they are ready to be harvested.

MANGROVES: Mangrove wood is used to build summer houses. Trees that are used from the mangroves are: *mekekad*, *tebechel*, *urur*, and *meduulokebong*.

Mangroves are recognized as being important habitats for replenishing invertebrates in the shallow areas and fish in their natural habitats. Areas near the mangroves that have seagrass are a feeding place for stingrays and dugong.

TREES: The forest areas surrounding the waterfalls, rivers, and springs are places where most birds and other animals are found. Many trees have fruits that birds and bats eat. The trees are also used as nesting and dwelling places.

Not many people use local forest timbers to build houses now. Some still use local timbers as posts for house extensions or for decorative posts.

Forest trees that could be used for building houses and canoes are: *btaches*, *kodenges*, *kelelacharm*, *miich*, *emeklachel*, *ukall*, *tilol*, *meduu*, *beokl*, mahogany, *las*, *bkau*, *ksid*, *blacheos*, *ngmui*, and *udeuid*. *Udeuid* is found only found in Aimeliik and Airai.
Important planted trees are: *lius*, *bisech*, *buuch*, *tuu*, *keam*, *riamel*, *miich*, and *meduu*.

Other plants that can be used when making a traditional style house are: *buuch*, *lius*, bamboo, and *buuk* for floors; *toechel*, *such*, *bekuu* for the roof; *cheremall* (hibiscus tree) and coconut husks for string and rope. *Cheremall* bark is also used to make grass skirts and the leaves are good mulch. The fruit of the *cheritem* tree was used to make dark red varnish.

MEDICINAL PLANTS: Medicinal plants are still collected from forests and savannas. Medicinal plants that are collected in Aimeliik are: *delal a kar*, *ngolm*, *kirrai*, *ngel*, *klsechedui*, and *kemokem*.

FRESH WATER: There are four big rivers in Aimeliik: Ngerderar, Ngeriwall, Tabecheding, and Ngchemiangel. These are important water sources for the State of Aimeliik. Imuul and Ngerkeai hamlets receive water from a dam on the Ngeriwall River. Ngchemiangel and Medorm hamlets share water from a dam on the Ngchemiangel River. A dam is being planned to be used by Elechui.

BIRDS and BATS: Ongisekikl is the area where the water for Tabecheding River comes from. It is an area rich in forest trees and bird life. Many birds are found in this area because there are a lot of plants with fruits near the river. *Bekai* (Micronesian megapode), *belochel* (pigeon), *olik* (fruit bat), *laib* (Nicobar pigeon), *biib* (Palau fruit dove) and *debar* (gray duck) all live in Aimeliik. Pigeon hunting is prohibited, but since the demand for pigeons is so high, hunting pigeon is a source of extra income for young men.

CULTURAL SITE: Omebael, the rock sticking out of the water in front of the power plant is a cultural site and an important landmark for travelers.

CHANGES IN RESOURCE USE PATTERNS

Traditionally *belochel* (pigeon) was food exchanged as an obligation or favor (*ngkall e ngarbab el telechull*). Now young men often hunt pigeons and trap mangrove crabs when there is a request for them, especially from people living in Koror who want the birds and crabs for customs or special celebrations.

Most men and women, except for the elderly, work at the State office, IPSECO power plant, the forestry department, Chinese Agriculture Technology Mission, High Adventure (a religious radio station), or the Aimeliik Elementary School. Because most people have jobs, selling fish and farm produce is not the main source of income. Women buy taro and tapioca from other women when they have customs, and when they do not have time to collect their own.

DUGONG: *Mesekiu* (dugong) was heavily hunted. Elekliis in Aimeliik is an area in the seagrass beds off the coast of Aimeliik where dugongs came to give birth. The animals were hunted from this spot as recently as the mid 1990s. Now, people are not sure if any dugongs still visit the site.

TURTLES: Hawksbill turtles were hunted from their feeding areas around Aimeliik. They are still caught when the community needs them for large events such as customs.

THREATS TO THE RESOURCES

DESTRUCTIVE FISHING METHODS: *Dub* (dynamite) and *derris* a toxic vine, were used extensively for fishing around Aimeliik. Schooling fish such as *kelat*, *smach*, and *terekrik* were targets for dynamite fishermen. Bundles of pounded derris were placed under coral heads to kill fish. Sea cucumbers and corals in the vicinity were also killed when derris was used. Reefs that were dynamited as long as 30 years ago, are still dead. Although dynamite is no longer used, it was unclear from the interviews whether *derris* is still used around Aimeliik.

NEW TECHNOLOGY: People use scuba gear to catch large fish and large schools of fish in the deeper water areas now.

INCREASED BOAT USE: Too many boats travel close to the mangroves and shallow nearshore areas when the water is rough. People believe this boat traffic has killed many sea urchins and sea cucumbers. Ngerchebal Island was a nesting place for sea birds. Most birds nest somewhere else and only use the island only as a resting place because the boat traffic has scared them away.

HABITAT DESTRUCTION: Forests and savannas have been burned and bulldozed.

POLLUTION: People are concerned about the possible affects of the pesticides, fertilizers and herbicides that are being used at many farms.

SEDIMENTATION: Soil from the dirt road and from the clearing of land for new houses has eroded into the mangroves and taro patches.

PESTS: There are many introduced animals that are becoming pests in Aimeliik. Escaped pet monkeys that have gone wild are increasing in number. They eat all kinds of fruits and bird eggs. People are afraid that they will have to face what people from Angaur are facing now - bands of destructive wild monkeys. There are also too many *chelub* (Indian monitor lizard) eating megapode and other bird eggs. Wild pigs are eating taro and everything else at the farms. Wild cats are also increasing in number. These cats also eat bird eggs. There are more wild dogs and rats. The native bird *uek* (purple swamphen) eats taro from the taro patches. Finally, coconut beetles have damaged coconut trees.

DANGEROUS ANIMALS: Crocodiles are increasing in number. Crocodiles eat crabs and fish in the mangroves. There are also many introduced honeybees (*hats*) that sting very badly.

INVASIVE PLANTS: Many invasive plants are growing in Aimeliik: *kebeas*, *ngesngesil, mechiuaiu*, *bokso*, and *tochedulik*.

MANGROVES: Mangrove roots are extending further into *lalou*, making this area too shallow for juvenile fish to live in and for adult fish to feed during high tide.

DREDGING: Dredging sand has caused siltation all over. However, some people who were interviewed said that there are more fish now where the sand was dredged.

SUSTAINABILITY OF CURRENT USE PATTERNS

One informant mentioned a Palauan belief that no man should take more than seven large animals over his lifespan. These could include dugong, turtles, or large fish like *maml* and *kemedukl*. If a man caught more than seven animals, the action of taking so many lives would turn on him. If followed, this belief would limit the number of large, slow growing fish and marine animals that were caught by fishermen and hunters. Unfortunately, the belief is no longer commonly held.

FISH and INVERTEBRATES: There are signs of depletion of marine resources around Aimeliik. The areas in between *lalou* and the bay on the southern coast of the state, and also near the reef at the western end are not as rich as they used to be. There are few juveniles and adult fish in these areas. Stingrays are not commonly seen feeding.

Twenty to thirty years ago, the use of dynamite to catch schools of fish was very common. The reefs around Aimeliik where dynamite was once used to kill fish are still dead. There are no longer large schools of fish and numerous invertebrates, such as sea cucumbers in these areas.

The mentality regarding fishing and collecting invertebrates leads to actions that are not sustainable. Although most young men and women do not rely on resource collection for their livelihoods because they have other types of employment, they are still catching a lot of fish and collecting a lot of invertebrates from the reefs. They can catch a lot of fish in a very short time without apparent concern for possible damage to the resources. If the catch is too large for immediate needs, the excess is frozen.

Fishing is now more a sport than a necessity. Overfishing is not seen as a negative action. Today, to catch a lot in a single fishing trip is a sign of a good fishermen. This attitude together with the belief that the ocean in front of Aimeliik and around Palau can never run out of fish, will lead to seriously overfishing.

New equipment and big boats are signs of success. The new gear is much better, stronger, lasts long, and catches more than traditionally used gear. New equipment is non-selective and does not discriminate between big fish small, adult or juvenile. Everything is caught. In addition, the equipment can be uses anytime, day or night.

The ocean and creatures living in it are no longer respected and treated as a vital part of the local livelihood. The ocean is normally thought of only as a highway for boats. The creatures are seen as objects to be caught.

CROPS: The family farming practices are sustainable. People still terrace hillsides to prevent erosion and plant crops in ways to replenish the soil.

TREES: Tree cutting is currently sustainable in Aimeliik because it occurs on a small scale. The trees are cut only for small projects.

HUNTING: Hunting of pigeons may not be sustainable, although it is unclear how many are actually being caught or what the status of the bird population is. Many requests are received by the young men for pigeons, and they are eager to make the extra income from their hunting activities.

DISTRIBUTION OF BENEFITS

Everybody at Aimeliik benefits from the resources Aimeliik offers. Because most people work, nobody needs to sell farm produce or fish to markets in Koror. Most produce and fish are used for family consumption. If there are requests for pigeon and mangrove crab, then a few young men go out to collect them. These men make money from their catch.

UNUSED AND UNDERUTILIZED RESOURCES

Fruit and nut trees: coconut, cacao, coffee, citrus fruit, betelnut

Cheritem and mahogany trees

Medicinal plants such as *delal a kar* and *ngel* (Indian mulberry)

Farmed mangrove crabs

Edible seaweeds

INFORMATION GAPS AND NEEDS

Ways to conserve local resources and to replenish ocean species that are collected for food

Status of Micronesian megapodes, pigeons and dugong are unknown

The extent of sedimentation from eroding soil in Aimeliik is unclear. The areas that people frequent and know (mangroves and taro patches) have been affected. However, they do not often go to the rivers or other areas, so do not know if the sedimentation has damaged these areas.

The impacts of dredging operations are unknown. Some people say there are more fish around the dredged sites; others say the dredging is damaging the marine habitat.

Impacts of pesticides, fertilizers and herbicides on the environment.

Airai

EXTENT OF RESOURCE USES

The State of Airai is situated at the southern end of the big island, Babeldaob. The Palau International Airport is located in Airai. Airai supplies fresh water for residents and businesses in Airai and Koror. In 2000, the population of Airai was 2,104. Seventeen people in Airai were interviewed in this study.

Main Natural Resources

- Marine fish
- Marine invertebrates
- Mangroves
- Land
- Farm crops
- Taro
- Trees
- Medicinal plants
- Fresh water

FISH: *Lalou* (the outer edge of the mangroves) is a place where many juvenile fish are found. *Lalou* is also a resting and a feeding place for stingrays (*rrull*) and fish such as rabbitfish (*meas*). It is a good fishing place early in the morning during high tide for stingrays and rabbitfish.

Fishermen fish at patch reefs for different kinds of reef fish. For daily meals, fishermen fish at patch reefs both on the east and west sides of Airai. Mud-bottomed passages (*lemau*) at the edge of *uet* (deeper areas of water, basically a salt water pond that is left in seagrass beds or other areas at low tide - marine lakes are also called *uet*) contain a variety of fish. Fishermen treat these passages with care. Men fishing with spearguns usually fish for bigger fish at coral heads. Both barrier and fringing reefs are places where many kinds of fish can be caught, normally to sell and for traditional customs. Fishing is the main source of family income especially for those who do not have jobs. It also provides families with fish daily.

INVERTEBRATES: Women collect mangrove clams (*ngduul*) for family consumption, and to sell at markets or small stores. Men collect mangrove crabs (*chemang*). Crab sales are one of the best sources of income for unemployed men. Most crabs are sold at restaurants or fish markets.

Rock islands between the reef and the mangroves protect the shallow area with seagrasses and the land. Residents collect *kesuar*, a type of land crab, land crabs (*rekung*) and coconut crabs (*ketat*) at the rock islands. The beach at Ngerduais is the only place in Airai where hawksbill turtles nest.

Nobody collects turtle eggs. Little sand clams (*chesechol*) are also collected on rock islands beaches. Rock islands are also places for family picnics.

Women collect invertebrates at the shallow areas with seagrass (*kerker*) for food, and mostly to sell at market places and small stores. Selling invertebrates is the main source of income for non-working women.

Reefs are the only places to collect trochus during trochus season.

LAND: Whether lands are public, clan or family properties, people in Airai consider land very important to the survival and the continuation of family tradition and customs. With close proximity of Airai to Koror where jobs are concentrated, many new families are moving into Airai. Most of these people are not from Airai, but have obtained land leases to build their houses. There are two new housing subdivisions that are bigger than the original hamlets. These newly developed areas are Kesebelau and Ngerikiil. Housing development is encroaching on wooded areas.

The northern edge of the state up to the boundary with Ngchesar and the northwestern side near Aimeliik are still covered with forests, semi-forests, and savannas.

FARM CROPS: Most families have gardens for tapioca, sweet potatoes, taro, and vegetables used for daily consumption. Some women who have extra produce sell products for small amounts of income. Most of the local vegetables sold in Koror come from farms that are along the side of Ngerikiil River. These farms are some of the biggest in the country.

TARO: Taro patches (*mesei*) feed many families everyday. Taro (*kukau*) is planted in *mesei*, with giant taro lining the raised dividers (*cheliuis*). Giant taro (*brak*) are planted in fresh water swamps (*omrekongel*). Women put more work and art of taro patching into *mesei* than *omrekongel*. Many adults depend on taro and other root foods daily if they cannot afford to buy rice.

MEDICINAL PLANTS: Medicines are collected from both forests and savannas. Most medicines collected are for *omesurch*, a Palauan ritual of cleansing and healing for women after having a first child. Important habitat for medicinal plants is being destroyed as housing development expands.

TREES: Big posts for building homes, extensions, and summer houses are still taken from the Airai forests. There is a plan to require permits when cutting down trees. People still collect firewood from forest.

FRESH WATER: There are three watersheds in Airai. Ngerikiil is the largest. It is enclosed by a ridge except at the southeastern end which is opens into the ocean. The water collected from the area feeds into small tributaries and two big rivers (Kmekumel and Edeng). The water then feeds into the Ngerikiil water storage area. Water is also drawn from the Ngerimel River. Residents from both Airai and Koror depend upon these two river systems for their fresh water supply.

CHANGES IN RESOURCE USE PATTERNS

FISH: Airai is well known for the spawning of rabbitfish, especially during the months of April and May. This kind of fishing is called "community fishing" (*omenged el buai*). Fishing for rabbitfish (*meas*) in a traditional way is no longer practiced, but was the best method of sustainable fishing. It was a controlled fishing that was meant for the whole community. It is no longer so, and this uncontrolled fishing is the main reason for the depletion of rabbitfish.
Not only people from Airai fish in Airai waters. Airai is so close to Koror, it is an ideal place for Koror residents to fish and collect invertebrates here. Other nationalities are also fishing and collecting invertebrates.

The ocean feeds not only people from Airai, but also those Palauans and non-Palauans living in Koror. When the temporary bridge was still in use, it was the most favorite fishing area for non-Palauans.

Fishing with *ruul*, the traditional fishnet made of coconut leaves, is no longer practiced. It has been replaced by nylon fishnet which are sturdy and non-biodegradable. But all kinds and size of fish that are caught in this new fishnet could not escape. It is one of the best fishing gear for fishermen, but the worse type of gear fish, big or small could escape from this kind of fishnet.

INVERTEBRATES: Not all women collect mangrove clams or invertebrates. Those who collect invertebrates sell most of their catch to help family income. Mangrove crab collection has changed. New metal traps (*bub*) are used instead of the old bamboo traps (*kual*). Most crabs are now collected for commercial sale. In addition, people are setting baited traps rather than going to *ochab,* a natural place in the mangroves where crabs can be found. Small crabs are generally not thrown back into the water, but are taken home for the family.

Both edible and inedible invertebrates are decreasing in number. This is due to: sedimentation and siltation from earth moving (airport, road and housing development), sand mining and filling areas to make land. Sedimentation (at Uchul-a-Ngas) comes up to the knees. Coral heads are covered with soil sediment and silt. Siltation is damaging and killing seagrasses, thus removing an important habitat for fish. Chlorine bleach and chemicals from laudromats or kitchens flow into mangroves and the sea. Overharvest for the purpose of selling at market places. Very few clams can be found near reefs where water is still clear from sedimentation and siltation.

TREES: The forest is very important to people in Airai. Water, fog and dew collected by the forest is stored in soil and the excess runs down into rivers and small tributaries. People have noticed that when big forests were closer to the village, the air was cooler, especially at night. In fact, during easterly wind, coconut oil will get harder after standing overnight. It was so cold at night that people used thick blankets at night. As communities expand and the forests get smaller, the temperature of the air is getting warmer.

Very little timber is taken from both forests and mangroves. People from Airai still use local woods to build outdoor extension to their houses, outside kitchen and resting places called summerhouse. There are houses in Airai with the local lumbers as framework. Older Palauans prefer to build their houses with local lumbers. But due to some inconveniences, imported lumbers are used to build houses to meet local demands and low cost.

Mangrove trees are not used to build houses as they were previously. However, they are still used as building materials for summer houses and outdoor extensions. The survivability of *lalou* (the seaward edge of the mangroves where many juvenile fish are found) is largely dependent on the mangroves acting as a huge filter system.

MEDICINAL PLANTS: Common medicinal plants for *omesurch* (hot bath ritual for new mothers) are getting harder to find these days. Women need to go farther into forest and far away savannas to collect (*mengereker*) common medicinal plants as well as family special ingredients. It is getting harder to find medicinal plants near villages. Clearing areas to build houses, and the development and expansion of new communities, has destroyed many important habitats for medicinal plants.

FARM CROPS: Products from gardens, farms and taro patches are no longer just for family consumption and once in a while for customs. Most of the products are sold at markets or stores both in Koror and Airai. This is a good income generating means for non-working women. Even though selling local food is increasing, families still eat local food on a daily basis. Most people who buy local food at markets or stores are Palauans.

TARO: In Palau, taro patches are well known only as women's places. However, many women are now hiring men from the Philippines and Bangladesh to work the taro patches for them. Most women who tend taro patches are getting too old to do taro patching. Younger women are busy working in Koror or with the State Office.

In addition, many *mesei* and *omrekongel* have been left uncultivated. These areas become overgrown and are then known as *dechel*. Some *dechel* at Ngediull have been converted back to *mesei* or *omrekongel*. Many women are planting taro at dry-soiled farms rather than maintaining *mesei*.

Many taro patches are not the same because of sedimentation from erosion. The work of the national airport started during Japanese administration and finished during American administration in the 1970s. Since that time, women have noticed changed in their taro patches, in the rivers all the way out into the ocean, and throughout the other fresh water swamp areas. Taro patches are dryer and do not produce big, healthy, good and heavy roots, and have fewer seedlings.

BIRDS: Airai residents that were interviewed for this study claim that no one hunts pigeons or fruit bats. There is a law prohibiting pigeon and fruit bat hunting.

THREATS TO THE RESOURCES

FISHING METHODS: Scuba tanks are used while some fishermen catch many big fish, especially napoleon wrasse (*maml*), bumphead parrotfish (*kemedukl*) and schools of fish such as unicornfish (*chum*). Some people may be using chlorine bleach when fishing as well.

Fishermen think of getting everything now because tomorrow never comes, or they think that if they leave some, somebody comes along and get them for themselves. This is a very greedy attitude. Fish are not only depleting but also are getting smaller in numbers, and do not travel in schools like they used to.

LOSS OF TRADITIONAL PRACTICES: Traditional skills are disappearing very fast. This affects fishing, farming, hunting, medicinal plant collection, tree cutting and taro growing activities. It also results in people being less aware of the state of the natural environment around them. They are becoming more removed from the rhythms of the land and sea.

INTRODUCED SPECIES: Bees (*hats ra ngebard*) that were introduced to make honey are seen as a threat by some Airai residents. They claim that the bees do not pollinate the plants properly and that they sting more often than native bees.

DISEASE AND PESTS: Plant diseases and insect infestations, such as *mellill* and "aids," have damaged tapioca crops.

HABITAT DESTRUCTION: Bulldozing land for housing development and for the Compact Road may destroy Airai taro patches, mangroves and ocean. Inner mangrove areas (that side closest to land) are being filled for development purposes. At the same time, mangroves are spreading farther out on the ocean side, into the deeper edge (*lalou*), and out into seagrass beds.

Burning forests and savannas is a large problem in Airai. It kills many plants and animals, destroys their home, destroys top soil, and causes erosion that eventually will destroy rivers and water sources, fresh water swamps (especially taro patches), mangroves and ocean.

DEVELOPMENT PRESSURES: Land is more and more in demand for development as people move to Airai from other states. Airai is rapidly becoming a suburb of Koror. Land is used for houses as well as for the dumping of solid wastes.

SEDIMENTATION: Mangrove are no longer good nurseries because of sedimentation and siltation. As natural filters from land erosion, mangroves can no longer do a good job with the amount of sedimentation caused by human activities on land.

The nearshore areas that act as nurseries for fish (*lalou* and *uet*) are filling up with sediment and silt from land and sand mining, as well as from ocean currents. This is creating new land. As the edges of the mangrove (*lalou*) fill with sediment, the mangrove shoots can move in. Many mangroves are no longer good fish nurseries because of excess sedimentation and siltation. The sedimentation has filled areas that are important habitat for juvenile fish.

INCREASED MARKET DEMAND AND NEEDS FOR CASH: Market demand is the greatest contributor to the depletion of marine and terrestrial food supplies. It is a difficult situation, because people need to sell products in order to provide for their families. The demand for fish and other seafood is rising, and there is little attempt to find sustainable ways to produce more to meet the demand. Often people's attitudes have changed. People are living more for their present needs, and hope that the future will take care of itself. Attitudes such as this greatly impact how people behave in the environment.

SUSTAINABILITY OF CURRENT USE PATTERNS

FISH: Demand for fish in Koror is increasing, and the higher prices are very attractive incentives for people to sell fish. All kinds of reef fish are being depleted. Overharvesting is becoming an issue. Too many people (both from Airai and outside Airai) fish to sell (*omond*). Few people are practicing traditional and sustainable fishing skills. Fishing equipment has changed and has made it easier to catch more fish. Boats are often equipped with good lights and fish finders. Nylon nets of all kinds, spearguns, flippers, masks, flashlights, and scuba tanks are all being used to catch fish.

Many residents believe that there are too many motor boats traveling the same spots almost everyday where fish, corals and invertebrates spawn. They believe that the boats kill the larva floating near the surface of the water before they have a chance to develop fully and settle into the water column.

INVERTEBRATES: Non-traditional mangrove crab traps (made of chicken wire instead of the traditional bamboo, vine and mangrove root traps) catch both big and small crabs. Most crabs caught are female, as this is what most people want. These methods are unsustainable over the long term. Mangrove crabs have already shown signs of depletion.

Demand for mangrove clams is increasing. Areas where lots of clams (*ongduoll*) are found need to be taken care of in order to remain productive. Even though clams live all over mangrove areas, it is time consuming and not profitable to collect clams in many areas. The few places where women have put effort into clam collection have been overharvested. There are fewer mangrove clams which are smaller than the clams found in the past.

FORESTS: Many changes have been seen in forests in Airai. Soil underneath trees is dryer. Trees do not bloom and bear fruits as they used to, nor at the regular seasons (the two Palauan seasons are the six months that winds are from the east and the six months when winds are from the west).

Cutting trees from the forest for lumber is not done by many people since transporting timber out of the forest requires good equipment and a road system. People find that cutting mangrove trees is much easier logistically than cutting forest trees. During high tide small boats can tow trees out. Alternatively trees can be floated out of the mangroves to deeper water areas where boats can then tow them to a landing where they can be picked up by trucks.

BIRDS AND BATS: Pigeons fly to forests when certain trees are in fruit. The birds eat the fruit of a number of trees, including *choes*, *dekemerir*, *chelangel*, *ksid*, *miich*, *las*, *amansis*, and *demekegad*.

They travel from north to south and then south to north throughout the year in search of ripe fruits. Pigeons and bats are diminishing in number. It is not clear whether this is due to hunting activities, habitat loss, increased development or to other factors.

DISTRIBUTION OF BENEFITS

On land, only those who have taro patches or have access to those of their relatives and in-laws can plant taro for family meals or to sell to local markets and stores. This is approximately 75% of Airai's population.

Everyone has access to ocean resources. However, most younger people from Airai have jobs and therefore buy local food at local stores or at markets in Koror. Benefits are distributed well among the residents of Airai, however the cash economy is becoming much more widespread.

UNUSED AND UNDERUTILIZED RESOURCES

Betelnut, coconut and *cheritem* trees

Bauxite for use when cementing

INFORMATION GAPS AND NEEDS

How to control and manage the mangroves in order to protect the nearshore reefs. Residents are concerned that the mangroves are growing too far into the *lalou,* the deep areas on the seaward side of the mangroves.

Real impacts of sedimentation and road construction.

Angaur

EXTENT OF RESOURCE USES

Angaur is the southernmost island in the main island group of Palau. In 2000, the population of Angaur was 188. Fifteen people from Angaur were interviewed for this study. Most of Angaur's registered voters live in Koror or off island; less than half of the registered voters of the state reside on the island. Currently, there is a road construction project aimed at paving all of the roads within the town itself. This project is the largest employer on island and many young men are now employed to work on the road project. A small number of individuals work for the state or national government. Those who do not hold a position in either of these organizations are self-employed, which means that they either fish or harvest crops to sell locally or in Koror. All other residents fish and farm for themselves or are dependent upon other relatives.

Main Natural Resources

- Marine fish (*desui*, *keremlal,* tuna)
- Marine invertebrates (*oruer*, *kim*, crabs)
- Crabs
- Turtles
- Mangroves
- Land resources
- Farm crops (*buuch*, *kebui*)
- Taro

FISH: Fish are an essential part of the local diet. The few people who own boats do most of the commercial fishing in Angaur. They typically go out two or three times a week to fish when the weather allows it. The fish caught is almost always bought by the people in town who are unable to fish from boats. Almost everyone else fishes from several areas along the coast where line fishing is convenient. Everyone in the village uses the fish that are caught for household consumption.

INVERTEBRATES: Various types of molluscs are also collected from the reefs. The consumption of these molluscs is strictly local as there is an impression that it is unsustainable to collect them for sale. The types of molluscs commonly collected are *oruer*, *kim*, *delsangel*, *chechui* and *cheaol*. Both men and women collect these species. People usually eat them when they are out fishing. Some people will go out with small buckets and collect enough for several days. Collectors may use old windshield wipers and screwdrivers as tools to obtain clams. Harvesting molluscs depends on the tide and weather conditions, it is not always possible when the weather is rough.

CRABS: Land crabs and coconut crabs are collected by both men and women. Most of the crabs are consumed locally, however, there is growing trade to residents in Koror. *Kesuar*, another land crab, is also collected. Other crustaceans harvested include *chemang er a lekes*, a crab similar to the

mangrove crab found in the shallow areas inside the lagoon and *kesakou* or *rereek*, a crab found along the rocks on the shoreline.

TURTLES: Marine turtles are still harvested although current consumption is reported to be greater than in past years.

FARM CROPS and TARO: Cultivated crops are very important for the residents because they provide a regular source of food which does not have to be bought. Crops are not sent to Koror because the residents know that there would not be enough to support both local needs and to meet additional demand from Koror. This practice seems to have been maintained specifically with farmed crops and *ongraol* (starch foods such as taro). All households have a taro patch or a farm area where they grow their own starches and vegetables. Only *buuch* and *kebui* are commercially sold.

Women harvest crops for use by their families. Common planted crops are taro, diokang, *kalbasang* (pumpkin) and *chemutii* (sweet potato). The taro patches in Angaur and Peleliu are not as deep as those in Koror or Babeldaob. They are easier to maintain and take less effort for the women to plant or grow the taro. About 20 years ago the women found that it was easier to plant the yellow taro (*brak*) between the purple taro. Many continue to use this method of planting. Some women burn the area to prepare the taro patch for planting.

CHANGES IN RESOURCE USE PATTERNS

FISH: The two most common forms of fishing in Angaur are line fishing and trolling. There used to be a fishing cooperative, but has not been active since the 1980s. Currently there are only five motorized boats in use. The men who own them go trolling and line fishing and sell their catch to those who cannot go fishing. When there were more residents, there were more boats, however, since most people have moved off island, there are only the few boats left.

TURTLES: Marine turtles are still harvested and current consumption is reported to be greater than in past years. No reason was given for this increase in use. Despite the increased use, it is still possible to go out at the right time and catch 2 or 3 hawksbill turtles in one outing.

CRABS: Increasingly, Angaur residents are receiving special requests from relatives in Koror for land crabs. These are not necessarily used for household consumption, but for customs. The demand for kesuar and coconut crabs is also high.

TARO: The practice of kneading the taro patches is not used much anymore as people think it does not improve the quality of the crops.

FARM CROPS: The present site of the town in Angaur is not the site of original settlements on the island. Previous settlements were relocated from prime farming areas in order to allow for phosphate mining by the Germans in the early 1900s. Most of the areas formerly used for plantations are now overgrown and forested. The big areas traditionally used for growing taro have also been abandoned and now most patches are adjacent to the town. One of the major reasons

people say these areas have not been reclaimed is because of the persistence of invasive pests such as monkeys and shrews. There may also be less young women interested in farming the areas.

THREATS TO THE RESOURCES

INVASIVE SPECIES: The introduced population of macaque monkeys (*Macaque fascicularis*) in Angaur pose a serious problem for many of the residents. The monkeys were introduced to the island in the early 1900s by German settlers. Today, there are estimates that the monkeys outnumber people on Angaur 5 to 1. They raid crops and damage taro patches. Monkeys are the main reason why farms have not expanded beyond the borders of the town. Any farms away from town are difficult to protect at all times. However, there is one group of people who have started farming an area outside the village. Individuals in the group take turns visiting the farm everyday to ensure monkeys do not damage or raid crops.

The shrew is another invasive species that has become a significant problem. They eat root crops and are very difficult to trap. Because of their venomous bite, cats stay away from them.

Programs initiated by the state to eradicate both monkeys and shrews have not been successful and the animals continue to be a problem.

DISEASE and OTHER CROP PROBLEMS: Women say that there seems to be a greater incidence of crop diseases than in previous years. For example, *nguk* is a pest that eats the taro plant (*dait*). This is a problem that has always been around but it is appearing more frequently in the *mesei*. An older woman explained that within one month a whole taro patch that was planted was destroyed as result of *nguk*. Also the *uek* (purple swamphen) is a constant pest that eats the taro. Another change noticed is the increase in the tide which floods the taro patch, *mesei*. The yellow taro survives during the floods but the purple taro does not and is usually destroyed. One woman claimed the flooding helped her yellow taro grow stronger and better.

FOREIGN FISHING BOATS AND VESSELS: Residents suspect that foreign fishing boats have been stealing large giant clams located in areas called *bkul a Medorm* and *Elechol ra Ngerdis*. Residents say foreign vessels have been seen fishing in Angaur waters. The most recent sighting of foreign boats was in October 2002.

SUSTAINABILITY OF CURRENT USE PATTERNS

FISH: There is a general consensus among fishermen that fish abundance and sizes have decreased over the years. While individuals can still collect the same weights of fish as in past years, the average sizes of the fish have gotten smaller and therefore more time is required in order to collect the same amount of fish. In the past it was common to catch 30 or more pounds of yellowfin tuna and 10 pounds of skipjack. These days the fish caught are usually smaller. At one time, a fisherman could catch 10 yellowfin in a day, however, now the usual catch is less than that and of smaller sizes.

INVERTEBRATES: Angaur does not have a lot of habitat suitable for many of the invertebrates that are found elsewhere in Palau. The small-scale collection of invertebrates currently appears to be sustainable. Molluscs such as *cheaol, chechui*, and *oruer* are commonly harvested for local consumption. A few women said that the sizes of *cheaol* and *chechui* have become smaller. Others claim that in general, the invertebrates are still abundant and they have not noticed any decline. Only one resident claimed that these food items were currently in demand from Koror residents.

There is a consensus that crustaceans, especially land and coconut crabs are decreasing in number and size. A few women noted that there are more land crabs but their sizes were much smaller. Currently land crab populations are more viable in Angaur than in Peleliu.

Kesuar are being collected in large numbers. It is a resource that may soon decline with the rate people are collecting. The state boat makes six visits to the island every month and on average will bring back 40-50 sacks of land crabs. Locals reported that coconut crabs had decreased in abundance in recent years. One trapper said that in the past it took one visit to collect 15 but that today it took 2-3 visits to collect 3-4 crabs.

MANGROVES: There are stands of mangroves, however, they are on private land and therefore the extraction of resources from these areas is limited to land owners. It was reported that resources collected in there were crabs and molluscs. Angaur has a relatively small area of mangroves, which is limited only to the southern tip of the island.

FORESTS TREES: The forests are not currently being used aside from occasional uses for building summer houses and other small scale projects. Such small-scale harvest of forest trees is sustainable.

UNUSED AND UNDERUTILIZED RESOURCES

PLANTATIONS: The main option for many homes is to expand their farms and taro patches out from the vicinity of the village and into the parts of the island which were formerly mined for phosphate. It was stated by residents that the soil is more fertile there and many fruit plants would grow well.

TOURISM: This is always an option for Angaur as it has beautiful scenery and is quiet. There are tourists every month and currently there are only a few individuals who take advantage of these visits by the tourists. In future it is possible more people will be involved in the hospitality industry on Angaur.

SPECIALITY FOOD: The making of bread and cookies made with coconut milk is a delicacy that can be capitalized into a profitable business for the women to supply to Koror stores, restaurants, hotels, etc. Eventually, this can be expanded to export outside Palau. All women or households know how to make this kind of bread and cookies.

DISTRIBUTION OF BENEFITS

Those who do not work on road construction or for the state or national government are self-employed. This means that they either fish or harvest crops to sell locally or in Koror. All other residents fish and farm for themselves or are dependents of relatives. Because extended families are still very strong, family members in Koror send goods to Angaur and vice versa. In this way, much of the benefits from various resources are shared.

INFORMATION GAPS

None of those interviewed could give a clear picture of how much of the forests trees and plants are being used today. More information is needed on who is using the trees and what they are being used for.

There is no data on how much *buuch* and *kebui* are exported from the island for commercial sale.

There is not much information about how often turtles are harvested in Angaur and for what purposes. There is also not much information about the extent that turtles use Angaur beaches for nesting. Both green and hawksbill turtles have been reported by residents to nest there.

It was not clear from the interviews exactly to what extent people in Angaur rely on molluscs species and how important they are to the local diet.

The mangroves used to cover a larger area on the southern tip of Angaur island. It is unclear as to why the mangrove area has become smaller. The land crabs, *rekung el daob* (*Cardisoma carnifex*) can be found in this area in very limited numbers. Angaur had more *rekung el daob* in the past, and it is unclear what has caused their decline. Historically, the *rekung el daob* population in Angaur has not been as abundant or as heavily harvested as the one in Peleliu.

One of the women interviewed was concerned about an invasive vine that spreads quickly and has white flowers. According to the woman, this vine began appearing about two years ago. This should be investigated soon, because the description resembles *Mikania micrantha*, a very invasive and persistent vine found elsewhere in Palau.

Hatohobei

EXTENT OF RESOURCE USES

Hatohobei State consists of the atoll island of Hatohobei (also called Tobi) and Helen Reef (Hotsarihie or "Rock of the Giant Clam"). Hatohobei is approximately 360 nautical miles to the south of the main Palau islands and about 125 nautical miles north of Mapia, Indonesia. Fewer people are living on the island now than in previous years. Most people have moved to Echang, a hamlet at Ngarekebesang, Koror. Currently there are thirteen people from three families living on the island of Tobi. Only older adults and young children are living on the island. Children attend primary school on the island, but must go to Koror for secondary education. The state lacks a commercial economy and jobs for its residents, so they must find work elsewhere. As a result, people are quickly losing their traditional and cultural ways of living.

Transportation to and from Koror is difficult. A supply ship makes biweekly trips down to the islands. The trip takes at least 3 days. These trips allow residents living in Koror to visit the island or allow anyone needing medical care to go to Koror. In addition to bringing supplies to the community in Tobi, the ship takes products of the islanders, such as coconut honey, back to Koror to be sold by relatives.

The land area is very small but very valuable as people's original birthplace. Even though the majority of people are not living on Hatohobei, they identify with the island as "home." Nowhere else in Palau can they feel quite as confident and free. Although, many Tobians no longer reside on their island, many still depend upon the resources of their state. They are also very knowledgeable about the local resources. Sixteen people from Hatohobei were interviewed for this study; all are currently residents of Koror.

Main Natural Resources

- Marine fish
- Coconut crabs
- Land crabs
- Turtles
- Birds
- Farm crops
- Taro
- Medicinal plants

The village is located at the southwest part of the island, where it is protected most of the time from strong winds and ocean currents. It is close to the only channel inside the reef and close to the

beach. The beaches shift. During the season of easterly winds, the sand shifts to the western side. The sand shifts back to the east during the season of westerly winds.

Japanese settlers mined phosphate at the northeastern side of the island early in the century. The mining was stopped with the outbreak of WWII. This prevented the entire island from being mined, as was done at Sonsorol.

Helen Reef is a conservation area with many resources. The small land area is a sanctuary for sea birds, especially *kuel* and *kedam*. The small land is also a nesting place for turtles. The sand shifts back and forth following easterly and westerly winds. This changes the size and shape of the island.

FISH: Most fishing, (trolling, line fishing, torch fishing, kite fishing, and deep-sea fishing), takes place outside the reef. Fish catch includes reef fish, tuna and other migratory fish. When the ocean is too rough, no fishing takes place. Men go spearfishing on the edge of the reef. This is where lobsters are caught.

INVERTEBRATES: There are very few invertebrates available due to strong currents in the seagrass areas. Coconut and land crabs are reserved for bad weather, or when someone is very sick and wishes to have a certain crab. They are collected with moderation.

FARM CROPS: As an atoll island, the soil is sandy, porous, and just a few feet above sea level. The soil is not very good for planting crops. Small areas around taro patches have better soil. With few people living on the island, these small patches provide enough space to plant crops for subsistence living.

Farm crops that the locals depend on are taro, *bisesh*, pumpkins, tapioca and sweet potatoes. Families maintain the taro patches close to the village but have allowed the taro patches farther from the village to become overgrown because of a lack of people. These farm crops are used primarily for subsistence and customary purposes.

NUT TREES: Although copra is no longer sold, coconut trees are still the most important tree in Hatohobei and all of the southwest islands. It provides food, drink, roofs for summer houses, and is still the main source of income (coconut syrup). The production and sale of coconut honey from the sap of the coconut palm is the only commercial use of plants in Tobi. It is sold in the markets in Koror. Betelnuts are grown by the few people who chew.

FOREST TREES: The forest is home to many birds and animals in Hatohobei. When women clean an area to plant crops, they are careful not to destroy the forest. The forest in Hatohobei is not like the forest in Babeldaob - the there are less large trees and coconut palms predominate. The forest also keeps the island cool and protects houses from strong winds.

FRESH WATER SWAMP: There is an *omrekongel* (fresh water swamp) at the southern end of Hatohobei. This is a very important place because most giant taro, the stable food of the islanders, is grown here. Purple taro (*kukau*) also grows in this area. The soil is rich like the taro patches in Koror.

FRESH WATER: There are eight fresh water wells. Even with eight wells, water supply is limited and was conserved mainly for drinking and cooking. There is a special well where drinking water for babies was collected. The wells are mostly located along the western side of the island. Rainwater is now collected for use in the homes.

TURTLES: The beaches are the nesting places for green turtles. Turtles are collected. They are increasingly being caught and sold in Koror.

BIRDS: Sea birds are also used in several ways. The larger birds (*kedam* and *kuel*) are eaten during special occasions. The feathers were used to make fishing hooks. *Bedaoch* are also caught for cooking over fires. This activity is especially common whenever the supply boat is at the island. Visitors bring their guns and sling shots to hunt the birds.

MEDICINAL PLANTS: Individual families still collect plants for use as medicine.

CHANGES IN RESOURCE USE PATTERNS

FISH: Several species of fish (especially surgeonfish) are no longer seen schooling in the seagrass and nearshore areas. In addition, there are less juvenile fish seen in areas where they were formerly abundant.

Traditional fishing activities were done as a group. Fishing trips were times, not only to get fish for family meals and community gatherings, but also times to teach fishing knowledge and skills to younger men. Methods such as using kites to catch *sekos* (needlefish), using torches to catch *kok* (flying fish), and feeding rainbow runners at certain spots to lure them together are no longer used anymore. People either spearfish, linefish or go trolling. Even the use of stone traps has ceased.

Now that there are no canoes and very few strong young men on the island, traditional fishing is very seldom practiced. Most young men were raised in Koror, so they never learned the traditional knowledge and skills for fishing. They also never learned the art of making their own hooks from turtle shells, lines from coconut husks and sinkers or weights from rocks, corals or *namari* (lead). Much of this knowledge is being lost.

INVERTEBRATES: In general, there seems to be a decrease in the abundance of several species of molluscs and crustaceans. Several species of giant clam are less abundant than a decade ago. Residents have noticed more crown-of-thorn starfish (a predator of some species of corals) on the reefs. There are extensive areas where the coral has been bleached both along and within the fringing reefs. People have noticed a decline in coconut crab numbers.

TURTLES: Turtles are now eaten as an everyday food, by individual families, and are used as a source of income. Previously they were reserved for special occasions where many families and groups were fed.

BIRDS: Woven nets were used to catch *bedaoch* as they flew into the trees to rest for the evening. It was reported during the interviews that a regular catch in one evening was around 300 birds. This

does not occur anymore as none of the young men on the island know how to weave the nets. They prefer to use air guns to hunt the birds, which are hunted upon request for special occasions.

THREATS TO THE RESOURCES

OVERHARVEST: Overharvesting of turtles has become a problem, since there are no limits on the turtles being caught. Now that turtles have become a resource for commercial sale, they have been collected more frequently than in the past.

LOSS OF TRADITIONAL KNOWLEDGE: The loss of traditional knowledge has changed people's fishing and hunting activities. Fishermen no longer make their own gear, but now use more effective fishing and hunting equipment. There are also no longer any strong traditional controls on resource collection activities.

POACHING: Poachers from Indonesia and the Philippines have been caught fishing in Hatohobei waters, especially around Helen Reef.

SEA LEVEL RISE: Sea level rise is a concern for the people who live on the low-lying atoll island.

PESTS: The *quell* bird has become a pest to the people on the island who believe the bird's droppings are bad for their plants due to its high salt content.

SUSTAINABILITY OF CURRENT USE PATTERNS

FISH: When there were many people living in Hatohobei, fishing was a daily activity for most men. There were plenty of fish and fishing was educational and fun. Today, although there are less people fishing, there seem to be fewer fish. It is unclear whether they are unable to catch the same amounts of fish in the past because the fish are not there, or if less people are able to catch less fish.

TREES: Canoe building is no longer practiced. As a result, big trees such as *btaches* and *meduul* (breadfruit) are not being cut to build canoes. *Meduu* is still one of the main sources of food on the island.

TURTLES: Every time a ship returns to Koror from a trip to Hatohobei and all the Southwest Islands, many turtles are on-board. They are sold or given to people who have requested them. It is a good source of income for a few people who live on the island. However, the practice does not appear to be sustainable.

PRODUCED ITEMS: At one time copra, *dilukai* (wooden carvings), salted fish, *katsuobusi* (dried bonito fish) and coconut syrup production and sales were the main sources of income. Making and selling coconut syrup is still done, but on a much smaller scale. Thus this activity is sustainable.

DISTRIBUTION OF BENEFITS

Everyone from Tobi benefits from land and sea resources of the state. Many of the resources are being used for subsistence purposes on a small-scale. A few individuals make money from making coconut syrup, and from catching turtles.

UNUSED AND UNDERUTILIZED RESOURCES

There are many old coconut trees that could be made into lumber for houses.

Migratory fish could be caught and sold.

Land crabs could be caught. However, residents were concerned about finding a way to raise them, so that the crabs are not all depleted in a short period of time.

INFORMATION GAPS AND NEEDS

There is no real information on the bird populations in Hatohobei. It is unclear at what levels the various species are being harvested.

There was no clear information on the kinds of plants which are currently used for medicinal purposes and how that use has changed over the years.

There is no recent information on nesting turtle populations on all the islands and atolls in Hatohobei.

There is no real data on coconut crab populations. These are very important to the local community and yet there has been no real effort to record infringements of harvesting or to record the decline in numbers over the years.

The status of the land crab population is also not known.

Kayangel

EXTENT OF RESOURCE USES

Kayangel is Palau's northernmost state. It has a permanent population (in 2000) of 138. Twenty-one people from Kayangel were interviewed for this study. Although many of Kayangel's residents are transient, splitting their time between Koror and Kayangel, there are also those who are full time residents of Kayangel. They travel to Koror only when they have business or customs to attend. Most of these full time residents are self-employed and rely on fishing and weaving as primary sources of income. There are a few individuals employed by Kayangel State. There are several young men from the Epang Seinendang group who are currently employed by the State on the Workforce Investment Act program. However, these positions are internships and will last half a year.

Main Natural Resources

- Marine fish
- Marine invertebrates
- Sea turtles
- Farm crops
- Trees
- Plants (Pandanus)
- Birds
- Taro
- Lime (*aus*)

CHANGES IN RESOURCE USE PATTERNS

FISH: All households in Kayangel collect fish every week. These households rely on fish as an important source of protein and income. Many young men spearfish on the reefs. There is no harvesting of fish by *kesokes* (barrier nets). People go out whenever the weather permits. If it is calm, many people will go out as many times as they can. The fish are sorted. Fish with high market value (i.e., those fish that sell well in markets such as *chum*, *erangel* and some species of parrotfish) are separated and sold and the rest of the fish are kept for local consumption. Some of the fish that is caught by the residents of Kayangel is consumed within the State. These days there is not a lot of fish being sold to markets in Koror because the markets are getting fish from people closer to Koror. There are only a handful of local fishermen who accumulate their catch over a week and transport it to Koror to sell by the pound at the fish markets. There is a perception shared by all individuals interviewed that half of the fish caught in Kayangel is caught by people who are not residents of the state. All the fish caught by non-residents is consumed out of the state.

Kayangel currently has fishing restrictions. Technically non-residents cannot fish anywhere in Kayangel's waters without permission from the State Office.

It is mostly the men who go fishing, although there are some women who fish as well. The daily fishing occurs over the range of available habitats: patch reefs, barrier reefs and open ocean. There is a range of fishing methods being used as well: cast net, line fishing, spearfishing, fish traps and trolling.

INVERTEBRATES: The main invertebrates collected on Kayangel are coconut crabs (*ketat*), small sand clams (*kesiamel*) and land crabs (*rekung*). Under the *bul*, these species can only be collected for subsistence and they are not allowed to be sold, however, there are a few individuals who do sell coconut crabs when there is an order from Koror. Mostly, the crabs are consumed locally, although not everyday. Most people usually open a few coconuts and place them at the base of a tree; after a day, that tree is visited to see if any crabs have been attracted to the bait. They are usually caught when people go out to the three islands immediately south of Kayangel for weekend trips. In the last five years, the abundance and average size of coconut crabs has declined. Today, however, most of those collected are smaller than the 4-inch legal minimum size.

TURTLES: Sea turtles continue to be harvested in Kayangel when legal-sized individuals are found. Greens, hawksbills, and when they are found, migrating leatherbacks are all caught in Kayangel. There were reports that some individuals still harvest turtle eggs (greens or hawksbills) when they are found, although it is illegal to do so. Overall, these species have been declining all over Palau and Kayangel is not different. This year, 2002, saw the fewest nesting turtles in Kayangel in a long time (only one was recorded). While there are fewer and smaller turtles seen in the Kayangel lagoon, there are indications that the number and average size of turtles seen at Ngaruangel atoll are showing that protection of the area has been positive for the turtles.

FARM CROPS: Most residents have crops, which they harvest for in-house consumption. The only plant that residents are not prohibited from selling is *such* (Pandanus). The leaves of this plant are collected and dried. They are then cut into strips, which is used for weaving baskets, handbags and other such crafts for sale in Koror. *Such* is actively planted all around the island. Most of the women who are not otherwise employed weave everyday. The income that weaving brings to Kayangel is comparable and at times greater than income is generated from selling fish to markets. Weaving goods are sold in Koror, usually at the Old Age Center. Crops of *brak*, *kukau*, and *diokang* are important sources of starch for many homes but are not a source of income. They are grown for consumption in households across the island. It seems that in recent years, the tendency is to buy rice for the home and use planted crops for customs.

TREES: The use of hardwood trees on the islands is limited. From the interviews, it seems as if only one or two individuals are using hardwood trees at a significant level for firewood. There are one or two individuals who make lime (for chewing betelnut) by burning clam shells or coral boulders that have washed ashore to produce the white powder. These people cut down trees on any of the islands to fuel the fires, which will eventually make lime out of clam shells and other sources of calcium carbonate.

BIRDS: Resident bird populations on Kayangel and the nearby islands have decreased over the years. The reasons are unknown, although some blame reckless collection of eggs and hunting of birds. People used to shoot birds for lunch when picnicking on the smaller islands on weekends. While the abundance of these birds have decreased in the small islands, Ngaruangel's resident population of terns does not seem to have decreased significantly. This may be due to the fact that no harvesting of any species is allowed in Ngaruangel Reserve.

OTHER: It is notable to mention that those individuals who produce lime, use limestone rocks along the beaches or clam shells from harvested species. In addition to cutting trees for firewood to burn the lime, the use of rocks from the beaches is not sustainable should more people from Kayangel decide to get into the business.

THREATS TO THE RESOURCES

OVERHARVESTING: A major threat to the resources in the state is overharvesting. Most of the households in Kayangel are already harvesting their resources on a daily basis. There is concern that harvest of these resources by non-residents could drive many of the targeted species to disappear or become so scarce that residents would not be able to make money from these resources.

DISEASE: A major problem for many households is that diseases have struck their food crops making it necessary to work longer for the same amount of food. There is concern that if this issue is not addressed, the diseases will eventually kill most of the productive farming areas and make it impossible to sustain households on these crops.

PESTS: It is possible that the hermit crabs on the Ngaruangel islet are reducing the number of bird hatchlings that survive to maturity. Observers have seen hermit crabs eating eggs and biting hatchlings on the islet. On the main island of Kayangel people are complaining about fruit flies and cane toads which seem to have increased in numbers so much that they have become a significant pest. The impact of these pests on native flora and fauna is not clearly understood at this time.

SUSTAINABILITY OF CURRENT USE PATTERNS

There is a general prohibition of selling Kayangel's resources outside of the state. This is widely understood and respected, since people realize the finiteness of their limited resources.

FISH and INVERTEBRATES: Most fishermen in Kayangel fish at Ngereal and Ngkesol reefs. There has been some evidence of decline for many species of fish, molluscs, and echinoderms at these sites and around Kayangel itself. About 10 years ago, it was possible to collect between 500-700 lbs of fish on the reefs in one day. These days the catch is usually between 100-200 lbs. Even echinoderms and molluscs are not commonly found on the reefs today (1 to 3 a day). There were certain coral bommies that people visited regularly when looking for certain fish (*maml* or *kemedukl*). These days those bommies are dead or bleached and the fish, which once were common to the site, cannot be found. In the past, most people fished for themselves or their families. If any fish was sold, it was sold to the local fishing Federation extension on island. When people did fish

for the market, they usually went out as a village. These days, more people fish on their own or with only a few people from the village to sell to fish markets.

There is a traditional prohibition, *bul*, on selling anything caught within the reef and lagoon of Kayangel and its islands. Only subsistence fishing is allowed in this area. Despite having had such management tools in place over a long period of time, the total productivity of the reefs seems to be declining. There are less fish and people have to go out for longer periods (4 hours or more) in order to catch fish to last a few days. With refrigerators people can fish for as much as they can accommodate and not worry about the fish spoiling. In nearshore seagrass areas, there have been some changes in species composition. Where there once were only shorter seagrass species, long species of seagrass are now common.

DISTRIBUTION OF BENEFITS

The benefits from local resource uses are well-shared among the residents of Kayangel. All households collect fish for daily consumption. Very few local residents sell their catch outside of the state. Crops are raised for local use. Women earn income through the sale of basket and other products woven from locally grown Pandanus.

Increasingly, the benefits of local marine resources may be leaving the state in the form of non-residents who fish illegally in Kayangel waters. Residents estimate that as much as 50% of the fish is now caught by non-residents. Permits are required, and the state has closed some areas to fishing. However, the state does not yet have the ability to effectively monitor all boats in state waters. Marine resources are being depleted in other states, and faster boats make the trip to Kayangel less expensive and prohibitive. The rich waters of Kayangel have become much more attractive and accessible to more fishermen.

UNUSED OR UNDERUTILIZED RESOURCES

AQUACULTURE: This has been identified as a future venture given the marine resources available to Kayangel. Clam farms or milkfish farms were options mentioned as potential future ventures within the State.

PLANTATIONS: Another resource people said was going to be used more often in the future was the *such* plants in Kayangel. If demand for woven crafts from the state increased, there would be a need for a steady supply of *such* leaves throughout storm events and dry periods. It was suggested that people might begin to plant these species on state land.

TOURISM: Fishing will continue to be important to the local community as a source of income and sustenance. There is hope that in the near future, sportfishing in Kayangel will develop into a major revenue generating venture which the state can manage. People also suggested that ecotourism could flourish with many water activities occurring in the Kayangel lagoon.

INFORMATION GAPS AND NEEDS

There is no real information on the bird populations in Kayangel and how they are being impacted by development and overharvesting. There is also no real information on the levels at which the various species are harvested.

There was no clear information on the kind of plants that are currently used for medicinal purposes and how that use has changed over the years.

There is no recent information on nesting turtle populations on all the islands and atolls in Kayangel.

There is little information on how many permits are being issued for fishing in Ngaruangel. And little information on how much fish is being caught by non-residents of the state.

No real data exists on coconut crab populations. These are very important to the local community and yet there has been no real effort to record infringements of harvesting or to record the decline in numbers over the years.

Koror

EXTENT OF RESOURCE USES

Koror consists of 13 hamlets. It is the most populated of Palau's states. In 2000, Koror's population was 13,303. Resource use in Palau is complicated for many reasons. The first is that the resource base is quite large and varied, especially in the marine environment. There is a much larger economic base in Koror than in other states. Tourism and foreign fishing, among other businesses, provide revenue and also create additional uses and stresses on the resources. Many of the residents of Koror are originally from other states or countries. Thirty-three percent of Koror's residents are non-Palauan, 85% of these non-Palauans are from Asian countries. If a person is from another state or has family ties to another state, they often utilize the resources of that other state, as well as those in Koror. Koror's marine and terrestrial resources are used by many of its residents. Unfortunately, studying the true extent of resource use in Koror is a study unto itself, and was beyond the scope of this rapid assessment. The following account is based on 44 interviews from people living in the hamlets of Ngermid, Ngerchemai, Ngarkesoaol, Idid, Ngerbeched, Meyuns and Ngarekebesang.

Main Natural Resources

- Marine fish
- Marine invertebrates (especially *ngduul*)
- Mangroves
- Forests
- Plants and trees
- Farm crops
- Taro
- Medicinal plants

FISH and INVERTEBRATES: Both men and women fish for reef fish, but women (and sometimes children) are generally the only ones gleaning for invertebrates. The large southern lagoon where the Rock Islands are located is owned and managed primarily by Koror state (although a portion belongs to Peleliu). Local fishing activities, however, often occur closer to the islands where people live, which is in the northern part of the lagoon. Popular local fishing sites are in Nikko Bay and along the western coast of Toachel Mid. Ngederrak reef was also a popular site for some Koror hamlets, especially during bad weather, before it was closed to fishing as a conservation area by Koror State. Mangrove clams (*ngduul*) are collected from Ngesaol and Didal, near the causeway to Ngarekebesang. Didal was also an area where people once collected clams (*oruer*) and fish.

Although many residents of Koror have salaried jobs, many people still collect marine resources for daily consumption and for income. Some men in Koror consider fishing their second job if they already hold a full-time job. Without this additional income, their wages often cannot provide for all

of their financial needs. More people are fishing and collecting invertebrates purely for commercial purposes.

TARO and CROPS: The main resource uses on land for local people involves cultivation of gardens (*sers*) and taro patches (*mesei*), and planting fruit, nut and mahogany trees (the latter is presently used for house construction and for carving storyboards). One informant also plants her own Pandanus plants for weaving so she does not have to purchase the leaves from others.

The main cultivated crops are blue and yellow taro (*kukau* and *brak*) in *mesei*; tapioca and sweet potato in *sers*. All of these are cultivated for consumption, customs and to sell in the market. However, most of the women interviewed said they did not cultivate large *sers* or *mesei* because they already had a full-time job and did not have enough time or they did not own large plots of *sers* or *mesei*. As a result, they usually just have enough to eat and use in customs, and rarely sell their crops. In hamlets like Ngerbeched, there are a majority of older women who sell a large portion of their taro and other crops in the market.

FOREST: Koror is not blessed with much forested area, except in the Rock Islands, where tree cutting is not allowed under traditional law. Some people may still be harvesting small amounts of *ngis*, which has a very hard wood and is used for tool handles. Previously ironwood, *dort* (*Intsia bijuga*), was harvested in the Rock Islands. However, a *bul* was declared making ironwood cutting illegal throughout Koror. Within Koror town, all the forests are privately owned so this makes it harder for all people to use resources from the forest.

Residents interviewed in this study said that birds and bats are not hunted in Koror. It should be noted that Ngarekebesang and Meyuns once had a viable population of ducks (*debar*) that has declined over the past thirty years to the point where it is rare to catch them. It was not possible for the interviewers to identify the species of duck that once lived in those hamlets since the elder experts were not available at the time of the interviews.

ROCK ISLANDS: The rock islands spread from Airai in the east to Ngarkebesang in the west. Rock islands near Ngermid are important to the people and the hamlets of Ngermid and Ngerbeched, as well as to the whole state of Koror. They protect Ngermid and Ngerbeched from strong winds and currents that come in from the southeast. They also protect the deeper waters of Nikko Bay.

The rock islands are home to many different kinds of organisms. Coconut crabs and land crabs (rekung and kesuar) are collected for local consumption and for family income. Mangrove clams are collected from the mangrove areas that grow around a few of the islands. Giant taro grows in taro patches on a few islands, as well. The shallow waters around the rock islands are places where women collect a variety of invertebrates for their family and for local markets.

Ngermid rock islands are family recreational areas. These are places where children learned the arts of fishing and preserving fish; collecting and preserving invertebrates; collecting and keeping crabs alive; how to use water wisely; how to build and control fires; and how to select and cut down trees. They learned the important relationships between water, air and land. As long as the islands provide the useful organisms, families continue to use the rock islands as recreational areas.

CHANGES IN RESOURCE USE PATTERNS

FISH: Palauans and foreign residents are harvesting more frequently. One informant explained that before people would harvest marine species once a week but now people go fishing everyday. In addition, for a particular hamlet like Ngermid, there were common fishing areas that everyone could access and there were other areas for fish traps that were only open to three chiefs. Moreover, in the past it was common to go fishing for the whole village (*chei el beluu*) and the fish caught were shared among all the households.

Most methods used in fishing are still the same (line fishing, spearfishing), what is different today is the equipment used. For instance, spearfishing today involves spearguns, flashlights, ice chests, and fast boats. The changes in technology have allowed fishermen to have greater access to more areas than in the past. Other tools that have helped fishermen increase their catches are nets made of synthetic materials and various types of nets that capture everything. In the past, fishermen were limited by equipment and techniques. Previously, fishing methods consisted of fish traps, line fishing, and spearfishing. These changes in gear have made it easier to overfish.
There are more people collecting fish from waters around Koror. In addition to Koror residents, people from Airai and other states are seen fishing in Koror's waters. Also residents from other hamlets are fishing in hamlets which still have viable fish stocks. In addition, non-Palauans are also fishing. One popular site for fishing, especially at night, for non-Palauans was the temporary floating bridge between Koror and Airai. While this bridge has now been removed, people still fish from the areas along the water near the bridge.

Fishermen and women have noticed that there are fewer fish. They no longer see large schools of rabbitfish (*meas* and *klesebuul*). Sardines, although protected by seasonal closures, are much less abundant than previously. It generally takes longer and people have to go farther to obtain the desired amount of fish. They need to travel further to catch the fish required for customs (large species such as *maml*, or larger schools of species such as unicornfish, *chum*).

INVERTEBRATES: Some women collect mangrove clams (*ngduul*) at Ngesaol. These clams are generally collected for sale. Some of the Ngesaol mangroves are used by others as dump sites, so pollution may be a problem. In addition, some of the women say the clams are less abundant and smaller than those collected before. they believe that is because the clam collection sites are not being "maintained" properly. Mangrove clams can also be collected from one of the marine lakes. However, the lake is difficult to reach, so they are not often collected from this site.

A particular area in the mangroves for collecting mangrove clams (*ngduul*) was identified as an important place by Ngermid women. The women would like to see the area treated as a farm or an area closed except for mangrove clam collection. They believe it is a special area where the clams grow particularly abundantly. The clams can be found within and just outside the mangroves. It is known as *Bkul a btil a uel* (the area is shaped similar to the tail end of a turtle). Many people come to this area to collect *ngduul*. People from other hamlets come to the area to collect as well. According to these women, *ngduul* should be harvested regularly because if left for longer than two years they are not good for consumption.

The mangrove clams are decreasing in abundance. In the past, on typical day women would go out when the tide was neither too low nor too high. They would collect for an hour and return with a whole basin full of clams. Now they say, they collect for a whole day and are still unable to fill a basin. There were also set times for collecting mangrove clams. When the *meduu* (breadfruit tree) and the *matakui* tree bore fruit, then the women would go collect clams. At that time the mangrove clams would be "fattest" (*melaoch*). People collect the clams at any time of the year now.

Mangrove crabs seem to be abundant in certain areas. In some places, it takes only a couple of days to catch 8-10 crabs with only two traps. This is probably because only a few people trap mangrove crabs in Koror these days so the population has rebounded. Some fishermen complained that crabs were being stolen from their traps, so they decided to stop using traps.

Coconut crabs (*ketat*) and land crabs (*rekung* and *kesuar*) are collected from some of the Rock Islands. Previously the residents of Ngermid collected these crabs from some of the nearby Rock Islands solely for food. However, now people from Ngermid are receiving orders for *kesuar*, which are difficult to collect from the steep forested islands.

Other invertebrates that are collected from around Koror are sea urchins, sea cucumbers and small crabs. One of the main sites for gleaning is at Ngetmeduch, that reef flat right before the causeway leading to the Palau-Japan Friendship Bridge. Many of the best sites for collecting these species are no longer productive or have been closed to harvest. Some sites were damaged by sedimentation that flowed from the dredge sites on both sides of the Bridge.

The fish and invertebrates collected from the Didal area have declined in recent years. It was reported by one informant that some people were using hammers or chemicals such as bleach and vinegar while they collected. There was also an increase of users in the area for a while. In addition, the repair of the sewer pipe along the causeway for the past three years has visibly polluted the area. Some people no longer want to collect from the area.

MANGROVES: Mangrove trees are not harvested as much for use in construction. They are used occasionally to build small structures such as outdoor toilets, extensions or summer houses. In many areas they are being leased and many have been filled or replaced by houses. In Meyuns, there are more houses and other buildings being built in filled mangrove areas, especially near the Didal area and in Morisong.

In Ngermid, there is a channel that is not as widely used as it once was because it has become overgrown with the mangroves.

TARO and FARM CROPS: A few taro patches are abandoned in Koror. Some women from Babeldaob who live in Koror have obtained permission to use those plots abandoned by their Koror owners. In Idid, only three taro patches have been abandoned because of a garbage dump nearby. They are too close to residential areas and the residents (who do not own or use these *mesei*) do not care for them and are dumping their refuse near these areas. Other taro patches have been severely damaged by sediments that have run down hillsides from construction projects on the hills. Some taro patches have been filled in completely.

Women in Ngermid, who have lost a lot of their productive *mesei*, often plant taro in the dry-soiled farm areas rather than in *mesei*. They also harvest *brak* from some of the nearby Rock Islands in Nikko Bay.

According to a minority of women, fertilizers are now widely utilized in the *mesei* and *sers* to speed growth and size of crops.

The traditional techniques or stages for growing taro are not always followed in Koror. Some women have hired male foreign workers to knead and maintain their taro patches. In addition, some women who are unable to tend to their *mesei* hire another woman's helper to maintain their taro patch for a short period. In the past a woman would usually pay a younger or stronger Palauan woman (this woman usually had no regular occupation) to do the same tasks in the *mesei* or *sers*. Thus the younger women are less involved in taro production than they were in the past.

There also have been changes in the process of planting taro. The act of turning over the soil in the taro patch (*omesaul*) has been replaced with an instrument similar to a pitchfork, used to break the ground. As a result, most of the time the *mesei* soil is simply turned over and there is not much use of *ramek*, which are leaves from trees used as nutrients or fertilizers for the taro plants (*dait*). These changes have been made because the *mesei* are generally drier and shallower. Large plastic trash bags and cardboard boxes are sometimes used instead of banana leaves and other leaves as protection for the growing taro plant.

FORESTS: Some residents are concerned that some of the Rock Island trees have been cleared in the areas that tourists frequent. They are also concerned about the rock quarry that has leveled one of the Rock Islands close to the Bridge.

Mahogany is not a native tree but is abundant in Koror because many were planted after WWII. Today, it is used more often than local trees for storyboard carving, as well as for house and furniture construction. Mahogany is the preferred wood for one storyboard carver. As majority of the consumers of storyboards are visitors from cooler and dryer places, Tebang woodcarving company only works with mahogany as it fares better in those areas.

PLANTS: Traditionally, Pandanus (*such*) was obtained from Kayangel because they had the best quality, but today some weavers have begun to plant their own Pandanus plants in Koror in order to minimize expenses. They have found that the quality does not vary that much. So more such is being planted and used in Koror today than before. Pandanus products are colored today by imported dyes from the Philippines, because the traditional colors are harder to find partly because the trees (Barakusa leaves) that provide the raw material for the dyes are fewer and the skill to make the traditional dye is probably already lost.

Medicinal plants have become hard to find in some places in Koror because of habitat destruction. Some women plant medicinal plants in gardens next to their homes. According to these women they are still abundant. However, some plants are becoming more difficult to find.

THREATS TO THE RESOURCES

OVERHARVEST: Today fishermen do not go for quality but quantity. Fishermen are no longer selective, they take everything they can.

One of the main reasons for present overfishing is the belief that if we deplete the resources inside the reef, we can always move our operations outside the reef. People say that fishermen don't realize that the fish living outside the reef started out within the reef, so depleting everything within the reef destroys the stock for the outer reef.

Another major cause of marine resource decline is the increased market demand. This has provided additional incentive for fishermen to take more than is needed for their consumption and traditional customs.
Women believe the mangrove clams are being overharvested. According to one informant, the movement of a collector in the muddy area helps activate the clam's life cycle. Unfortunately, there are more people collecting the clams than before. They are collecting too many, even the small ones.

HABITAT DESTRUCTION: Mangrove areas in Koror are being filled in order to create land for further development. Mangrove areas are leased, filled and replaced with infrastructure and buildings. Some mangrove areas, especially those near residential areas, are used as garbage dumps. Sedimentation from building development has filled many taro patches and ruined cultural sites.

Ngermid and Ngarekebesang residents blame increased boat traffic in their area for degrading fishing spots and disturbing habitat area where invertebrates such as *ibuchel* and *delsangel* were once abundant. One woman explained that there are so many people that have boats and the constant traffic in places like Ngederrak have resulted in sea urchin loss.

POLLUTION: Some taro patches have been polluted by sedimentation and debris, such as broken glass, which have made it hazardous for women who look after them. It is not uncommon to get cut by broken glass these days in the taro patch. One woman enters the taro patch wearing a dive suit in order to avoid getting cut. Pig pens have polluted other *mesai*.

Dump sites have been sited too close to *mesei* areas. Dumping has also occurred directly into the taro patches.

Some houses in Koror are probably not connected to the sewage system and may be dumping raw sewage. Pollution from sewage runoff has been blamed for degrading mangrove clam habitats and fishing areas along the shoreline of hamlets like Ngarekebesang, Ngermid, and Dngeronger or Meketii.

SEDIMENTATION: Sedimentation and debris have ruined many of Koror's taro patches, small creeks and mangroves. People are concerned about possible infection and contamination that could happen if they use the *mesei* or bathe in the creeks. Sedimentation has also damaged nearshore invertebrate collection sites.

LOSS OF CONTROL: Residents in Ngermid were concerned about their loss of control over the resource uses that are occurring in some of the Rock Islands that were traditionally under their jurisdiction. They say they are not involved in the decision making that allows recreational activities for tourists in these sites. They are concerned about pollution and damage from jet skis and the larger tour boats. They would like tourism to occur in the area, but according to their specifications. For instance, they would like to ban the use of jet skis in the area.

LOSS OF TRADITIONAL PRACTICES: In the past there were set resource use traditions that are now no longer practiced and are not being passed on in Palauan households. Senior citizens that were interviewed commented that many traditions or customs have been changed or forgotten. In Koror resource use is no longer about respectfulness (*delodau*) and having concern for others (*betik er reng*). For example, fish traps are no longer set because trapped fish were taken by people who did not own the traps. Moreover, the dollar value for a specific resource is becoming more important than the resource itself.

In addition, it is harder to gather people from a hamlet to work on a *ureor beluu* (a village clean-up or communal work project). Mangroves were managed and did not overgrow into channels, because they were cleared by the community. Then if a new mangrove seedling was growing in an unwanted place it was cut back by whoever saw it.

SUSTAINABILITY OF CURRENT USE PATTERNS

FISH: Overfishing has become a common occurrence, because fishermen are abusing the benefits provided by introduced modern equipment, such as boat engines, nylon nets, ice chests, fish finders, and scuba gear.

The "true" fishermen still practice sustainable fishing methods because they usually go back to the same place to fish. Because of this they only take what they need and leave the rest for another day. Unfortunately, there are very few of these kind of fishermen today. The majority of fishermen do not know the fishing sites and therefore have no designated or regular fishing site. So when they get lucky and find a lot of fish someplace, they tend to take everything they can.

One informant claims that despite the number of fishermen and the common practice of overfishing seen today, there is still plenty of fish out there if one knows where, when and how to obtain them. Furthermore, the fishes are adapting and have altered their spawning seasons and locations. The people who say there is very little fish today must be missing one of these critical factors. However, the same informant stated that particular reef fishes (groupers, the parrotfish *ngiaoch* and *mellemau*, and snappers), are fewer and in greatest danger. These fish will be the first to disappear if the present trends continue. Other fish, such as those in schools, *kemedukl* and *chum*, are still abundant.

MANGROVE CLAMS: Mangrove clam (*ngduul*) collection may not be sustainable as currently practiced. Women have noticed declines in abundance of the clams in the few remaining collection sites.

TARO: Tending to *mesei* and *sers* is still sustainable because women use fairly traditional methods that do not disturb the soil too much. Although one woman interviewed said that currently there are

more women who tend gardens instead of taro patches because women have less time and there is less space available in Koror to have both a garden and a taro patch. According to this woman, it was easier to tend to a garden (*sers*) than a taro patch (*mesei*). Western fertilizers are not used extensively because women believe that they will damage the soil in the long run. Women also say the taste of taro and tapioca from the farms are worse when these fertilizers are used. Some do not use fertilizers because they are just too expensive.

The *mesei* and *sers* are functional, however in some places they are not as healthy as in the past. Diseases in the taro patch have become more common in Ngarekebesang. Runoff from the road and ditches have ruined taro patches nearby. In the past, only water would flow into the taro patch, but now harsh liquids such as bleach, oil, soap, and sediment flow with the water. The taro patches in Ngarekebesang were deep at one time but now they just come up to a woman's knee.

In a majority of the hamlets development and increased numbers of residences have resulted in severely damaged or filled in taro patches. There is a consensus among the women interviewed that the taro patches are drier and shallower than in the past. The soil in both taro patches and gardens is not as good as before. Medicinal plants that were commonly found in the *mesei* are no longer seen. The presence of medicinal plants (*ulekelakl* and *yamell*) and those used for making grass skirts (*kerngimes* and *kerdikes*) indicated a healthy *mesei*. Rarely are these plants and shrubs found in the taro patches where they once were abundant.

TREES: The use of mahogany is sustainable today mainly because all the trees are privately owned so it is not a "free for all" commodity, like fish. To use this tree you either have to own it or purchase it at a higher cost than if you were to purchase local trees found in wild forests, so very few people use it. Also, it is relatively abundant in Koror because it is one of the trees that people make the effort to plant. In the 1980s, one company was exporting mahogany and a rapid decline of mahogany was apparent then, but today they are not threatened at all.

PLANTS: The use of *such* (pandanus) for weaving is sustainable. Not many women weave today so it is not overharvested. Plus, those who do weave, have chosen to plant their own pandanus to minimize expenses. The woven products are seen to be environmentally friendly since they only require *such* and dye. Furthermore, the informant actually recycles empty wine and other small bottles by weaving covers for them and selling them as flower vases.

DISTRIBUTION OF BENEFITS

Some informants say benefits are evenly distributed because Palauans still live in extended families and are active in customs which involve sharing and exchanging of goods and services. So even those who are not able to maintain *mesei* or go fishing still eat taro and fish almost daily. Those who sell their fish or taro benefit more in terms of cash, but that is because they put in extra work for it.

UNUSED OR UNDERUTILIZED RESOURCES

Chetermall (a type of sea anemone) and *kdor* (clam) are not eaten much anymore.

Many people are planting mahogany trees for construction these days. However, no one is planting other good construction trees such as *btaches* (*Callophyllum inophyllum*) and *blacheos* (*Gmelina palauensis*). *Dort* is considered one of the best construction trees in Palau and it has become rare, yet no one is replanting them.

Kerngimes is a very good raw material for weaving, but tends to be treated as a weed because it kills taro plants if left alone.

Tourists are increasingly using the rock islands of Ngermid. Kayaking is possible almost everyday, since the islands are close to town and well-protected from winds and currents. The islands are also used by researchers of coral reef species.

INFORMATION GAPS AND NEEDS

Some of the people interviewed did not understand why the state closed Ngederrak reef to fishing, collecting and entry. This area is an important fishing ground for people without boats since it is close to where people live. It is also the only place people from Koror could fish during bad weather.

People wanted to know how to control the "Aids" taro pest that has spread all over their gardens and *nguk* which is a small animal that infests taro leaves.

They are concerned about an invasive weed (*Mimosa diplotricha*). They say is grows worse when the area is burned. Another invasive weed is called *renrak*. Initially it was used to prevent erosion, but it has become invasive.

It was suggested that the distribution or coverage of taro patches may have decreased. Heavily populated hamlets in Koror might have very little land area left for taro patches and gardens; alternatively women in those areas just might not have the time to continue these practice.

Information on the mangrove clam life cycle is needed. Harvesting of clams can be more sustainable if more information on the life cycle of mangrove clams was known. There is a belief that if you move the clams from the mud, they die. So when collecting, if someone picks up a small mangrove clam they keep it because they believe it will not survive if put back in the mud. However, one informant does not believe that this is true. She has collected mangrove clams and kept them alive for at least a week, as long as the saltwater was changed.

Women in Ngermid suggested that the mangrove area in Ngesaol called *Bkul a btil a uel* where mangrove clams are abundant should be closed for short period, possibly a year to allow the clams time to repopulate. They have talked to their legislator and expressed their concern to the Bureau of Marine Resources at one time but nothing has ever been done at the state or national level to increase protection of this *ongduoll.*

Melekeok

EXTENT OF RESOURCE USES

The state of Melekeok had a population of 239 in 2000. Fourteen people in Melekeok state were interviewed for this study.

Main Natural Resources

- Marine fish
- Marine invertebrates
- Forest trees
- Mangrove trees
- Farm crops
- Fruit and nut trees
- Fresh water
- Medicinal plants
- Taro

Melekeok State is located on the east coast of Babeldaob. It is halfway between Koror and Ngarchelong. The State offered Palau a big piece of land to build the new National Capital, which is now in the process of being built on a nice area overlooking Babeldaob from all corners. The National Capital building covers many acres of land that were once forests and savannas. This will increase the value of land in Melekeok as well as the nearby states in the near future. Many government jobs will relocate to the new capital and presumably people may move to Melekeok and the surrounding states, as well.

The villages of Melekeok lie along the seashore on both sides of a paved road.

FISH: The edge of mangrove (*lalou*) are very important because these are places where juvenile fish live. During high tide, adult fish such as rabbitfish (*meas*) and stingrays feed in the *lalou*. This is a favorite place for early morning fishing for a day's meal.

Uet and *lemau* are good places for fishing during low tide.

Halfway between the beach and the reef is an area open for everyday fishing. This area is where families get most of their daily fish. The other half, farther out towards the reef, is reserved for fishing activities for customs or to feed people during community activities (such as cleaning the road, channel, waterways for *mesei*, or building and repairing the community *bai*, pier and dock). Fishing in this area requires permission from the chiefs.

Although they are not hunted, one resident mentioned the presence killer whales (*chelechil*) and *medob* (possibly sperm whales, *Physeter catadon*) outside the reef during the month of June.

INVERTEBRATES: Mangrove is a home to mangrove clams (*ngduul*, *delbekai*, *debuongel*), mangrove crabs (*chemang*, *chechoech*, and *senges*), mangrove snails (*bsungel*), juvenile fish, eels, stingrays, and octopus. *Ngduul* are collected by women, mainly as a source of income. Men trap crabs, also for sale. Fish and stingrays for family consumption are caught.

Small sand clams (*chesechol*) are collected to make soup, especially when water is rough during easterly wind. *Delsangel* are also collected at rocks at the edge of water.

In the seagrass beds, women collect sea cucumbers (*ngimes*, *molech*, *cheremrum*, *irimd*, and *sekesaker*), sea urchins (*ibuchel*), sea anemones (*chetermall*), bivalves (*kim*, *oruer*, *delbekai*, *kikoi*, and *tiuach*), sea snails (*rechiil* and *semachel*), and sea worms (*chiull*). Most of these are collected for family consumption.

The trochus sanctuary is off limits to everyone, except during open season. The sanctuary is located on the reef. Trochus meat is eaten and the shell is sold. Recently, trochus buyers have been buying meat with the shell.

The governor and one of the high chiefs have giant clam (*kim*) farms in the nearshore area. Melekeok elementary students were the first to have a clam farm in the state. This farm is still maintained in front of the school.

TURTLES: Some years ago when Melekeok did not have a paved road and no cars, turtles (*uel*) nested at Melekeok beaches. There have been no nesting turtles sighted for many years.

DUGONG: With a law prohibiting dugong hunting, they are seen often in a feeding area in front of Ngermecheluch hamlet. They comes in pairs, sometimes with young.

MANGROVES: Most local summer houses, outdoor toilets, and extensions are made from mangrove wood. This is because it is easier to transport trees out of the mangroves than it is to remove trees from the forest.

FARM CROPS: Family farms and gardens are tended by both men and women, whereas a taro patch (*mesei*) is strictly a woman's place. Private and community lands are used to grow tapioca, taro (*kukau* and *bisech*), sweet potatoes, sugar cane, fruits and vegetables. Most of these are for family consumption, but there are some women who sell their produce at markets in Koror.

FRUIT AND NUT TREES: Betelnut and pepper leaves are favorite market items for many families in Melekeok for both buying and selling. Residents chew betelnut with the pepper leaves, but nobody is serious about planting a lot of both. So often, betelnut is bought in the local stores. Coconut trees are the same. Coconuts are used in cooking and as drinks. A few are sold at the markets.

Fruits such as mango, avocado, citrus fruits, breadfruit, rambotan, and *riamel* (football fruit) are usually planted near homes. Families generally do not buy fruits at stores.

TREES: People of Melekeok use many kinds of forest trees to build houses, canoes, outdoor toilets, and summer houses. More than 30 years ago, most houses were built with local materials except for roofs. Woods used for houses are: *ukall*, *blacheos*, *btaches*, *ksid*, *las*, and breadfruit trees (*meduu*). Mahogany, an introduced tree, is another favorite tree now.

Ukall was used to build canoes, especially *kaeb* (large sailing canoe), *kabekel* (large sailing canoe used for transportation, especially in war), and *brotong* (transportation canoe). *Btaches* (Alexandrian laurel tree) was used to make *kotraol* (a small racing canoe). A large canoe has just been completed from *ukall*. The young men did most of the construction work as the older and experienced men supervised. The canoe was built for the Pacific Arts Festival that will be held in Palau in 2004. More importantly, it was built so young men could learn how to build one type of canoe before the few skilled old men die.

MEDICINAL PLANTS: Traditional medicines are still collected from forests and savannas, especially for *omesurech* (hot bath for new mothers). However, most medical problems are treated at the dispensary in Melekeok or referred to the Koror hospital.

FRESH WATER: Ngardok is the only freshwater lake in Palau. This is a national conservation area. The lake has ducks, many kinds of birds and crocodiles. Many ducks have moved into other swampy areas to be safe from crocodiles. Many rivers come from Ngardok. It also feeds into many swamp areas.

Melekeok is rich with *omeklochel* (fresh water swamps). Most are left uncultivated (*dechel*). Many trees have grown inside some of the *dechel*. *Kerdikes* (a type of grass used for grass skirts) has taken over most *dechel*. Without crocodiles, these have become safe places for ducks to live in. They also offer plenty of food for ducks.

Fresh water swamps are sometimes planted with giant taro (*omrekongel*) and left unattended for years. This allows women time to take care of taro patches (*mesei*) which require more attention.

The cultivation of taro patches (*mesei*) requires certain knowledge and art. The work is hard and time consuming. To families and communities, a *mesei* is a place where taro for family meals come from and a source of income to the family. To women, a *mesei* is one place where women congregate to communicate, share information, joke, learn from each other, and hand down the art of taro patching. It is also a place to go to relieve tension and pressures. A *mesei* is strictly a women's place.

BIRDS AND BATS: When *choes*, *dekemerir* and *chelangel* have fruits, pigeons are very fat. They were once hunted at that time. Residents say they are no longer hunted. There used to be lots of Micronesian megapodes. Now, they are hardly ever seen. Fruit bats follow *sim*, especially when plants are flowering. They also eat flesh of Pacific almond nuts (*miich*). *Sim*, a season of flowering and fruiting trees, travels from southern to northern Palau, and then back again. The fruit bats move

from one place to another in Palau, with the flowering of the trees. The bats were once hunted when they passed through the area, but residents say they are not hunted these days.

CHANGES IN RESOURCES USE PATTERNS

FISH: Fishing methods have changed a lot over the years. Very few men use spears or *choltoir a ngikel* (run after fish with a spear). Fishing with spearguns is more convenient than line fishing. One can select what kind of fish to spear, but it is also a good tool to take a lot of fish under coral heads. *Bidekill* (throw nets) are used only by young men. Almost every male in Melekeok owns at least one throw net, whereas before few owned such nets. With 24 hour electricity, almost every home has a deep freezer where extra fish and seafood can be stored. One fishing trip that brings enough fish for several days is common these days.

Many traditional fishing methods such as using *ruul* (a fishing net made from coconut leaves), are no longer practiced. The new kinds of fishing equipment are preferred because they are sturdy, last a long time, and are easily accessible. Today's fishermen do not need traditional knowledge and skills. They only need to know the tide schedule and moon phase which can be read from a calendar.

Beng were owned or used only by *rubaks* of Udes clan. A *beng* is a stone fishing trap made from rocks that are lined with an end shaped like an arrow. The trap faces the reef. The arrow part is deep enough for fish to be trapped safely. Fish can be selectively speared once in the trap. Smaller fish or species that are not desired can be left to swim free. In addition, only enough fish for a meal or an occasion can be caught with this method. The others are left for the next high tide to come. Several *beng* are still being used, but not as much as before.

Some large fish, *kemedukl* and *maml*, were said to be "*odimir ar meteet*," (fish for high clans) because they were big and hard to catch. They were also caught when there was a community occasion that called for a big feast. Before scuba tanks, very few men were known to be able to catch these fish. Fishermen with scuba tanks can get many maml and kemedukl a day. These two fish are now favorites at restaurants in Koror.

The presence of *kemokem* (type of large seaweed) used to be an indication that there's lot of fat *chum* (long-snouted unicornfish) and *komud* (rudderfish). This is still the case, but fishermen generally do not pay attention to such signs. They go fishing at any time.

INVERTEBRATES: The new type of mangrove crab trap is not the same as the traditional one (*kual*). With traditional traps, small crabs can get in to feed and escape from the trap. The small crabs cannot escape from the new traps made from chicken wire. The small crabs never get to the market or return back to the mangrove. They end up in family dinner pots.

There are plenty of land crabs (*rekung*). Since the road has been built, people from Koror and other states come to Melekeok during times of the full moon to collect crabs.

BIRDS AND BATS: Traditional hunting methods for pigeon and bats (*mngumll*) are no longer used. Before hunting, the hunter sat in the smoke of a fire, so that his scent would be disguised. Pigeon hunters used to tame pigeons to call other pigeons to fruit bearing trees. He then used a blowgun, a bow and arrow or slingshots to kill the birds. If birds or bats are hunted now, the men use shotguns. They no longer train pigeons to attract wild birds.

THREATS TO THE RESOURCES

OVERFISHING: Overfishing has become a problem as more people fish with less traditional methods. Fish that were hard to obtain before are now routinely caught from deep areas using scuba tanks.

DANGEROUS ANIMALS: Crocodiles have become a big threat to women when collecting *ngduul* in the mangrove areas. Crocodiles nest at *kebokeb* (inner edge of mangrove and dry land), mostly near rivers. Women are now afraid to go to some areas. For instance, they refuse to go into areas in the mangroves where the fresh water comes out from the land. The thought of crocodiles being in these areas is enough to limit the areas where the women can collect mangrove clams.

HABITAT DESTRUCTION: The fisheries dock was extended by filling in part of a mangrove. A channel was dredged to allow boats to dock.

Sea level rise is also a concern of some residents.

SEDIMENTATION: Development on the land has caused soil to erode into rivers, swamps, taro patches, mangroves, and into the ocean where it has killed corals and invertebrates. The women think that the fine soil trapped by the sand has killed sand clams and ghost crabs (*chesechuul*) that were once plentiful. They also believe that the sediment is the main reason that the beaches have turned brown. There is too much sand on the seagrass, thus destroying the habitat for a number of invertebrates.

Dredging and sand mining occur along the coast of Melekeok. People say that they can no longer find sea cucumbers and sea urchins due to sedimentation of the nearshore areas.

PESTS: Wild pigs are increasing in number. *Uek* (purple swamphen) and wild pigs have increased in number. *Uek* eats taro (*kukau*). Wild pigs eat everything in the taro patches, *omrekongel* and gardens. In addition, fruit flies are killing many fruits.

DISEASE: Diseases, possibly, *bibrurk* or aid, kills papaya. Other diseases that have attacked plants are *kerkes* and *nguk*.

SUSTAINABILITY OF CURRENT USE PATTERNS

FISH: Current fishing practices appear to be sustainable in Melekeok because even though there have been many changes in fishing practices, there still are strong local controls on fishing activities.

INVERTEBRATES: Residents say that habitat changes have led to declines in some invertebrate species, especially sea cucumbers and sea urchins. Those invertebrates that are collected, are generally used locally. Only one full-time fisherman catches mangrove crabs. At current levels, such harvest should be sustainable.

TARO and FARM CROPS: Current activities in taro and farming are sustainable. However, wild pigs are a threat to some women and their crops.

TREES: Tree harvesting is currently at sustainable levels. However, there is a fear that the opening of the road will bring big equipment and will make the forest much more accessible to unsustainable tree cutting activities.

DISTRIBUTION OF BENEFITS

People who live at Melekeok all benefit from the state resources. Beside selling extras to help family income, produce and catches are sent to help their children living in Koror.

Food from land and ocean are used also during customs.

UNUSED AND UNDERUTILIZED RESOURCES

FRUIT AND NUT TREES: Betelnut, coconuts, bananas, mangoes, avocado, citrus fruits, breadfruits, rambotan, papaya and *riamel* (football fruit) are not planted except for family use. There is potential to plant these fruits for more commercial sale.

PLANTS: Pepper leaves (*kebui*) can also be grown for sale.

INFORMATION GAPS AND NEEDS

There is uncertainty in Melekeok about where the fresh water supplies for the national capital will come from. Residents are also concerned about where the sewage from the buildings will go and how it will be treated.

Ngaraard

EXTENT OF RESOURCE USES

The state of Ngaraard had a population of 638 in 2000. Twenty-five people were interviewed for this study.

Main Natural Resources

- Marine fish
- Marine invertebrates
- Turtles
- Mangroves
- Trees
- Birds and wildlife
- Farm crops
- Taro
- Medicinal plants
- Fresh water

Ngaraard has both east and west coasts and is one of the largest states in Palau. People who are traveling to Ngarchelong by land have to pass through the Ngaraard villages in order to reach Ngarchelong. Ngaraard's land is very important to the people, especially the older women (*mechas*) who have taro patches all around the state. Construction crews in Babeldaob have been stationed in Ngaraard so they can develop the new road quickly.

Most villages are built close to the shore. Long ago when there were no cars, people built their houses near the water for better and faster access to the water. However, they did not want to be too close where winds or water can cause damage to the houses. This practice is still followed today. Ngaraard residents often picnic on benches under shady trees on the beach.

FISH: Areas along the edge of mangroves (*lalou*) are important because these are places where fish spawn. Juvenile fish live in the deeper areas (*uet*) within shallow nearshore reef and sand flats. This area is important to people in Ngkeklau village on the east coast because it is where they collect stingrays and many kinds of fish.

The shallow area with seagrass (*kerker*) is also important for fishing. People go line fishing during the day or at night on full moon. They also go spearfishing at night. The barrier and fringing reefs (*chelmoll*) are other important sites for fishing.

INVERTEBRATES: Few invertebrates are found on the east coast. Some people collect clams from the beaches for food. They are cooked in coconut milk or water and a few spices. These small clams are usually collected when the wind is easterly when fisherman on the east coast cannot go out. Other invertebrates are collected from the mangroves: mangrove crabs and small clams (*ngduul*, *delbekai*, *debuongel*, *murch*, *bsungel*, and *senges*). Trochus is collected from the barrier and fringing reefs. Land crabs are collected from the forests and beaches. In general, invertebrates from the west coast are inaccessible and not commonly collected. They are said to be "*mekoll*," irritating and leaving an itchy throat.

MANGROVES: Mangroves are used for lumber to build houses and fish and mangrove crab traps.

TREES: The people from Ngaraard use many kinds of forest trees for building houses, fish and crab traps, and canoes. Trees are also used for firewood.

BIRDS and WILDLIFE: Birds and animals are hunted for food. The animals that are hunted are wild chickens, wild pigs, Micronesian and Nicobar pigeon, Micronesian starling and bats.

MEDICINAL PLANTS: Palauan medicines are taken from forests and savannas.

FRESH WATER: The village people use the water from the Lmetmellasch River. It is the major water source for most villages in Ngaraard. This River is located in Ngkeklau village. The other village, Choll, uses water from a different river located in the village. Ngaraard has another river located in Ngkeklau called Ngerchokl. This is a historical site and very interesting stories are told about this place.

CHANGES IN RESOURCE USE PATTERNS

FISH: Fishing methods have changed. People used to make traps or catch fish from bamboo rafts. Now, they use motorized boats, nets, fishing line, spearguns, tanks, fish finders and many other kinds of gear.

MANGROVES: Mangroves grow on both coasts. On the east side, there are few and smaller mangroves. The east side mangroves have grown and are full of life. West coast mangroves have been destroyed from the road development and sedimentation. *Kikoi*, Ngaraard is known throughout Palau as the home for the clams *kikoi*. They were common on the west coast near the mangroves but are hard to find now because of sedimentation from road construction.

TURTLES: Turtles used to nest on the beaches that line the east coast of Ngaraard. Some years ago, many turtles nested there. Now people use boats that scare the turtles away.

TREES: People used to cook food with firewood. Firewood was also used to prepare lime (*aus*) and to prepare varnish (*laok*) from *cheritem* (parinarium glaberrimum). Now everybody is using kerosene or gas stoves.

THREATS TO THE RESOURCES

OVERFISHING: People from different states come to fish in Ngaraard. Sometimes they use scuba and tanks to catch fish that live in the deeper waters.

SEDIMENTATION: Rabbitfishes are decreasing in number. People believe this is because of the damage that has occurred in the mangroves from sedimentation. Land development has caused sediment to flow into the rivers and the sea and destroyed lots of sea life.

The Ngkeklau *uet* has changed. The *uet* has become shallow like *kerker*. When people went out on a bamboo raft pushing it with a pole, the water was deep enough that the pole would disappear when you tried to touch the bottom. Now the water covers only a small part of it. People said that the area is now knee deep when it is low tide. Giant clams that were brought there for a clam farm died immediately because the water is too hot at low tide during the day.

POLLUTION: Residents are concerned about a sewer overflow that smells in the neighborhood and flows out to sea.

ROAD CONSTRUCTION: Noise has scared the animals and birds away from their homes in the forest. People say that the road construction has scared many animals and birds away. Some are scarcely seen. For example, pigeons, fruit doves, and megapodes are no longer seen. Megapode nests are still around, but residents have not seen any birds. Pests may also be a problem (see below).

PESTS: Fruit flies are one of the major threats to crops in Ngaraard. Years ago, people were able to eat many kinds of fruit, including papayas, bananas, and star apples. Now, people eat them only once in a while because the flies have spoiled the fruits. Lemons are scarcely used in preparing food and drinks because the flies invade them when they are young. Residents have tried using sticky traps, and other methods, but nothing seems to work.

There were plenty of megapodes many years ago. Now residents say that wild dogs, wild cats, and monitor lizards have eaten the megapode eggs.

DISEASES: There are lots of diseases on taro and tapioca plants. The women are concerned about the taro diseases *kerkes* and *nguk*, among others. The *mechas* don't know how to cure them. Tapioca has been affected by a disease that they call *bibrurk*, which means yellow. The tapioca leaves yellow and then fall to the ground. The root becomes dehydrated and inedible.

SEA LEVEL RISE: Sea level rise is another concern to residents of Ngaraard.

SUSTAINABILITY OF CURRENT USE PATTERNS

FISH: Local fishing activities are currently occurring at sustainable levels. Not many people fish for commercial purposes, so they are not taking everything. In addition, many people are still doing things as they did in the past. Full-time power supply has only been available in the past five years in Ngaraard, and people are not yet catching excess fish to be frozen. However, outsiders who come to fish in Ngaraard waters, may be fishing unsustainably.

DISTRIBUTION OF BENEFITS

All people from Ngaraard depend on the saltwater for fish and invertebrates for food. They also depend on food that comes from plants (breadfruit, tapioca, taros and bananas) and land animals and birds. They sell betelnut, taro and land crabs. The distribution of benefits is evenly spread since most resources are for family use.

UNUSED AND UNDERUTILIZED RESOURCES

People interviewed in Ngaraard recommended using firewood more often. They believe that it costs less than other fuel and is easy to find.

Different color soils can be used to make paint pigments as was done in the past. Traditionally, soil pigments were used to paint war canoes, *abai*, and houses.

INFORMATION GAPS AND NEEDS

Residents would like to know how to control the fruit flies.

Ngarchelong

EXTENT OF RESOURCE USES

Like the other states of Babeldaob, most of Ngarchelong's registered voters live in Koror or outside the Republic. In 2000, the resident population of Ngarchelong was 286. Many of the state's residents work for the local government (about 60%) and those who do not work for the state depend on the market for generating income. While many households now buy some of their food from local stores, most households in Ngarchelong still have individuals who fish and farm on a daily basis. Thirty-seven people in Ngarchelong were interviewed for this study.

Main Natural Resources

- Marine fish
- Marine invertebrates
- Sea turtles
- Farm crops
- Mangroves
- Dugong
- Pigs
- Taro

CHANGES IN RESOURCE USE PATTERNS

FISH: There is a continuous use of fish (especially *meas*, *klsebuul*, *ngiaoch*) in Ngarchelong. Because many people make money from the weekly market and because many homes still depend on fish for protein, there are always locals fishing in Ngarchelong. The average local might go fishing for food every two to three days. Those looking to catch fish to feed families will usually not travel far out into the northern reefs but will instead fish the barrier reefs closer to the villages. Those looking to catch fish for market will typically go farther north because fewer people frequent these areas, and the fishing is better (Ngebard and Cherasech). In the past 3 years the market for fish has not been good for those in the far northern villages. Some individuals will sell fish to Koror about once a month. If they have their own boats, they will usually go to market once they have collected 300-400 lbs of fish. If they don't have a boat they will usually send, at most, 100 lbs of fish with other boats or trucks going to Koror. More people in Ngarchelong own boats so there are more individuals who can go fishing by themselves. In the past, there were fewer boats and people usually went out as a group of 3 to 5 people.

On the weekends and anytime when the weather is calm, there are many people who live in Koror but are from Ngarchelong who come to fish in the state's waters. There are also many people who are not from Ngarchelong that accompany these people. They almost always catch fish that will be

used for food as well as for Koror markets. The visiting fishermen stop at the dock in Ngerchelong, so residents usually know who has been fishing that day.

In Ngarchelong, there are 4 or 5 individuals who have contracts with businesses in Koror to bring fish to Koror every week. Local residents have a perception that many other people in Palau fish in their reefs both for food and for sale at the markets. They believe that a lot of the fish that is caught in Ngarchelong is caught illegally (using scuba and or not complying with seasonal closures). Another major driving force motivating people to fish is to provide food for customs. Residents and non-residents alike fish in Ngarchelong's waters to accommodate requests for customs.

INVERTEBRATES: The crustaceans harvested most often in Ngarchelong are mangrove crabs. There are several mangrove crab experts who use traps (*bub)* to collect these crabs. If the crabs are big enough and several of them are collected then they are prepared for sale in the markets in Koror. The timing of collection for mangrove crabs is lunar and is continual throughout the year. There are some who believe that the northern mangrove areas of Ngarchelong are nurseries for mangrove crabs. They cite the fact that it is common to find many undersized crabs in these areas as evidence of a nursery.

Many species of molluscs are important to locals. All the species of giant clams were traditionally important to many people as a source of food and income. This is still true today. Ngarchelong is known for its giant clams and much of the harvested meat is sold to markets in Koror. Most women and fishermen who sell prepared foods at the markets will go out collecting clams to prepare for sale. Collection of giant clams as well as other types of clams (*ngduul* and *oruer*) occurs weekly. There is an organization in Ngarchelong, which runs a clam farm near Ollei. There are current projects to replant some depleted areas with juveniles from the clam farm and from the national clam farm in Koror.

Several species on echinoderms (the sea cucumbers *ngims*, *irimd* and *cheremrum*) are a major source of income for many of the homes in Ngarchelong. They are harvested every week and prepared for sale at the markets. While some of this meat is kept for food, much is sold to markets or harvested for customs as they occur. Women and men collect these species for income. Most of the older women send their children or grandchildren to do the collecting for them. As many of these species have declined in numbers, everyone stated that they have to expend at least twice as much time in order to collect enough to sell at the weekly markets. The decline of many species of echinoderms has occurred all over the coastal areas, particularly areas that have been developed with docks or ports. One species that has disappeared completely is the urchin *ibuchel*. This species was once very common in the seagrass beds of Ngarchelong, however in the past ten years, they have slowly disappeared from these areas.

TURTLES: Both the green and hawksbill turtles are very important traditionally for Palauans. Ngarchelong is no exception. The locals regularly hunt turtles outside the seasonal closure. Closed season for turtle harvest is from June to August and from December to January. Green turtles are mostly hunted for their meat while the hawksbill is hunted for its shell, which is used in making jewelry and money (*toluk*). These too have declined in abundance and size. The turtles traditionally were only harvested for special occasions. However, today people will hunt them because they like to eat the meat. The meat is not sold to markets but is distributed to nearby families. The locals do

not depend on turtle meat for regular income nor do they require it as a food source. In the past, harvesting of turtle eggs was common on the beaches of Ngerchur and Ngerkeklau. However, these days only the landowners and those with permission regularly go to Ngerchur. Its use is typically for traditional customs and is opportunistic most of the time.

FARM CROPS: Many families in Ngarchelong have a farm or a taro patch (eg. for *brak*, *diokang*, or *kukau*). These crops are important for many families' staple diet and are a primary source of income. Almost all the families in Ngarchelong that harvest crops will keep some of the harvest for the home and sell the bulk of it to markets. Sometimes the harvest is cooked and prepared for *bentos*; at other times the crop is sent raw in baskets to markets or for customs. In the past, families usually gave their crops to relatives for customs. Now, many women sell their crops to anyone who needs local foods for customs. There are many older women (*mechases*) who make their money from the sale of these crops. Younger women also harvest for market, however, many of them work for the state and do not sell as often to the markets as the older women. Every week there are *bentos* or baskets of harvested crops sent by car or by state boat to the markets in Koror. Many of the market goods go to the Ngarchelong's Blue House in Koror for sale. Fewer people maintain their own farms and taro patches. More often, younger people do not go daily to the taro patches or maintain farm crops. As a result, many of the taro patches have been abandoned and are now overgrown.

MANGROVES: Mangrove tree species are important for local building materials. The locals harvest the trees for specific buildings such as summer houses or beach front shacks or sheds. They are not sold commercially and their use is not frequent since the lumber is required only for small building projects.

OTHER: Megafauna such as dugongs are rarely seen anymore. In the early 1980s, it was common to see groups of 3 to 4 dugongs. These were often seen when people were line fishing from their boats. Locals did hunt them in the past, and even after national legislation made it illegal to hunt them the practice continued. It is not certain whether they are still hunted today.

Pigs are also a valuable resource. Many people used to own pigs and use them for customs or for sale to markets. They are convenient because they eat anything and can be kept anywhere. However, after health regulations were put in place many people could not afford to keep pigs. Today there are less pigs than ten years ago. There is a herd of domestic pigs on the island of Ngerchur, but these are not actively hunted today by the owners.

THREATS TO THE RESOURCES

SEDIMENTATION: Uncontrolled sedimentation resulting from improper road building activities has deposited significant amounts of sediment into the rivers, which drain these watersheds. The sediment and nutrients end up being deposited on downstream marine areas.

OVERHARVESTING: A major threat to any natural resource is overharvesting. There is concern that with most of the homes in Ngarchelong already harvesting their resources on a daily basis, excess harvest by non-residents could deplete many of the targeted species in a short period of time.

In addition, with the type of technology available to fishermen, they are able to catch more in a shorter period of time and they are able to exploit a wider range of areas than was previously possible. If the commercial fishing in Ngarchelong is not managed, there is a risk of severe overfishing which would hurt the local economy as well as jeopardize the local lifestyle.

DREDGING: There are two dredging projects in Ngarchelong, and there is concern that these projects pose a significant threat to important marine areas in which many people harvest. Alteration of natural tidal currents, the 'shallowing' of tide pools, and decrease in seagrass habitat quality are some of the impacts perceived to come from dredging. Therefore, this activity is considered a significant threat to Ngarchelong's natural resources. Already there is noticeable decrease and even disappearance of some molluscs and echinoderms in the immediate areas around these sites.

LOSS OF TRADITIONAL WAYS: With more and more people living outside the state, there is a danger of losing traditional knowledge about harvesting and fishing practices. Already there are fewer women involved in maintaining the taro patches. Many of these women are older than 60 and few of them have children who work their own taro patches. They said that none of their grandchildren were interested in going to the taro patches and they were worried that this way of life, though it makes money for them today will not be an option their grandchildren would choose. With less and less information passing from the elderly to the young it is quite possible that for practical purposes, future residents of Ngarchelong will not posses the hands-on knowledge required to maintain important local crops.

INVASIVE SPECIES: Ngarchelong has a problem with invasive species. *Kebeas* and *telentund* are two species which the local people feel are a threat. Already, the *kebeas* in the state has taken over much of the roadside areas and has enveloped many trees. There have been attempts at containing the plants but these have failed. If these plants are not controlled it is possible that they will outgrow and kill many of the local species.

SUSTAINABILITY OF CURRENT USE PATTERNS

FISH: Generally, there has been a decline in abundance for all species of food fish and molluscs (giant clam species) around the state. As early as the 1980s, fish such as *meas*, *ngiaoch*, and *klsebuul* began to decline in numbers. It used to be that fishermen could decide before going out on a fishing trip what fish they were going to catch. These days, people do not have that luxury and must take what they can find. Six years ago, 2 or 3 people could get 300-400 lbs of fish in one day. Today, it would take the same number of people three days to get as much fish.

There have been major changes to the reefs of Ngarchelong. At many fishing sites and around the northern reefs in general, coral colonies are dead or bleached and there are less fish seen around these areas. In some areas big patches of coral are covered with algae. In addition to these changes, water temperatures have been rising and ocean temperature is warmer than ten years ago. Giant clam species are much harder to find now than before. There are less large individuals and more time must be spent searching for them.

In the past very few people sold fishes and invertebrates to make money. More and more often, people are fishing for the market instead of for the home. To compound the situation, technology has allowed more efficient means of catching fish these days and allowing individuals to catch more than was possible in previous years.

INVERTEBRATES: These areas, too, have experienced dramatic declines in the abundance of fishes (*meas*), sea urchins (*ibuchel*) and other food invertebrates (giant clam species). The scale to which these species have declined is comparable to that of other reef species. Another change of significance is that seagrass beds and mudflats near the mangroves are shallower than in previous years. People used to be able to travel out to the edge of the seagrass beds on bamboo rafts. This is not possible anymore because at low tide, much of the seagrass/mudflats in front of the mangrove areas are exposed. Where once people had to be careful when walking on the seagrass areas, people can now walk or run barefoot because there are so few clams and other molluscs in these areas there is little risk of injury.

MANGROVES: The number and size of mangrove trees and plants has increased. The local demand for these hardwoods has changed over the years. There are less people harvesting lumber from mangroves so as a result much of the coast is still fringed by stands of mangrove.

However, some crustacean species, there has been a significant decline in average size and abundance. Mangrove crabs and molluscs such as *ngduul* used to be common in the mangroves. The average crab caught weighed 3 lbs or more. Recently, people say that there are fewer crabs and that it takes longer to find them. The average size has decreased so that it is rare to find many crabs that weigh more than 3 lbs apiece. Although there are fewer people collecting them now than before, they are collecting more often and for commercial sale.

TARO: The wetland areas are very important to local communities because they are where taros, yams and other important starches are planted. These areas used to function as the main source of food for villages in these areas. Every home used to have some plots of wetland, which would be cultivated and harvested for subsistence. There are fewer of these areas still suitable for cultivation. Ten years ago these areas were extensive and many families cultivated food crops. However, in recent years, there has been a decline in the number of people who cultivate these crops. In addition to this decline, there has been an increase in the occurrence of diseases in these crops. This reduces the net weight of edible crops per patch and means that people have to work longer to obtain the same volume of harvest. As a result, many of these patches have been abandoned and are now overgrown with weeds.

FORESTS: The forests in Ngarchelong are not extensive compared to other states and the residents are not actively harvesting them at the moment. Aside from the occasional tree that is cut down for local use, forested areas have remained relatively intact over the years. However, plants like the *kebeas* are rapidly taking over some parts of the forests and killing the trees they smother. Also bird populations in these forests have declined over the years. Birds like the pigeon (*belochel*) and Micronesian megapode (*bekai*) are not common anymore. Few people from Ngarchelong hunt, so it is unclear why these species are seen less often.

DISTRIBUTION OF BENEFITS

The distribution of benefits from local resources in Ngarchelong is relatively even. Most people who live in the state benefit from marine resources and farmed crops that are collected or grown for subsistence use, local sale or sale in Koror's markets. A few people make a living from fishing or invertebrate collection, however, not at the expense of other residents of the state.

There is a growing concern in the state that non-residents are benefiting from the sale of fish that have been caught in Ngarchelong's waters.

UNUSED AND UNDERUTILIZED RESOURCES

AQUACULTURE: This has been identified as a future venture to take advantage of the marine resources available to Ngarchelong. Clam farms were mentioned as potential future ventures within the State. It should be noted that currently there is a giant clam farm operating in Ngarchelong. The organization that runs the farm is planning to extend the farm's area and is also planning over the long term to become a supplier to buyers outside of Palau.

TREES AND PLANTS: Another resource people said was going to be used in the future is the hardwood forest in Ngarchelong. As more people move into the state and build homes there will be a greater demand for local wood materials for summer houses. Some people suggested that it would be good to plant certain species of trees on their land. Plants that many people cited as potential plantation investments are *buuch*, *kebui*, *meradel*, *tuu*, and *iedel*. Currently, there is no active woodmill in the state but that might change if the demand for local lumber increases.

INCREASE HARVEST: In the future, there is likely to be greater demand for food fish and invertebrates as more people move into the state. There might also be an increased demand for local crop foods such as taro and tapioca. It is also possible that the traditional practices of taro farming might eventually die since fewer and fewer children are shown how to plant and harvest such crops. There are plans to boost the local fisheries federation in the state so as to provide income generating opportunities for local fishermen. However this is accomplished, the result will be an increase in the level of fishing that occurs in Ngarchelong's reefs.

INFORMATION GAPS AND NEEDS

There is little information about forest use in Ngarchelong.

There is little baseline information about the diversity of Ngarchelong's forests and the relative abundance and distribution of dominant species.

There is very little information about the resident bird populations in the state.

There is no information being collected about the state of the fishery in the Ngarchelong.

There is no socio-economic information available for the state.

Ngardmau

EXTENT OF RESOURCE USES

A very small portion of land in Ngardmau State is occupied. Because there are fewer people living in Ngardmau than before, several hamlets that have been abandoned. The state of Ngardmau had a population of 221 in 2000. Sixteen people were interviewed for this study.

Main Natural Resources

- Marine fish
- Invertebrates
- Farmed crops
- Medicinal plants
- Trees
- Mangroves
- Taro
- Birds and bats
- Fresh water
- Recreational site (waterfall)

FISH: The area from *lalou* (mangrove edge) all the way to the edge of reef is utilized very much. Stingrays and many kinds of fish are caught at the edge of the mangroves. Seagrass beds are good areas for *mengesokes* (net fishing). The reef is still the best place to get lots of fish, especially the big fish (such as large parrotfish and snappers). Since the reef is far and it is separated by a deep channel with a strong current, it is fairly safe from land pollution, but not from fishermen. Most fish that are caught are sold in Koror. However, the local residents also depend on local fish for daily meals.

INVERTEBRATES: Ngardmau is well-known for sea cucumbers (*cheremrum*). These are found in the seagrass areas along with other invertebrates and sold at Yano's market. Mangrove crabs and clams are collected and sold as well.

FARMED CROPS: The negative affects of 18 years of surface mining for bauxite before WWII are still seen today, both on land and ocean. Seagrass areas are still dead from sedimentation; and it is hard to grow crops on the areas on land where the bauxite was washed because the soil is too pebbly. Bare hills were also left from the mining operations. Smaller portions of land are still used today to grow food for daily consumptions, for customs (*siukang*), and to sell in Koror (especially at Yano's market). Selling food in Koror is now the primary source of income to the community. Families grow food such as tapioca, sweet potatoes, and vegetables. Betelnut, pepper leaves, coconuts, pineapples, bananas, papaya and sugar cane are sold in Koror on a regular basis.

MEDICINAL PLANTS: Medicines are collected from forests and savannas, especially for *omesurch* (hot bath ritual for new mothers).

FRESH WATER: Ngardmau has the biggest waterfall and the highest point of land in Palau. The waterfall (Taki) is a tourist attraction. Taki and Ngertebechel River are the two main sources of fresh water for Ngardmau residents.

TARO: Taro patches (*mesei*) are an important part of Ngardmau society. Taro patches are used to grow two kinds of taro (*kukau* and *brak*). Giant taro are planted on the dikes between *mesei*. Most taro is used for daily consumption, some are used for customs, and some are sold in Koror. Women sell produce in Koror twice a week. However, since the few women in the village already have jobs, and the younger women are not interested in working in taro patches, many taro patches have been abandoned. There are *omrekongel*. These areas are planted with giant taro and do not require maintenance.

MANGROVES: Many outside houses, including summer houses, are built with mangrove woods such as *mekekad*, *urur*, and *tebechel*. Crocodiles are seen more often in the mangroves. They are becoming a nuisance for women collecting clams and for men who trap mangrove crabs.

TREES: Valuable trees used to build houses and canoes are similar to trees in other states in Babeldaob. For example, *ukall*, *btaches*, *esemolech*, *ksid*, *elebiobech*, *blacheos*, and *las* have been used for construction in Ngardmau.

BIRDS and BATS: There are very few land animals now. During the interviews, some people said that although pigeon hunting is prohibited, they are still hunted. Pigeons and bats are highly prized food.

ANIMALS: Domesticated pigs were mainly raised for customs. They are sold to other members of the community during certain customs, such as funerals.

There's turtles and dugong in the ocean. Because Ngardmau has no beach, turtles do not nest. However, hawksbill turtles are seen feeding in the local waters.

CHANGES IN RESOURCES USE PATTERNS

Many community works were done by groups of people. Group activities such as fishing, gardening, beautification, clean-up, deepening of mangrove channels, deepening of taro patch drainage ditches (*bong*), cleaning the water resource system, building *bai* (community house) and *diangel* (boat house at dock), putting up framework of individual house (*tatemai*), and clearing forest were educational in nature. Conservation and leadership knowledge, methods and skills were exchanged, discussed and practiced (hands-on-activities) during such activities. Now, all these have been replaced by new group activities such as baseball and basketball.

Subsistence living, which requires the use of natural resources, has changed considerably over the years. Locally made items such as cooking utensils, gardening tools, fishing gear, containers (for syrup, water, etc.), baskets, mats, thatch roofs, handicrafts, arts, fish and wild rooster traps, canoes and rafts, housing, ropes and strings to tie building materials, small tools such as *ebakl* (adzes), and pottery, have all been replaced by imported utensils, tools, and building materials. Much of the detailed knowledge and skills used to make these essential things are no longer practiced and are being lost. In addition, the roles that these essential items played are disappearing. For example, cooking for different occasions called for special tools and techniques, which very few people are knowledgeable of these days. Previously, if women were cooking for chiefs or for an occasion when a customary title was given, it was necessary to have pounded *belsiich* (tapioca). This food had to be made with particular tools and ingredients. Now, when *belsiich* is made, the women do not use special tools or methods.

Today, almost everyone sells food, produce, fish and invertebrates to markets in Koror. Most plant produce, and seafood collected are for selling purposes. The left over are for family consumption. When relatives come to Koror and stay with families, they normally bring such produce and seafood for their relatives. Now, they are mostly sold at markets or stores. Farm and *mesei* produce continue to be available because there is an effort to replant taro, tapioca, mad other farmed crops. However, little or no effort is put into planting betelnut trees, pepper leaves and coconuts. The emphasis is on making money now without thinking of conserving for tomorrow.

The traditional times to collect, fish and plant are no longer followed. To meet the market demand in Koror, collecting invertebrates, fishing and planting take place anytime, regardless of spawning time, or of flowering and harvesting seasons. The family income is the first priority at the expense of depleting natural resources. Selling produce is the only way for some families to earn money. Whatever they need to buy depends on the sell of their produce and their catch.

Ngardmau was the first state to sell to Yano's market in Koror. However, the market now buys fish and produce from other states. As a result of this larger supply, they choose what they want to buy. Sometimes the people from Ngardmau collect all they can and then are unable to sell everything to the market. Much of the fish, invertebrates and produce is thus wasted.

INVERTEBRATES: There are signs that the marine resources are being depleted. Sea cucumbers are decreasing in number.

Trochus are collected only during the summer every few years. The season used to be yearly. Now the opening of the season is declared through legislation from the national government, after a resource assessment to determine the abundance and size of trochus around the country. During the open season, each state may prohibit trochus harvest or limit collection to certain area.

BIRDS: Traditionally, pigeon was a specialty food used mostly for customs. Certain customs (especially when traditional titles are given) still require that pigeons and mangrove crabs be included in the plates of food. Lately, coconut crabs are also included in the preparation if these plates. The first food a baby would eat was mashed taro and pigeon. Occasionally stonefish were prepared for babies as well. Some babies are still fed these special foods.

In the old days, a few people were well known as pigeon hunters. They had pet pigeons that they used to call wild pigeons during hunting. Blow guns were then used to shoot the pigeons that were attracted to the call. The hunters had knowledge of the forest, behavior of pigeons, what pigeons eat and where they would be at different times of the year. They also had skills of how, when and where to hunt. After WWII, a new kind of pigeon hunter surfaced. These men who could afford a rifle. Pigeons became wild because of the rifle noise. The number of hunters increased slightly. After the installation of the Constitutional Government, citizens were not allowed to own or use guns, so hunters from Ngardmau used BB guns. However, today, young hunters have stopped hunting because of a national law prohibiting pigeon hunting.

TREES: Coconut trees are very important, but few people plant new ones. The trees are getting older and many are too tall for people to reach the young drinking coconuts.

Betelnut, bananas and coconuts were not market items before. They are now in great demand. Forests and savannas are not used as much as they used to be. Since there's a law not to hunt pigeon, few people, if any, hunt any more. Most families are using kerosene and gas to cook instead of using wood (*idungel*). Trees are not used to build houses for two reasons: it is hard to cut them down and transport them to the village, and there is no sawmill to cut them into useful lumbers. Once the road is finished, it would be easier to access and cut forest trees.

LAND: When a father dies, his sisters and aunts would give a piece of their land to his children. It is seldom done these days because Ngardmau residents are concerned that the land is being cut into smaller and smaller pieces. Instead, they have been keeping the land whole, and treating it as family land with the understanding that it is for the benefit of everyone in the family. In this way, they are also trying to avoid family disputes over land in the future.

THREATS TO THE RESOURCES

SEDIMENTATION and EROSION: Pollution from soil erosion through road building and development, sedimentation and siltation. "We hope that the building of Compact Road does not destroy our forest, our rivers, our mangroves and our ocean."

OVERHARVEST and FISHING PRESSURE: Fishing, collecting and gleaning anytime, especially just before fish and invertebrates spawn. Overfishing and overharvesting of seafood just to meet the demand in Koror are a main cause of depletion of fish and invertebrates.

Too many boats travel through the *lalou* (mangrove edge) where juvenile fish live, and where fish feed early in the morning during high tide.

PESTS: Wild pigs – too many now that eat giant taro at *dechel*, taro at *mesei* and everything at *sers* (farm/garden)

TREE CLEARING: Cutting down of big trees has made Ngardmau very hot.

DANGEROUS ANIMALS: Too many crocodiles are now in the mangroves.

DISEASE: Plants diseases have affected tapioca and taro.

SUSTAINABILITY OF CURRENT USE PATTERNS

FISH: Fish around Ngardmau are decreasing in numbers and in size. In 1989-1991, fishermen could catch 12,000 lbs. of fish in three days. This is no longer possible. When it is a good time for *o'mengesokes* (net fishing), 4,000 lbs of unicorn fish (*chum*) could be caught. Now if the best catch is no more than 1,000 lbs.

Fishermen in Ngardmau say that the fish are no longer in their natural habitats (*uet*, *chis*, *lalou*, and *melkesokl*). They believe that because of constant threats from fishermen and speedboats, fish have moved from their natural habitats to deeper areas. (Although it may be that the fish have not moved, but have been fished out of the closer, shallower areas.) They are no longer safe in the deeper areas either because fishermen can travel anywhere in the water in such a short time.

Previously, when it was time for *meas* to spawn, the *chis* were usually full of fish. However, this doesn't happen anymore. Traditional methods of fishing for *meas* are not practiced at all. Previously, there were communal fishing events where villagers went out with nets and a leader who directed which schools of fish to catch and which to leave alone. Fisherman are now capable and equipped to get a big school of *meas* with one or two helpers. No one is directing which schools to catch. Foreign workers are often hired to catch the fish.

INVERTEBRATES: Corals are dead. There are few giant clams (*kim* and *oruer*). Not only Ngardmau fishermen fish in Ngardmau's water. Many people stop and collect sea cucumbers, clams and sea urchins. There's very little sea cucumber and clams (*kim*) left. Sea urchins have not been seen at all for several years.

DISTRIBUTION OF BENEFITS

There are fewer people living in Ngardmau and all of them benefit from natural resources from both the land and the sea. Most fish are sold in Koror. However, the local residents also depend on fish for daily meals.

Not only Ngardmau fishermen fish in Ngardmau's water. Many people stop and collect sea cucumbers, clams and sea urchins. So the benefits derived from the use of Ngardmau's resources are spread to non-residents as well.

UNUSED AND UNDERUTILIZED RESOURCES

Fresh water from Ngertebechel River and Taki waterfall is more than enough to supply the neighboring states with water.

Bauxite that has already been mined and was left by the Japanese could be used in place of gravel when cementing small areas.

Betelnut trees can be grown. These trees help hold the soil in gardens.

Pepper leaves (*kebui*) could be grown easily because they could climb on any tree.

INFORMATION GAPS AND NEEDS

Ngardmau residents would like to know how to better utilize land, mangroves and ocean areas. They also are concerned about a lack of knowledge about animals' life cycles and behaviors. This indicates a loss of traditional ecological knowledge in the state.

Residents would like to know if aquaculture is feasible in Ngardmau.

Ngerchelchuus, the highest point in Palau, belongs to Ngardmau but is within Ngaremlengui's current boundary Both states claim this large and richly forested piece of land, causing considerable conflict.

Ngaremlengui

EXTENT OF RESOURCE USES

In 2000, 367 people lived in Ngaremlengui. Seventeen people were interviewed for this study.

Main Natural Resources

- Marine fish
- Marine invertebrates
- Farm crops and taro
- Fruit trees
- Forest trees
- Medicinal plants
- Fresh water
- Recreational site

Everyone in Ngaremlengui still uses marine resources for daily consumption, customs and income.

Mangroves are utilized mainly for harvest of mangrove clams (*ngduul*) and mangrove crabs (*chemang*), both for food and for sale. Mangrove trees can provide good construction materials and firewood, but are usually left alone because of national law that prohibits cutting of mangroves. They are also more difficult to obtain than other trees in the forest.

Crops are grown in *sers, dechel* and *mesei*. Fruit trees are also grown and harvested. Timber from the inland forest is cut for construction. Wild plants are collected for medicine. With the sawmill (*seidai*) in the village now, more people are cutting trees. However, this is not done on a large scale yet. There is a waterfall that attracts some tourists.

CHANGES IN RESOURCE USE PATTERNS

FISH: Fishing methods and equipment have changed. Traditional fishing methods have disappeared or declined. Few people use fish traps (*bub*) or bamboo rafts (*brer*). There is an increase in the use of new methods such as nighttime spearfishing with scuba.

More women are fishing in the men's traditional fishing domain today. Previously men caught fish and women gleaned for nearshore invertebrates.

People have to go out farther and it takes longer for them to obtain the same amount of catch today as was possible in the 1980s.

Fishermen today do not respect basic courtesy and ethical behavior. They no longer have a traditional fishing ethic. Fishing styles have changed. They are not selective, as when you went on a particular fishing expedition to catch a particular fish. Today people catch everything they can. Even fish that were considered unpopular, such as *imirchorch* and *budech* are now caught.

INVERTEBRATES: There may be a greater demand for *ngduul* from Ngaremlengui. Many people will not buy those collected from Koror's waters, which are believed to have made several women ill.

There's been a general reduction in abundance of mangrove crabs and *ngduul*.

MANGROVES: Residents have stopped cutting the mangroves for timber or firewood, due to easier access to trees from the forest.

FARM CROPS AND TARO: Many farm areas (*mesei* and *sers*) have been abandoned. There is a growing problem with wild pigs that have damaged many *sers* and *mesei*. Tapioca has been hit with the yellowing disease. There is also a lack of family members to help out with the laborious work of tending to the farms. Most of the woman said their children either resided in Koror or in other countries. The women themselves have become too old and weak to maintain the farm areas. Some have hired foreign assistants to help them and others only maintain a little area for their daily consumption. Farms are harder to cultivate these days. The taro seems much smaller now, no matter how much effort and fertilizers are invested in them.

TREES: With the Compact Road construction, forests that were once inaccessible are now much easier to reach, resulting in increased harvest of trees for construction.

The sawmill in Ngaremlengui plus trucks that can haul heavy trees are also contributing to the increasing harvest of forest trees. However, at present, most of the timber that goes to the sawmill are those trees felled for the construction of the Compact Road.

MEDICINAL PLANTS: Use of resources for traditional medicinal purposes are still the same as in the past.

THREATS TO THE RESOURCES

OVERFISHING: Overfishing has become a widespread problem. Faster boats and better fishing equipment plus additional demands from the tourism industry has put increased strain on the fish stocks.

LOSS OF TRADITIONAL CONSERVATION ETHIC AND COURTESY: A decline in traditional fishing courtesy or ethics is evident in both fish and invertebrate collection activities. For instance, it has become a common occurrence to find one’s trap (*bub*) empty because someone else has taken the crabs. Often, the traps are simply tossed back into the water and not set up again so the trap owner never gets anything. This is one of the reasons some fishermen do not want to trap

mangrove crabs anymore, which has led to a reduced use of the *bub*. In addition, the present tendency is to take everything that has been caught. Previously, fishermen would go out to fish for a specific species and they would only take that particular species; today, they take everything then can.

HABITAT DESTRUCTION: A barge containing about 700 truckloads of gravel that ran into the reef in the summer of 2002, is still on the reef. It sits right on top of the trochus sanctuary and threatens to spill the remaining gravel into the water and onto the reef.

WILD PIGS: Wild pigs have damaged farm crops and taro patches.

DISEASES: Tapioca farms have been hit with a plant disease the women call "Aids" which turns all the leaves yellow with the eventual damage to the tubers. This disease spreads so fast that the whole crop is damaged by the time the problem is identified.

SUSTAINABILITY OF CURRENT USE PATTERNS

FISH: There is a general agreement in Ngaremlengui marine resources from all habitats are being overharvested – mangrove crabs and clams, seagrass rabbitfishes, and reef fishes. A combination of factors is contributing to the overharvest. Most people now use modern equipment. The introduced fishing gear (eg., flashlight, nylon nets, scuba, ice chests, and speedboats) allow people to catch more fish in a relatively short time. People are generally taking advantage of this ability. So marine resources are being depleted at a much faster rate than ever before. When the fishing cooperative was first established in 1991, the lowest catch a person brought in was 80-90 lbs. By 2001, it was already difficult to bring in 80 lbs.

In addition, regulations are not always observed. People from other states are still seen fishing with scuba gear in Ngaremlengui's water even though this activity is prohibited by law.

There is new and increased market demand. Overall demand for seafood has increased so fish is now caught for subsistence, customs and for cash income. Furthermore, the market demand for seafood seems to be increasing and this puts even more pressure to overharvest certain marine species.

More people are fishing today than in the past. Many people who do not live in the state fish in Ngaremlengui waters. Many women who traditionally did not go out to fish in the reefs are now doing so.

INVERTEBRATES: The use of mangroves in Ngaremlengui are primarily for harvest of mangrove clams and mangrove crabs. Harvest of mangrove clams is sustainable with women still employing traditional gleaning methods. Most of the harvest is for subsistence use and occasional orders. However, with mangrove clams in Koror losing their market popularity due to pollution, demand for clams from Ngaremlengui is on the rise. This is a potential threat that may lead to unsustainable harvest of this species.

Harvest of mangrove crabs seems to be less sustainable than mangrove clams. Modern traps, which are preferred over traditional *bub,* allow in undersized crabs. These small crabs are not returned back into the water but taken along with all other crabs caught in the trap.

MANGROVES: National regulation restricting harvest of certain mangrove species has helped reduce interest in the use of mangrove trees for construction and for firewood. Today, no one cuts mangrove trees for these two purposes. However, mangroves have been filled for a baseball field.

FARM CROPS: Farming is generally still practiced the same way as before, except for the use of green machines to cut grass and some use of modern fertilizers. Some women claim, however, that they do not like the taste of taro that has grown with modern fertilizers so they do not use them.

TREES: Tree cutting is currently sustainable. However, there is a danger that it can increase too fast since there is more access to forest areas, as well as access to equipment.

DISTRIBUTION OF BENEFITS

It appears that the natural resources in Ngaremlengui are equally available to everyone. In other words, everyone has equal access to land for farming, to the mangroves to harvest crabs and clams, and everyone can go out fishing in the lagoon.

While access to these resources are evenly distributed, the actual receipt of benefits derived from these resources vary between groups and among individuals. For instance, fish and taro may also be equally used by everyone (for consumption, and cultural exchange and ceremonies), but timber resources are only used by a few individuals who can convert them into a marketable product, such as mahogany furniture. Likewise, the few full-time fishermen receive more cash from their catch than those who only fish on weekends or after a day's work.

UNUSED OR UNDERUTILIZED RESOURCES

Mangrove trees are not being used for construction or for firewood, and could be.

INFORMATION GAPS AND NEEDS

Some people mentioned that there is a lack of awareness about the fact that natural resources are limited. They believe that some people act as if no matter what they do, the resources will still be here, as they always have been.

Some people were concerned about a lack of awareness about mangroves' biological and environmental significance and contribution. One informant expressed a desire to set up aquaculture facilities in the mangrove area to farm mangrove crabs, rabbitfish and lobsters.

There was concern expressed about national and state regulation ineffectiveness. For example, seasonal and size restrictions on turtle harvest may not have been effectively designed. Some turtles are still pregnant when open season begins so many pregnant turtles are killed at this time. Also, one of the reasons pregnant turtles are killed is because of their large size. The law may need to be revised in order to properly protect the turtles.

Ngaremlengui has a law which requires anyone to plant five new seedlings within the forest for every tree taken. However, because most native trees do not have readily available seedlings, in order to observe the law people have to pull up seedlings from somewhere else and transplant them. Thus this does not replenish the tree population, but simply relocates the seedlings. There is a nursery that is supposed to be raising trees, but no staff to maintain the operation.

Ngatpang

EXTENT OF RESOURCE USES

Ngatpang had a population of 280 in 2000. Fifteen people were interviewed in this study. Many people from Ngatpang reside outside the state. Because land is very valuable, they maintain their ties to Ngatpang and their ownership to property through cultural activities, community work, and family responsibilities. The land may be vacant and the people may be living elsewhere, but because these actions are taken, relatives living in Ngatpang are reminded that the land is actually owned. Those living in the two hamlets, Ngatpang and Ibobang depend on the marine and terrestrial resources for their survival.

Main Natural Resources

- Marine fish
- Marine invertebrates (chemang)
- Mangroves
- Farm crops and taro
- Medicinal plants
- Fruit trees
- Fresh water
- Birds and bats
- Turtles

FISH: Ngatpang people are very dependent upon marine resources. Not only do they catch fish and invertebrates for family consumption, but often for family income.

Many habitats in Ngatpang support the local fishing activities. *Lalou* (at the edge of the mangroves) offers a lot of fish early in the morning during high tide, including female stingrays with babies. Any place between the mangrove and the reefs is a good place for fishing. The deep channel between the land and the reef where ships travel, is a good place for trolling.

The mangrove areas at Ngermeduu Bay used to be full of juvenile fish, adult fish, *chemang* and *senges* (mangrove crabs), *ngduul*, *cheremrou* (mangrove shrimp) and crocodiles. While the crocodiles and mangrove crabs are still there, the rest are no longer so abundant. Mangroves at Ngermeduu are not only nurseries, but also areas for big fish with cuts or missing fins to recuperate and heal.

INVERTEBRATES: The reef is a place where residents collect lots of lobster, trochus, and *rebotel* (sea crab). Ngatpang is well known as a source for mangrove crabs. Sometimes crabs are referred to as "coconut" (*lius*) because they were as plentiful as coconuts everywhere in the mangrove.

Women collect *ngduul* from the mangroves to sell. It is one of the biggest market items from the state. Men catch *chemang* to sell. Mangrove crabs are the primary source of family income.

There is a giant clam farm in Ngatpang.

MANGROVES: Ngatpang is surrounded by mangroves. The mangrove surrounding Mechebechubel, the central hamlet, is smaller than the mangrove inside Ngermeduu Bay. Ibobang is right on Ngermeduu Bay. Mangrove trees are used as building materials. The trees used for building are: *mekekad*, *tebechel*, *urur*, and *meduulokebong*.

MEDICINAL PLANTS: People from Ngatpang, especially those living in the hamlet of Ibobang, are the only Palauans who still use medicinal plants for many kinds of ailments. People travel especially to Ibobang for treatment. There is a plan for one of the local medicinal men to teach students at Ibobang High School to recognize and plant more medicinal plants. The plan calls for the plants to be planted especially near the dispensary at Ngaremlengui.

TARO: Like other states, most taro (*kukau*) in Ngatpang are planted in taro patches (*mesei*). However, many women are also planting taro in gardens (*sers*). Some people do not like the taste of garden-grown taro as much as the taro grown in *mesei*. Some people mentioned that alternating taro plants from a *mesei* to a *sers* and back, would make the plants healthy. Unlike the *sers*, the *mesei* requires hard work, lots of time and special knowledge.

There are patches (*omrekongel*) for giant taro (*brak*). Once planted, there is no need to take care of giant taro.

FRESH WATER: Ngermeduu watershed is the main source of fresh water in Ngatpang. It feeds three big rivers: Ngermeskang, Ngatpang and Tabecheding. Ngarmeskang divides Ngaremlengui and Ngatpang. Tabecheding divides Ngatpang and Aimeliik.

There is a waterfall between Aimeliik and Ngatpang that is visited by Palauans, especially students.

BIRDS and BATS: Bats are plentiful in mangrove areas when *urur* and *mekekad* have flowers. The bats may still be hunted. Some people blamed the fruit bats for poor harvest seasons (*sim*) that are not as bountiful as they once were. They said that when bats feed on flowers, the fruits do not develop to maturity. However, bats are well known to spread *miich* nuts (Pacific almond) and *dekar* (breadfruit with seeds).

There are *bekai* (Micronesian megapode) and *uek* (purple swamphen), but few in number. *Uek* eat taro (*kukau*) so are considered pests by the women.

A good number of *biib* (Palauan fruit dove) can still be seen, especially in the early evening.

TURTLES: Turtles feed around Ngatpang, but there are no beaches for them to nest. Turtles are hunted for food and to sell only during open season.

DUGONG: Dugong feed in the nearshore shallow area where there is a lot of seagrass. There's very few of them around.

CHANGES IN RESOURCE USE PATTERNS

MANGROVE CRABS: In the past, mangrove crabs were mainly caught for daily family needs, especially during the rough season, and when no fish went into Ngermeduu to recuperate. Crabs were also given to relatives residing outside Ngatpang to fulfill family obligations and responsibilities. Now crabs are rarely seen on family dinner tables unless they reach a family through a custom, or are bought from local trappers.

Very few people trap crabs as their main source of income, but those who do catch a lot. For example, one chief has at least 20 traps, and another man has 50 to 100 traps. He is a non-Palauan married to a Palauan. He traps crabs full time. Other trappers hire foreign workers to trap crab.

FISH: In the past, at least one male member of the family fished for family meals. His catches are shared with the neighbors, especially old men and women, whether they are relatives or not. When group fishing takes place, *temang* (gift of fish) would be distributed to community members at the dock. And when there's plenty of fish, women would make *urrekerek-el-uasech* (fish paste) to be saved for later when fishing cannot take place due to rough weather. Now, the fishermen leave a small portion of their catch for their immediate family, and the rest are sold. Members of the community can buy fish from the fishermen. The community spirit is not seen or felt as it once was. In addition, there are fewer fish.

Some fish have changed their habitats and spawning places. However, *meas* still spawn at the time they have always spawned.

INVERTEBRATES: No *ibuchel* (sea urchin) have been seen for several years, especially between Orachel, the rock island and mangrove. This was the most common spot to collect *ibuchel* for years.

TREES: Because of imported building lumbers, tin roofs and building blocks, very little timber are taken from the forest to build houses. Local timbers are also harder to use than imported woods since there is no good road to the forest, no equipment to take them out of the forest, and no local sawmill.

Forest trees that could be used as building materials are: *udeuid*, *ngmui*, *blacheos*, *elebiobech*, *emeklachel*, *ksid*, *ukall*, *las*, *biut*, *btaches*, *btachesked*, and *elas*. *Ukall* and *blacheos* were used to build canoes.

Lius, *buuch*, *chebouch*, *demailei*, *beokel*, and bamboo are used for floors. *Toechel* (nipa palm) is used for roofs of summer houses with bamboo as *olukl* (stick to which the thatching is sewn). Nipa palms are also used to make *zaru* (basket).

BIRDS: There's hardly any *laib* (Nicobar pigeon) at Ngatpang. Fewer and fewer *laib* were seen once cars started coming to Ngatpang. Most other birds are less common as well.

THREATS TO THE RESOURCES

OVERHARVEST: Overfishing and overharvesting of invertebrates for income purposes. Overharvesting of crab, especially taking all female crabs.

INCREASED BOAT USE: Speed boats traveling very fast and too often over seagrass areas and near the edges of mangrove (*lalou*). People believe this kills fish and invertebrate eggs and larvae floating near the surface of water. All kinds of invertebrates are decreasing in number because of overharvesting and because of too many boats travel over their habitat.

LAND SALES: Land is being sold to people who have no cultural ties to Ngatpang.

QUARRY: There is a rock quarry. An entire hill has been cut up and sold.

LOSS OF CONSERVATION ETHIC: The general attitude is to take as much as you can, and as soon as possible.

SEDIMENTATION: People believe the road construction has caused the depletion of fish, crabs, and invertebrates. They noticed that the water became murky, corals died, and mangroves were full of sediment.

ALGAE: Algae among the seagrasses is becoming a big problem in front of the dock. When the dock was originally built, no opening was left for the water to flow to the mangroves, and the mangroves were all killed in the area. Later, after a culvert was opened and the water was allowed to flow again between the seagrass beds and the mangroves, the seagrass areas were killed by an algae. Residents think that whatever algae was in the water near the dead mangroves is spreading and killing other areas.

INCREASED CAR TRAFFIC: Many kinds of birds disappeared with the increased noise pollution from vehicles.

CLIMATE: Ocean and air are getting warmer.

SUSTAINABILITY OF CURRENT USE PATTERNS

Because Palauans depended on what nature provided, they made sure the concept "make sure tomorrow is provided for" was understood and practiced by every member of the community. This is still practiced today in Ngatpang to a certain degree. However, there are a few individuals who are seen to overharvest, overfish, and find ways to get rich at the expense of the whole community and in the name of Ngatpang.

Traditional traps for crabs, called *kual*, have been replaced with new designed traps made from chicken wires instead of local materials. About 10-15 crabs can be caught with *kual*. With the new

kind of trap, many crabs can fit in and small crabs cannot escape. Trappers take the undersized crabs home for their families instead of releasing them. In addition, most crabs now caught are smaller than they were previously.

There used to be traditional *buls*, closed and open seasons for crab harvesting. These are no longer enforced and people believe that current catch levels are not sustainable.

When fishermen used *ruul* (fish net made from coconut leaves), small fish would escape through the bottom of the net. As for the new kind of net, which are made from strong and sturdy materials, no fish can escape.

Nobody fishes from bamboo rafts anymore. Motorboats tow bamboo rafts with fishnets. Spears are seldom used. The fishermen catch lots of fish because they own good fishing equipment and fast boats.

Fishing with fish traps is not practiced. Fish trap owners have become discouraged because they do not catch fish in the traps and that the traps are often broken.

DISTRIBUTION OF BENEFITS

All community members depend on land and ocean food everyday.
Not all members use these land and ocean food as source of income.
Very few sell crabs to markets and restaurants in Koror.
During the rabbitfish spawning season, people from Koror come to Ngatpang to fish.

UNUSED AND UNDERUTILIZED RESOURCES

Betelnut and pepper leaf
Coconuts
Crocodile

INFORMATION GAPS AND NEEDS

How to utilize the dead mangrove area effectively

Residents would like to close the area in front of Miked dock as a conservation area to stop boats from traveling near the mangrove. They would like to know why the algae is killing the seagrasses in the area.

How to repopulate fish, crabs and other sea animals

Extent of hunting in Ngatpang is unclear

Ngchesar

EXTENT OF RESOURCE USES

In 2000, the population of Ngchesar was 267. Fifteen people were interviewed for this study. Many people in Ngchesar are employed by the state office or work for the national government in the education system or public works. The other people with no regular salaries or means of income depend solely on the market.

Main Natural Resources

- Marine fish
- Marine invertebrates
- Mangrove crabs
- Trees
- Farm crops
- Taro
- Birds and bats

CHANGES IN RESOURCE USE PATTERNS

FISH: It was estimated that around 90% of homes in Ngchesar collect fish every week. These homes rely on fish as an important source of income. Many young men spearfish on the reefs beyond the mudflat/seagrass areas. Fewer men (less than 10) harvest fish by *kesokes* (barrier nets). The use of barrier nets is restricted to mudflat/seagrass areas, which become very shallow at low tide. Many women in Ngchesar who do not have day jobs usually line fish near channels and at the edge of the mudflat/seagrass areas. Children too, line fish and help set barrier nets after school hours. Ten years ago, most people would fish two or three times a week. Today, most people go out almost everyday.

There are indications of high intensity collection of the fish resources. Every day of the week in Ngchesar, there are boats out on the reefs fishing. Half of these boats are not from Ngchesar. They are from adjacent states; states which have banned non-residents from fishing in their waters. Since Ngchesar does not currently have these restrictions, non-residents can technically fish anywhere in Ngchesar's waters. The residents of Ngchesar who make a living from selling fish go fishing almost everyday. The daily fishing occurs over the range of available habitats: mudflat/seagrass, patch reefs, barrier reefs, and open ocean. There is a range of fishing methods being used as well: barrier net, cast net, line fishing, spearfishing, fish traps and trolling.

INVERTEBRATES: The main crustaceans harvested in Ngchesar are lobsters and mangrove crabs. Catches are almost always sold to restaurants or fish markets in Koror because they fetch a higher price. Few people buy mangrove crabs in Ngchesar. The mangrove crab that is consumed in

Ngchesar is caught by households that trap for them or are given by a relative. Lobsters have always been rarer than mangrove crabs and therefore are more of an opportunistic resource. In the last ten years, the availability of mangrove crabs has declined. Mangrove crab trappers used to be able to collect 10 crabs in one day. Today, in takes a week to collect that many. The demand for mangrove crabs from Koror drives many of the trappers to catch more crabs to sell. They are sold for $4-5 per pound.

Several species of sea cucumbers (*ngims*, *irimd*, and *cheremrum*) are a major source of income for many of the households in Ngchesar. Generally, women and children collect these echinoderms. Some men will also collect them if they do not have women in their households who can go out and glean. Incentives of cash economies have altered the patterns of use for these particular resources.

Like fish, these species are harvested on a daily basis. Where this gleaning activity used to take place only at the morning low tides (*bor*), there are now individuals who glean all day long at low and high tide. People from outside of Ngchesar, also come into these mudflat/seagrass areas to glean for echinoderms to sell at the food markets. In some hamlets of Ngchesar, such as Ngerngesang, target species have declined to a point where residents glean in mudflats and seagrass beds of other hamlets (Ngerewikl). Thus they are now competing with people from those hamlets for the same resources.

Ten years ago sea cucumbers were abundant and it took about 2-3 hours to fill a one gallon container of *ngims*. Today, it takes a whole day to collect the same amount. There are specific areas in Ngchesar where target echinoderms can usually be found in relative abundance. In general, most types of echinoderms that are edible have declined in abundance and in some areas, such as the Ngelukes reef, certain species have disappeared altogether.

TREES: The trees in Ngchesar are used for various building projects but generally the intensity of use is not at all similar to the level of intensity with which the marine resources are utilized. People usually harvest only the trees that are on their land. The trees are harvested when people decide to build houses or summer houses. Generally, people do not rely on these activities for a regular source of income. When the opportunity arises and there is a buyer, the trees will be harvested. Of the fruit trees of high value to residents, the betelnut is the most important. The betelnut generates monthly income for several families, which have stands of these trees on their land. Coconut trees are also a source of income as well as a food source for various families. At the markets in Koror, betelnut and coconut make up the majority of fruit tree products. Mangrove stands also have trees suitable for building or carving materials, but are only cultivated by a few individuals. Because most houses these days are made from imported materials, the demand for local wood materials is less then it was 10-20 years ago. Generally, people who are better off financially can afford to build houses made from local trees.

FARM CROPS: Many households in Ngchesar have a farm or a taro patch for crops (*kuri*, *diokang*, and *brak*). These crops are a very important source of food and income. This is especially true of families whose members are self-employed and rely on the market for income. Of the families with crops in Ngchesar, 90% or more will harvest their crops for the bi-weekly market in Koror. Even those with government jobs will go out on the weekend or after work and harvest crops or fish in order to prepare goods for market.

BIRDS AND BATS: Before legislation made hunting them illegal, Micronesian pigeons (*belochel*) were hunted and actively sold to individual buyers and some restaurants. Although the practice is now banned, there are still some local hunters who occasionally harvest these birds. When they are hunted, these and other birds as well as fruit bats, are almost always sold to people outside the state for a high price (as high as $20/*belochel*). While some bird species do not seem to be declining in abundance, target species such as the Micronesian pigeon and the megapode (*bekai)* have declined in numbers.

OTHER: Some large fauna such as crocodiles and sting rays are reported to be increasing in numbers. There is no one in Ngchesar who actively hunts crocodiles today since they have little market value in Koror, are not caught for any other reason.

THREATS TO THE RESOURCES

SEDIMENTATION: Uncontrolled sedimentation resulting from improper road building activities has deposited significant amounts of sediment into the rivers which drain these watersheds. The sediment and nutrients end up being deposited on adjacent marine areas. Of all perceived threats to the livelihood of many people in Ngchesar, sedimentation from improper road construction is considered to be one of the greatest. In some areas of the state where road building has occurred, people have had to abandon some of the crops or farms. In addition, some of the crops were damaged by the effects of construction.

OVERHARVESTING: Another major threat to the resources is overharvesting. There is concern that with most of the homes in Ngchesar already harvesting their resources on a daily basis, harvest of these resources by non-residents will drive many of the targeted species to disappear in a short period of time. Another concern is that there are now more people non-Palauans who live in the state harvesting target species on a daily basis. These people may be harvesting by unsustainable methods.

DREDGING: There are two dredging projects in Ngchesar, however, there is concern that these projects pose a significant threat to important marine areas in which many people harvest for food and income. Alteration of natural tidal currents, the 'shallowing' of tide pools, decrease in seagrass habitat quality are some of the impacts perceived to come from dredging. Therefore, this activity is considered a significant threat to Ngchesar's natural resources.

SUSTAINABILITY OF CURRENT USE PATTERNS

MUDFLATS AND SEAGRASS BEDS: In general, mudflats and seagrass beds have experienced a general decline in productivity over the last 10 years. There are less fish, less echinoderms, and less molluscs. Poignant examples comes from Ngersuul. Ten years ago, one fisherman could, in one day, set up barrier nets and expect a catch of 200-300 lbs of fish. Today, a good day's catch weighs 50 lbs at the most. Women from could fill a 1-gallon container with *ngims* in one hour. Today, it takes most people a whole day to collect the same amount.

The change in productivity of these mudflats and seagrass beds is accompanied by changes in substrate composition. There is significantly more sediment on the mudflats/seagrass than 5-10 years ago. Previously people had to wear protective footwear when walking on the mud flats because of numerous small, sharp molluscs (such as *delbekai*). Today, most people can walk barefoot on the mudflats because there is hardly anything left that could pose a risk of injury. There used to be 2-3 foot deep pools (*chis*) in the seagrass areas where locals could catch fish trapped at low tide. These areas had many juvenile fish (rabbit fish) living in them. Many of these tide pools are now too shallow (less than 1 ft) at low tide to fish in. Fishermen are now seeing more juvenile fish at the edges of the seagrass beds (*bkul a toachel*) at low tide. At other areas extensive dredging has altered tidal current patterns thus affecting settling rates of sediments and ultimately changing the benthic composition. An example is the area referred to in front of Ngerewikl. Dredging has altered water current patterns in front of an estuary, which has resulted in the deposition of much of the sediments coming out of the estuary into the tide pools. Where once the area was several feet deep at low tide, now much of the area is exposed.

REEFS: There is some evidence of decline for several species of fish, molluscs, and echinoderms. About 10 years ago, it was possible to collect 100 lbs of fish on the reefs in one outing which could last one night or one tide. These days the catch is almost always below 100 lbs. Invertebrates such as cowries and urchins are rarely found on the reefs today (1 to 3 a day). There is more siltation on the reefs. After major rain events, the reefs in front of the Ngerdorch River are shrouded in red, silty water for several days.

MANGROVES: In terms of the number and size of individuals of various species of mangrove trees and plants, the overall biomass has increased. However, there has been a significant decline in the availability of some mangrove crabs. Though the relative sizes remain the same from area to area (average size in Ngersuul tend to be smaller than areas to the north), there has been an overall decline in the total catches in the last 10 years.

UPLAND FORESTS: Excluding the tree coverage cleared for road and house building, there has not been any significant decline of upland forest tree coverage in Ngchesar. There are still stands of old growth forests and anyone desiring forest fruits can still find them in abundance when in season. There does not seem to be any one specific stand or area of Ngchesar that has suffered extensive deforestation. Certain avifauna (*belochel*), however, have declined in abundance over the years and despite national legislation prohibiting the taking of these species, they continue to be hunted on occasion. Other winged species (*olik* and *uek*) continue to be common in the forests.

RIVERS: There have been no changes in water level at the dams, which supply water to the State, although people's access to fresh water has increased. All houses in the State are linked to the water system from the Mesekelat pumping station. Several houses also maintain their own water supply from nearby streams (in Ngersuul).

DISTRIBUTION OF BENEFITS

Some of the fish that is caught by the residents of Ngchesar is consumed within the State. However, much of that catch is sold to markets. All the fish caught by non-residents is consumed out of the state. There are only a handful of local fishermen, such as the barrier net fishermen, who accumulate their catch over a week and transport it to Koror to sell by the pound at the fish markets. There is a perception shared by all individuals interviewed that much of the fish caught in Ngchesar is caught by people who are not residents of the state.

There are five hamlets in Ngchesar and each has a designated day on which they go to Koror to sell their products. Several people stated that of all the resources actively harvested in Ngchesar, most goes to people who do not live in Ngchesar.

UNUSED OR UNDERUTILIZED RESOURCES

AQUACULTURE: This has been identified as a future venture to take advantage of the marine resources available to Ngchesar. Clam farms, milkfish farms, and shrimp farms were all options mentioned as potential future ventures within the State.

PLANTATIONS: Another resource people said was going to be used in the future was the hardwood forests in Ngchesar. As more people move into the state and build homes there will be a greater demand for local wood materials for summer houses. People might begin to plant certain species of trees on their land, be it for the fruits they bear or for the wood they provide. Currently, there is no active woodmill in the state but that might change if the demand for local lumber increases.

INCREASE HARVEST: Future resource use might focus more effort on resources that are already being harvested. There is likely to be greater demand for food fish and invertebrates as more people move into the state. There is talk in the current legislature about designating conservation areas in order to allow depleted stocks to recover. There are also other areas where the ecological integrity of the area is considered important and worthy of some form of protection. For instance, there are areas that are important for protecting water quality and that are important habitat for marine invertebrates.

INFORMATION GAPS AND NEEDS

There is no real information on the bird populations and how they are being impacted by development and overharvesting. There is also no real information on the levels at which various species are harvested.

None of those interviewed could give a clear picture of how much of the forests trees and plants are being used today. More information is needed on who is using the trees and where they are going.

There is no information on the predicted future water needs of the state and what the status of the streams and rivers in the state is.

There was no clear information on the kind of plants which are currently used for medicinal purposes and how that use has changed over the years.

There was no information on major changes in people's lifestyles and how they have changed recently (eg. how much of the food consumed by one household is bought and how much of it is harvested locally?).

Ngiwal

EXTENT OF RESOURCE USES

The state of Ngiwal had a population of 193 in 2000. Twenty-three people were interviewed for this study. Like other Palauan states, many people who live in Ngiwal are employed by the state; others work for the national government in education or public works branches. Most households have at least one person living there who is employed by the local government. Many of the young men (18-30 yrs) are employed by the state while the old age group, which is comprised of elderly women, are self-employed and sell their wares at shops in Koror. Others people with no regular salaries or employment depend on the market or *makit* as a source of income.

Main Natural Resources

- Marine fish
- Marine invertebrates
- Mangrove crabs
- Farm crops
- Plants (Pandanus)
- Taro

CHANGES IN RESOURCE USE PATTERNS

FISH: Fish are still a very important resource for Ngiwal's residents. For those with no regular source of income or who are dependent on part-time work, fish are a primary or supplementary part of the daily diet. It's costs no money provided individuals have the time to go fishing. Any man still capable of spearfishing, line fishing, or fishing with nets is still doing so; women who have the time and do not have taro patches also go fishing. Those working for the state government also still go fishing almost everyday. When someone with a boat goes out fishing there are always others with no boats ready to go with them. Because the supply of fish for market is not guaranteed, people fish primarily for subsistence. The fish that is brought back on trips like these is shared among all those who went out. This situation itself is evidence of the extent to which fish abundance has declined in Ngiwal. It was stated by all individuals interviewed that all types of fish had decreased in size and abundance over the last 10-20 years (older people said that abundance has decreased over the last 50 years). The important fish once common to Ngiwal such as *meas*, *klsebuul*, *kotidu*, and *chum* are much more difficult to find these days.

INVERTEBRATES: The main types of crustaceans harvested in Ngiwal are mangrove crabs, land crabs, and lobsters. There are several individuals, all men, who hunt for mangrove crabs. Most of them use traps but there are some who hunt for them by snorkeling. Those who hunt for these crabs, sell them to restaurants or fish markets in Koror. The timing of collection is continual since people

who set out traps visit them every two to three days. The most crabs anyone can hope to catch in a week is not more than twenty. In years past, crab hunters have stated that they could catch twenty individuals in one day.

Many people in Ngiwal collect land crabs when they emerge from the forest to lay their eggs in the ocean. There has been an increase in the number of people from other villages who come to collect land crabs in Ngiwal. It was reported that people come to Ngiwal carrying drums in the back of their trucks to collect land crabs. The drums are filled with crabs and then the collectors leave. Residents are convinced that these land crabs are prepared and sold to markets in Koror. Most residents in Ngiwal do not sell land crabs and instead use them mostly for local consumption. There are only a few individuals who collect land crabs for sale at the markets. The timing of collection coincides with the new and full moon cycles.

There are many different echinoderms that are harvested by Ngiwal residents. Many of those who do sell at the markets, cook the *ngims*, *ngduul*, and *molech* that they sell. It is women who collect and prepare these animals for sale at the markets in Koror. They collect the echinoderms at low tide in Ngiwal and, sometimes, in other states as well. Although some of what is harvested is used for local consumption, the majority of what is collected is sold at the markets.

FARM CROPS: Crops from taro patches and farms are also very important to local residents. The main cash crops are *kukau*, *brak*, *buuch*, and *kebui*. Pandanus leaves (*such*), exclusively harvested and woven by the old age women's group, are also a major cash crop in Ngiwal. Women harvest and prepare most farmed crops for market.

Many of the young women and men sell *buuch* and *kebui,* while the older women sell the *brak* and *kukau*. As a source of income, these cash crops are very important to the livelihoods of many people. There has been some diseases in the *brak* and *kukau*. However, in general people say they are making money from their crops. There are however, fewer taro patches today then in previous years. This is because there are fewer people in the village than before and fewer younger women willing to go out and work in the taro patches all day. As a result, former taro patch areas have been overgrown and are now unproductive.

The old age women's group has a plantation of *such* which they just began harvesting this year. They sell such leaves at 15 cents each or $15/100 leaves. It is a potentially lucrative business since each leaf of *such* can be used to weave crafts worth up to $20 each.

THREATS TO THE RESOURCES

SEDIMENTATION: Uncontrolled sedimentation resulting from road building activities has deposited significant amounts of sediment into the rivers, which drain these watersheds. The sediment and nutrients are deposited on downstream marine areas.

OVERHARVESTING: Another major threat to the resources is overharvesting. There is concern that since most of the homes in Ngiwal already harvest their resources on a daily basis, an increase in the level of the harvest will drive many of the targeted species to disappear locally. This would

force people to collect outside the state or quit altogether. Another concern is that there are now more non-residents and non-Palauans harvesting target species on a daily basis. These people may be harvesting by unsustainable methods.

DREDGING: There is one dredging project in Ngiwal. There is concern that this project poses a significant threat to important marine areas in which many people harvest for food and income. Although this project is no longer operating, the dredge material is still on site and poses a potential threat to the adjacent marine areas if it is improperly managed. Alteration of natural tidal currents, the 'shallowing' of tide pools, decrease in seagrass habitat quality are some of the impacts perceived to come from dredging. Therefore, this activity is considered a significant threat to Ngiwal's natural resources.

SUSTAINABILITY OF CURRENT USE PATTERNS

The following reported decreases in marine resource abundance seem to have occurred gradually. Most of the people interviewed, however, agreed that the rate of decline began to increase sometime between the mid 1970s and the mid 1980s. More individuals began to own boats and gill nets were introduced (less than 3 in mesh size) around this time. More people were able to catch more fish than was previously possible and thus more people were able to sell fish at the markets. Traditional practices such as fishing under the supervision of elders and fishing with other families eventually ceased. They are no longer practiced.

The advances in technology such as motorized boats, refrigeration, and fishing nets, have changed the way people fish. In the past, people fished for themselves and their families. After new technology was introduced and individuals began to afford their own boats, freezers and nets, more people went fishing in order to sell fish at the markets in Koror. The move from a subsistence economy to a more cash driven economy is driving the changes in people's usage of these resources.

FISH and INVERTEBRATES: There has been a general decline in the amount of resources available from coral reefs around Ngiwal. There are fewer food fish, food invertebrates, and healthy colonies of corals on Ngiwal's reefs. In past years people could catch 50 or more pounds of fish in a day. Today, it would take several people working together to catch the same amount in the same amount of time. For those who started to use gill nets when they were first introduced, a good day's catch was around 500 lbs. Today, the most one can hope for is 10 or 20 lbs. In the last five years there has not been enough fish to support a market from Ngiwal. The average size of fish caught has declined and more time must be spent fishing.

There are several changes to the coral reefs of Ngiwal that people have seen over the last 30-50 years. Much of the coral that was bleached has not recovered and algae has taken over some of these areas. Coral cover has been receding from the shore areas. Fifty years ago the reef flat was covered in coral, which came right up to the beach in front of the village. Today, much of this area is bare sand and rubble with several patches of seagrass beds.

The declining trends seen in coral reefs are also seen in their seagrass beds. These were areas of high productivity and various types of echinoderms, molluscs and could be found here. Today, these areas are almost completely depleted of the food species which were once so abundant. In the past, people used to collect food species such as *ngims*, *cheremrum*, and *kim* from the seagrass areas in front of the village. Today the amount of edible organisms found in these areas could not feed the village for even a day. A local dredging project has buried some areas of seagrass beds and these areas in front of the village seem to be getting shallower.

Where people had to be careful when walking in the seagrass beds they can now walk around freely without running the risk of stepping on a clam and getting cut. The seagrass beds were targeted for net fishing as there was less chance that the nets would get stuck on coral. The fishermen who were interviewed stated that today, there are hardly any fish in these areas except for those places near the boundaries of the Ngemai Conservation Area. Fish coming off Ngemai reef at low tide swim up to these nearby areas. Still, there are not enough fish to produce the size of catches seen in the early 1980s.

MANGROVES: There are still many people who fish in front of the mangroves. They fish for mangrove crabs and fish (eg. *kelat*, *meas*, *klsebuul*). One old man, who is an expert in catching mangrove crabs, said that thirty years ago, he could catch 20 crabs in a day. Now, it is possible to catch only 2 or 3 mangrove crabs in day. There was a time when many people were spreading nets across the front of the mangrove areas and catching anything that came out with the tide. While this is not an everyday practice anymore, many blame this form of fishing as a major reason for the decline of crab and fish in the mangroves. Overall, there has been a general decline in the abundance of fish and crustaceans in these areas.

UPLAND FORESTS AND RIVERS: The rivers of Ngiwal were stated as important natural resources. Some of these rivers run over spectacular waterfalls, which the locals hope can become a viable option for ecotourism in the future. However, there is no current use of these rivers by the locals. Wells drilled in the hills supply tap water to the village. There are still extensive stands of upland forests on the steepest slopes of the hills. Other stands were cut down for farming purposes during the Japanese period (1914-1945). It is because the steepest slopes could not be farmed that they remain forested today.

Currently there are no organized efforts to make use of upland resources. There is the occasional felling of trees by individuals on private land. Recently there have been incidences of burning of the savannas. It is not clear how often this occurs although it is the preferred method for clearing overgrown areas. Local residents use rivers and upland areas less today than in the past. People are not as dependent on the upland areas as they are on the marine resources and lowland areas. Although the current use of these resources is at a very low level, there is consensus that this is soon to change with the completion of the Compact Road.

DISTRIBUTION OF BENEFITS

While local consumption seems to be the only use for the residents, it would seem that much of the land crabs and the benefit from the species as a resource is not going to people in the state.

As there is usually a high demand for these types of local foods, most of the crops harvested in Ngiwal go to Koror for sale at the markets or for customs elsewhere. This means that most homes in Ngiwal use imported rice as a substitute for local starches.

UNUSED OR UNDERUTILIZED RESOURCES

AQUACULTURE: This has been identified as a future venture to take advantage of the marine resources available to Ngiwal. Clam farms, milkfish farms, and shrimp farms were all options mentioned as potential future ventures within the state. These ventures would likely be located in front of Ngiwal's extensive mangrove area in the inner lagoon, except for the clam farm which will be located on the reef flat.

TREES: Another resource people said was going to be used in the future was the hardwood forests. As more people move into the state and build homes there will be a greater demand for local wood materials for summer homes. It was suggested that people might begin to plant certain species of trees on their land. Currently, there is a program to begin a nursery in Ngiwal to supply local plant to residents. This program is being run with the aid of the national forestry/agriculture department.

TOURISM: There are hopes that an ecotourism venture can be started, which would take advantage of the old growth forests, waterfalls, and mangroves of the state.

INFORMATION GAPS AND NEEDS

None of those interviewed could give a clear picture of how much of the forest trees and plants are being used today. More information is needed on who is using the trees and where they are going.

There is no information on the predicted future water needs of the state and what the status of the streams and rivers in the state is.

There was no clear information on the kind of plants which are currently used for medicinal purposes and how that use has changed over the years.

There is little information on the quantity of various marine species which are currently harvested in Ngiwal. No information was gathered on the amount of echinoderms sold weekly or harvested weekly. There is also no information about how often locals collect marine resources outside the state for sale at the markets.

It was not clear from the interviews how much *kukau*, *brak*, *buuch* and *kebui* is sold to markets and what percent of residents actually sell at the markets weekly.

Peleliu

EXTENT OF RESOURCE USES

In 2000, Peleliu had a population of 571. Twenty-three people were interviewed for this study.

Main Natural Resources

- Marine fish
- Mangrove crabs
- Mangroves
- Land crabs
- Farm crops
- Taro
- Fruits and nuts

FISH: Peleliu fishermen fish both within and outside of the barrier reef. Main uses for fish are for subsistence and as a source of income. Job opportunities are limited so many are fully dependent on fishing for their income; these men make up about 25% of all the fishermen in Peleliu. Those who hold jobs claim that they sometimes sell their fish catch for extra income. The women, like the men, also fish for subsistence and for income. The women, who are unemployed are also dependent on these resources (eg., small fish) for their whole income. Peleliu has regular market days in Koror twice a week, where the women have the opportunity to make some money.

Large aggregations of *chum* (bluespine unicorn fish) were identified by three informants. These fish aggregate from December to March and are very abundant (*temel a chum*) at that time.

MANGROVES: Mangroves in Peleliu are not as muddy or earthy (residents describe them as cleaner (*beches*)) as those found in Babeldaob. The mangrove waters are said to be saltier and there is sand in many parts. Thus, some people say there is a difference in the taste of mangrove clams and crabs found in Peleliu than those caught in Babeldaob. This difference in taste is subtle and does not affect the consumption of Peleliu's mangrove clams and crabs.

Mangrove trees are used to make small structures like summer houses and *diong* (outdoor shower building); a couple of mangrove areas have been enclosed and used for milk fish ponds. One of the milk fish pond belongs to the state and one is being developed as a private enterprise.

INVERTEBRATES: In Peleliu, *cheled* (invertebrates such as sea cucumbers and clams) were not harvested from the nearshore areas as much as in other states because local people said they did not like the taste. However, they are now being collected and sold in the market in Koror. Giant clams are a popular local food. Mangrove crabs and *debuongel* (or *eduib*) are harvested for subsistence and for income from mangrove areas.

LAND CRABS: Land crabs are harvested for household consumption, to send to relatives in Koror and Babeldaob,and to be sold in Koror. Land crab sales serve as the main source of income for at least 50 women. There is a species of land crab that lives in the mangroves, *rekung el daob* (*Cardisoma carnifex*) that is heavily harvested for subsistence and for selling. It is a crab that is widely found in Peleliu and is much larger than the common *rekung el beab* (*Discoplax hirtipes* formerly *C. hirtipes*) that can be found in Peleliu and in other states such Anguar, Ngiwal, and Melekeok. Another species of crab, *cheoich* (*Eriphia sebana*) is also commonly sold in the market that is held in Koror every two weeks.

FARM CROPS, FRUIT and NUT TREES and TARO: The use of the land is mainly for cultivation of *sers* and *mesei* to farm tapioca and yellow taro, respectively; to collect land crabs and to harvest fruits and nuts from certain trees (eg., *meduu*, *rebotel*, *miich* and *bobai*). All of these food items are harvested both for subsistence and for income.

The land in Peleliu is unlike other states. It is porous and mostly limestone soil. Most women said the porous land often flooded (*klou a dolech*) especially in taro patches. The taro patches in Peleliu are different from those in Babeldaob. They are much shallower so the women do not need to knead the soil (*smaul*). They do not use *ramek* (compost), or *omult* (turn over) the taro patch, they just use an *osib* (instrument for breaking ground) then plant the taro.

The rock island of Ngercheu is a place where many women go to harvest yellow taro. Large taro can be found there while on the main island the taro is smaller. These women most likely have some family relation to the island.

OTHER PLANTS: *Kebeas*, the invasive vine, is used as medicine for women who have given birth and used as feed for pigs.

CHANGES IN RESOURCE USE PATTERNS

FISH: Two major changes in marine resource use patterns are an increasing dependence on these resources for income (the market) and the use of new fishing equipment, such as nylon nets. These two changes are believed to be the main factors causing the decline of Peleliu's marine resources.

People have noticed that fish stocks are declining and the sizes of the fish caught are much smaller. According to some informants all seafood (fish and invertebrates) have decreased in abundance.

The decline of fish stocks began in the 1980s when more people obtained boats. This enabled more people to obtain a lot of fish within a relatively short time. It also enabled them to sell their catch in places like Koror that were previously too far away.

Fishing methods used today are still the same as before, such as *melebed* and *mengesokes* (net fishing), *omalech* (spearfishing) and *mengereel* (line fishing), but the equipment used has changed to include nylon nets, top-of-the-line fishing reels, and spearguns.

Fishing today takes longer and requires greater fishing knowledge and skills. One has to know where to go at what particular time in order to get fish, because these fish have either become fewer or have become smarter prey. In the past, it did not matter where you fished, a person could go anywhere to fish. Fishing close to shore was common but now people say they have to go further out to fish. Before, when using a barrier net (*omengesokes*), fishermen would catch up to 300 lbs. Today, they usually cannot catch more than 25 lbs. Spearfishermen could catch over 50 fishes; but today, they usually only catch 15. In the 1970s and 1980s, the fishing coop would receive 1,000-2,000 lbs of *klsebuul* and *meas* per day. Declines in catches of these fish began after nylon nets were introduced in the 1980s.

In the past there were community fishing activities (*chei el beluu*) where a group of fishermen went fishing and then shared their catch with each household on the island. None of the fish were sold. In 1965-1970 people also used to chase fish (*ultoir*) with a spear. This activity no longer occurs. Nine or ten people took part in this chase. Targeted fish were *kelat, uluu, kotiko*, and *oruidel*.

In the past, not all fish were harvested all the time. Some species, such as *derutm* (stone fish), *mekebud* (sardines), and *kesebekuu* were only collected occasionally or when they were found in large schools close to Peleliu.

INVERTEBRATES: The women claim that some *cheled* (invertebrates) such as giant clams (*kim*), have become less abundant. The young women's group has communicated with PMDC (Palau Mariculture Demonstration Center) to set up a giant clam farm in Peleliu to restock the waters with giant clams.

Coconut crabs were once abundant in Peleliu and many people expressed concern about the decline. Overharvesting may be one reason for the decline but other causes such as lack of food and habitat area were also mentioned as possible causes. One woman reported that coconut crabs have declined a lot in the last 5 years. In one night of collecting coconut crab she cannot catch more than two crabs, while previously they were much more abundant and easy to find.

MANGROVE CRABS: Residents say the mangrove crab population is smaller today. One informant believed the increased crocodile population is the main cause of this decline. Another informant disagreed and said the main problem is overharvest due to market demand. One informant said it was hard to find even 10 crabs in a day. He believes the decline began about 5 years ago. There is a high demand now from hotels and restaurants in Koror for mangrove crabs that has led to people's increased collection efforts.

LAND CRABS: The marketing of land crabs and *ukaeb* (stuffed crab) has intensified over the past 5 to 10 years.

Land crab harvesting techniques have generally remained the same except access and equipment have changed. The introduction of flashlights, shovels, knives, and cars has increased access to more of the crabs' habitats. This new equipment enables collectors to harvest during the night, early morning, and late afternoon. Moreover, refrigerators and freezers provide better storage methods so crabs can be kept longer and much more *ukaeb* can be made and stored until it is brought to the

market in Koror. Most households have crab pens where land crabs and coconut crabs are kept and fed, until they are needed for consumption or for selling.

Women say that overharvesting of land crabs is a problem and they have to go to more areas to find a sufficient number of crabs. It was reported that some people are now using shovels to dig the crabs from the holes. Before the crabs were just collected when they had emerged from their holes to feed or spawn. The crabs still have an abundance of food and no major changes were mentioned regarding the habitat area. Some people blamed the hot weather for the fact that they have not seen as many crabs recently.

Legislation that bans land crab harvest for the three days before and after the full and new moons (peak spawning time for both species of land crab) has recently been passed in the state. While the women who were interviewed understand its motive, they are not happy with some of the law's requirements. In particular, they were concerned about the complete prohibition of harvest during the full moon. This is the time when the land crabs are most abundant. The women who are completely dependent on selling crabs for a living say they will have a very hard time finding another way to earn sufficient money. Instead of this ban on harvest, they would prefer legislation that set a minimum size and banned the collection of crabs with eggs. Another suggestion was to restrict the sale of crabs and *ukaeb* to people and markets in Koror at certain times. The high market demand from Koror is one of the main reasons for the decline in land crab population due to overharvesting. The people believe the harvest could still be sustainable if such restrictions were enacted.

Other women interviewed believed that the new legislation banning land crab harvest during the full and new moons was a good measure to ensure the crabs have an opportunity to release eggs.

TURTLES: Up until the 1980s, a lot of hawksbill turtles nested on Peleliu's beaches. The numbers of turtles had decreased by the end of the 1990s. One person suggested that increased boat traffic might be a source of noise pollution that scared the turtles away. However, he also said that no one in Peleliu can leave a nesting turtle or the nest alone. He recommended stricter law enforcement with daily patrols to stop people from disturbing the nests and turtles.

FARM CROPS: The soil and land are not as healthy as they once were. In the past, the same area could be planted more than once and it would produce crops. Today, this is not possible. If an area has been planted and harvested once, people move to another piece of land because crops will not grow again. One informant explained that many people have cleared forest areas for farming because the land quickly loses the nutrients to the first crops.

One older informant reported that there are more papayas now but the fruit is much smaller compared to the Japanese times. During that time whenever land was cleared, papayas would sprout. The trees would produce bigger papayas. Now, although there seems to be more papaya trees, the fruit they produce is much smaller.

TARO: Since the Japanese occupation, it has been traditionally taboo to sell *ongraol* (particularly taro) in Peleliu, because crops have generally been poor due to poor soil. Recently, however, many taro patches were damaged by fire so now there is a lot of taro that has to be harvested before it rots.

Therefore, taro is being sold today. However, this will only occur until the excess taro supply from the damaged taro patches has been sold. Some women interviewed said that nearly 85% percent of the taro harvested goes to customs but others say it is mostly for household consumption.

THREATS TO THE RESOURCES

OVERHARVEST: Overharvesting of marine species such as mangrove crabs and fish is a threat that is recognized by many Peleliuans. However, they are unable to decrease their catches as it is their only source of livelihood. One informant described it this way: in the past he could catch 200 pounds of fish but now his catch is only 50 pounds. According to this man, all food items have been decreasing over the past ten years. Before you chose the fish you wanted to catch, but now you choose what is available or target the fish that will bring you the most money, such as *kelat* and *klsebuul*.

More people in Peleliu harvest the resources, especially in response to the increase in demand from Peleliuans living outside the state. People believe there are more users of the marine resources now because Palauans from other states and non-Palauans often go to Peleliu waters to fish. Koror-licensed fishing boats with foreign workers aboard have been caught catching fish with long nets in Peleliu's waters.

In the 1970s and 1980s, Peleliu fishermen contributed to some reef destruction when the use of bleach and cyanide became popular. These chemicals have not been used since then, but some of the reefs that were destroyed by the chemicals have not yet recovered. Peleliuans have learned their lessons from this destructive method and those that were interviewed maintain that it was not used anymore.

Some people said they had seen changes and the disappearance of various habitats although they were not sure what had caused such changes. Some fishermen said the loss of food and habitat areas have contributed to the decline in the fish population.

The dive sites in Peleliu are being fished. However, it was unclear whether these sites are protected from fishing by law. The state is currently implementing a visitor permit system similar to Koror's but there have been many difficulties in the daily permitting process and in its enforcement. There are currently three dive operations based in Peleliu. Many divers visit the Peleliu dive sites with Koror-based dive operations.

INCREASED BOAT USE: Increased boat use has contributed to the decline of fish populations by making it easier to obtain more fish in a relatively short period of time. Engine oil pollution, physical damage, and noise pollution from the boats are also believed to be impacting fish larvae and turtle nesting.

POLLUTION: Sediment and pollutants flowing from drainage ditches from the roads may be impacting the *kereker* (shallow area with seagrass towards the reef). A majority of the informants interviewed mentioned the ditches as a source of pollution that goes into the water, degrades the

seagrass beds and kills the fish. EQPB has sampled the ditches and is awaiting the results of the tests.

FLOODING: Women said that the *mesei* and *sers* were flooded by saltwater at high tides every once in a while. One woman mentioned that after the El Niño event in 1998 the yellow taro was *mechut* (decayed and rotten) for an entire year.

SHALLOWING OF REEFS: Some people say that the reefs are getting shallower. They mentioned that some of the areas which used to always be underwater are now exposed at low tide.

Many young Peleliuans live in Koror but many are returning to reside on the island after they've finished their schooling. It is sometimes difficult for them to find jobs in Peleliu. One informant thought this was a social issue that will increase and continue in the future.

SUSTAINABILITY OF RESOURCE USES

Many marine resources are not being harvested sustainably. Before natural resources were harvested mainly for subsistence. With greater dependence on cash to meet today's needs (eg., electric, TV, and phone bills) people are overharvesting their resources so they can sell them to make money. Unfortunately, people have become careless and everyone harvests what they want. One woman explained that the quest for money would be the downfall of Peleliu.

There is a great need for alternative sources of income for a majority of Peleliuans because many people rely heavily on their resources for food and income. One of the state conservation rangers explained that violators of the conservation area (Teluleu) have said that the state should provide job opportunities so they would have an alternative to harvesting the resources. For many households the selling of natural resources is their only source of income. More than half of the people who live in Peleliu sell goods in the market or sell on request.

Regulations that have been passed into law, such as the one regulating land crab harvest, are not always observed. Currently in Peleliu there are three state law enforcement officers (usually called Rangers) and one police officer (who enforces national laws). The Rangers enforce state laws given to them by the Governor. To date they patrol the conservation area, check divers for permits, and enforce the law on land crabs. The state needs further capacity building especially with their conservation and law enforcement department. The Rangers do not have a clearly defined program and often do not have much authority. Many people who were interviewed suggested the need for stronger enforcement of the laws, yet many also expressed dislike with some of the laws that were enforced.

DISTRIBUTION OF BENEFITS

The people of Peleliu are dependent on the Palauan system of *ongraol* and *odoim*. Women still work in the *mesei* and *sers* to produce *ongraol* (starch foods). Men still fish, *ngar a chei*, to provide *odoim* (meat).

Some informants believe the benefits derived from Peleliu's natural resources are evenly distributed because extended family members live together and share what they have, whether it is fish that are caught, taro that is harvested or income derived from selling these items. Others claimed that not all households have extended family members living together, so this cannot be applied to everyone. For example, the elderly who cannot fish or farm, and therefore do not sell anything from Peleliu may not get their share of the benefits from these resources.

Other fishermen interviewed said that although most of the fish is sent outside of the state, everyone still benefits. A few people said that those who regularly sell items in the markets have a better standard of living than those who do not actively market their produce or fish.

UNUSED OR UNDERUTILIZED RESOURCES

Phosphate could be mined as a source of income to the state.

Bisech, miich, and *meduu* trees were once widely used as another source of *ongraol*. Now the fruits and nuts from these trees are foods that only a few older people eat.

Rebotel (wax apple) was widely eaten in the past and no longer eaten as much.

Some speciality foods such as *telib* (fermented wax apple), *suub el mengur* (sweet soup made of young coconut), and *uledel* (sweet and sour snacks) are once again being made by an older woman who sells them in the market and for special occasions.

INFORMATION GAPS AND NEEDS

People wanted to know why the reefs are shallower today.

People would like to know how to imprive the soil quality of the *sers*. During the Japanese period, one was able to reuse the same plot every year. Today, the same plot cannot be used more than once or twice because subsequent yields will be of very poor quality.

According to one informant the invertebrates *ibuchel*, *kim*, *oruer*, *molech*, and *ngims* have all disappeared but he does not know what has caused this occurrence. However, the informant did not believe that selling them in the market in Koror was the cause, since the market was relatively new and the declines in abundance of these species were observed before the market was established. Some people were interested in finding out more about the phenomenon called *dillides*. *Dillides* is an occurrence where dead and dying fish are washed ashore. This occurs in Peleliu about once a year, usually after a heavy rain. The fish may be shocked when the cold rain water meets the warm seawater. People collected the fish and salted or smoked them. Two fishermen said that this occurrence has decreased over the years and there are less fish washing up on the shore.

One woman interviewed wanted to know more about the biology the Micronesian megapode.

Megapode eggs are a delicacy and are collected even though it is illegal to do so. This woman noted that once a nest is disturbed the eggs in it will rot.

Development of the tourism industry is needed. There are only three tour operations in Peleliu and only a few people are employed in the industry. The tourist recreational sites are not well kept and usually have debris all over the ground.

Some people interiewed expressed interest in working for the tourism industry in some manner. Others did not want to. One fisherman explained his view in this way, “Only a few people are in tourism, but it is not something I can see myself involved with in the future. There are no jobs here so I fish in order to survive. That is my only source of income.” This man has been a fishermen for 15 years and fishes 6 days a week. He said that if he had a steady job he would not have to rely heavily on fishing.

In the interviews, many people mentioned that the weather has become less predictable. They also noted that it seems much hotter especially since the road was paved.

Some people are concerned about the impacts of motorized boats and increased boat traffic.

FUTURE PLANS

Most fishermen sell the large fish in their catch and keep the rest for their families. There are plans to limit what people harvest to just enough for household consumption. Currently, there is a proposed bill to prohibit net fishing in all inshore areas. If the bill prohibiting use of nets is passed, some fishermen say that it will be very difficult for themn to provide for their families.

During the assessment, the young women’s and men’s group (*Sheinedang*) had upcoming projects that included landscaping of hospital, beach clean ups, and to begin a farm for giant clams.

The speaker of the legislature explained that in the next 5-10 years, Peleliu will explore aquaculture opportunities with the milkfish pond and other enterprises such as increasing the diving industry.

Sonsorol

EXTENT OF RESOURCE USES

Sonsorol State consists of four very small islands: Sonsorol, Merir, Pulo Anna and Fana. They are two hundred miles from Koror and at least 50 miles from each other (except Sonsorol and Fana which are close to each other). Three of these islands are inhabited: Sonsorol, Pulo Anna and Merir. In 2000, the resident population of Sonsorol state was 39. Most people from these islands have moved to Echang at Ngarkabesang, a hamlet of Koror State. Lack of regular transportation, poor economic development, and no medical facilities have forced people to leave their islands. The Sonsorolese living in Echang have maintained their cultural relationship with their respective island(s) for many years. They all have lived on the islands periodically and are knowledgeable about the resources of their respective islands.

Because of the distance from Koror, and because transportation is not reliable or available on a regular schedule to and from these islands, the community consultation was conducted with Sonsorolese living at Echang. It is hoped that the team will have a chance to go to these islands for information confirmation in the future. However, Sonsorolese still depend upon the resources of their state, which are collected and shipped to Koror on a biweekly basis. Forty-one people from Sonsorol were interviewed for this study; all are currently residents of Koror.

Main Natural Resources

- Marine fish
- Marine invertebrates
- Turtles
- Mangroves
- Fresh water
- Land and farm crops
- Taro
- Forest
- Birds and bats

The residents of Sonsorol completely depend upon local plants, reef fish, a few edible marine invertebrates, turtles, wild and domesticated animals, land crabs and birds for food. All four islands have sandy, porous soil that is not very fertile. The few plants grown for subsistence, such as two kinds of *bisech*, bananas, papayas, tapioca, betelnut, pepper leaf plant (*kebui*), sweet potatoes, tapioca, *seboseb*, and pumpkin, are grown with lots of care. Coconut crabs (*ketat*), land crabs (*rekung*), and birds (*kedam* and *kuel*) are food for bad weather. The most important plants to Sonsorolese are three kinds of taro (*brak, kukau*, and *bisech*), breadfruit, and coconut trees. Coconut trees are one of the main sources of food and drink on the islands.

FISH: The ocean keeps Sonsorolese alive. They depend on the reef for reef and migratory fish, lobsters, clams and turtles for their daily protein needs. Fishing is still the main activity on the islands for men. Fishing is done on the reef for reef fish and lobsters, and outside the reef for migratory fish and other schools of fish. The islands have no dredged channel or constructed landing to facilitate small boat access.

INVERTEBRATES: The islands are surrounded by a fringing reef varying in width. The islands are surrounded by beaches. The shallow areas between reefs and beaches are very narrow, and susceptible to strong ocean currents and waves. This makes these areas unsuitable for seagrass and invertebrates to grow. However, a few clams (*kim, oruer, melibs* and *ripkungel*) and sea cucumbers can be found in these areas.

TURTLES: The Southwest Islands are known as havens for green turtles in Palau. The four islands are surrounded mostly by beaches which are ideal places for green turtles to nest. In Sonsorol, the main island, northeastern and southern parts of the island are nesting places for green turtles. The turtles do not use the western side as a nesting place because it has rocky beaches. Few green turtles nest in Fana. In Pulo Anna, many green turtles nest in the beaches of Pulo Anna.

MANGROVE: Sonsorol and Fana have no mangroves. More than half of Merir is mangrove (*keburs*). It has trees such as *tebechel* and *urur*. The mangroves are little used now, and are seen as the breeding ground for mosquitoes.

Pulo Anna is the only Southwest island with a large central body of open water, a brackish swamp. This water body has no channels for small canoes or boats to get to the mangroves. It is another breeding place for mosquitoes. Local people have tried to eradicate the mosquitoes by clearing mangrove trees. However, another type of mosquito (*kerkard*) has taken over. This species is worse than the eradicated kind of mosquitoes. The chiefs are trying to find ways to utilize the mangroves.

FRESH WATER: In Sonsorol, the water well near the village is a vital source of freshwater on the island. Sonsorolese on the other islands rely on rainwater for drinking, cooking, and washing.

LAND AND CROPS: The islands are low-lying atolls only a few feet above sea level. Even though land area is small and the soils are poor and sandy, land is valued highly by every Sonsorolese. Each island is an ecosystem that barely supports the local inhabitants. Those living on the islands rely on land for subsistence livelihood. With such poor soil, people still manage to raise food they need for daily living.

In Sonsorol, a bigger portion of the land was surface mined for phosphate during Japanese administration. The topsoil that was fertile was stripped away leaving the island unsuitable for growing plants. Even giant taro (*brak*) and regular taro (*kukau*) could not grow in it.
Fana is less than a mile from Sonsorol. It is now uninhabited, but is visited for food and raw material collection. Wood for building and giant clam shells for tool parts were collected on Fana. It is also like a supermarket for people living in Sonsorol and Koror. Everything is taken with respect. There is a plan to clean the old village site for educational use.
Sonsorolese from Merir have more land-based food than those from Sonsorol and Pulo Anna because the land is a bit more fertile. However, there are fewer coconut and land crabs and fewer

useful trees at Merir. The only village is located at the northwestern side of the island. People use the rest of the island for farm crops, taro, domesticated animal raising and for collecting wild plants and animals for their daily needs.

Pulo Anna is smaller than Merir. It is the second smallest of the Southwest Islands. An old village was located at the west side. The new village is at now further south where it is closer to a safer entrance to and from the reef.

TARO: Sonsorol has no taro patches. Taro (*brak* and *kukau*) cannot grow where phosphate was mined because the water is saltier than brackish water. Only plants that have no great value except for their intrinsic values, and coconut trees survive in the area. Fana has a small piece of wetland. People said that the area gets wet during high tide and dries out during low tide.

The biggest taro patch (*mesei*) in all of the Southwest islands is located at the northern end of Merir. This is where most giant taro (*brak*) and regular taro (*kukau*) are planted.

FOREST: Forests play a vital role to the existence of people and animals. It is a common knowledge to Sonsorolese that ocean currents shift sands from one area to another around the islands, especially in areas where there are few plants to hold the sand. Locals have noticed that the presence of big trees in the forest keeps the islands cooler and the soil moist and fertile.

Coconut trees are still an important resource for Sonsorolese. It is mainly used for food, drink and as one of the main sources of income to the islanders. Coconut syrup is exported to Koror for sale as a sweetener. Coconut leaves are no longer used to make thatch roofs.

BIRDS AND BATS: The forests are also home to variety of animals, and sea birds such as great frigatebird (*kedam*), brown booby and red-footed booby (*kuel*). These two birds are delicacies to Sonsorolese. Pigeons were introduced but not hunted. Fruit bats are hunted to sell in Koror.

CHANGES IN RESOURCE USE PATTERNS

The way Sonsorolese use their resources have not changed much over the years. Resources are used for daily living, especially for food, shelter, resources income, social, religious, traditional and cultural activities. A few people who can still climb coconut trees, make coconut syrup to use and to sell in Koror. Besides coconut syrup, they export fish, coconut crabs, fruit bats and turtle (during open season) on a small scale to Koror whenever transportation is available.

Copra used to be number one source of income to the islands. It is no longer so due to lack of copra buyers in Koror and outside of the country. Making salted fish and dried tuna (*katsuobusi*) is no longer practiced. The survival and the development of these island communities before depended on groups of strong young men and women working together. Now, the communities are too small and composed mainly of old and very young people. Also, schools of fish do not come near the islands on schedule or in the number they used to be. Other activities stopped due to introduction of new equipments. For example, trolling, the main type of fishing for migratory fish, stopped when

motorboats were introduced to the islands. When gasoline and oil runs out, trolling for daily meals stops.

Big trees (such as *btaches* and breadfruit) were very much valued before as raw materials for houses and canoes. However, imported materials such as cement, tin roofs, lumbers, nail, and paint have replaced local materials for building houses, community buildings, churches, schools, and canoe houses (*diangel*). Canoe building is also no longer practiced due to introduction of fiberglass boats. Breadfruit trees (*meduu*) are no longer used to build canoes. They remain an important source of food.

THREATS TO THE RESOURCES

POACHING: Poachers with big fishing boats and big fishing nets

OVERHARVEST: Overfishing is a concern for all marine species, but residents feel that turtles are especially being overharvested.

PESTS: Coconut beetles are killing many coconut trees, especially in Fana where 90% of the coconut trees are affected. There is also an increasing number of rats.

LOSS OF TRADITIONAL KNOWLEDGE AND SKILLS: Since so few people live their entire lives on the islands, the traditional knowledge and skills that accompanied the lifestyle are being lost. This loss of knowledge is often reflected in unsustainable uses of resources, especially as they are used more often for commercial purposes.

SEA LEVEL RISE: The residents of these low-lying areas are concerned about sea level rise that could inundate their islands.

SUSTAINABILITY OF CURRENT USE PATTERNS

Since the introduction of new fishing equipment, such as spearguns, flashlights, and sturdy nets, many traditional methods of fishing are no longer practiced. Most traditional fishing required older men and younger men fishing together, and how much could be salted or dried by so many people for a certain length of time. This is a time for older men to pass on the traditional knowledge and skills to younger men. It is a time to groom young men for manly responsibilities to take leadership role in the community later.

Torch fishing for flying fish at night requires knowledge, skills, and good organization. It is a sustainable use of resource because older men controlled when, how, and how much fish to take to feed the whole community for a certain length of time. The older men knew the number of households in the community and the number of people living in each household. But torch fishing has been replaced by fishing with spearguns and flashlights. Trolling from canoes has been replaced by trolling from motorboats. Fishing lines, sinks and hooks are no longer made by fishermen using

local materials. Everything is store bought and are usually non-biodegradable. *Techou*, small handnets made of coconut fibers and used while torch fishing are no longer made.

There are very few men living on the islands. They are either too old or too young to continue the traditional methods of fishing. Trolling with a speedboat requires a minimum of two people, and anyone can spearfish by themselves. There is a fear that the traditional methods of fishing are at the edge of existence, since younger men have very little experience with traditional methods of fishing and the older men are dying faster than expected. The traditional knowledge of when reef fish and when migratory fish come near the islands is not being passed on to younger generations. In addition, schools of fish are disappearing and fish in general are getting smaller in size.

Even though there are very few people living on the islands, it has been noticed that fish are declining in number and are smaller in size. Schools of fish are getting smaller and smaller. However, the number of birds is increasing. Most trees are not being cut down and have provided the islands with shade, food and lower temperature.

Methods used at taro patches and at gardens are still sustainable. For example, most leaves are returned to the soil as mulch for new plants.

DISTRIBUTION OF BENEFITS

When it comes to daily food, all Sonsorolese living on the islands benefit from the direct use of these resources for their livelihood. Living on these islands one must rely on the local resources to stay alive. Not all residents though use resources as a source of income. Animals and plants are more often used for food to meet community needs. Some benefits are evenly distributed and others are not. For example, benefits from plants and birds are evenly distributed since they are used locally. However, turtles and coconut crabs are sold outside of the community so only those who catch and sell them benefit.

Some benefits do trickle down to Sonsorolese living at Echang in Koror through food. When transportation is available, Sonsorolese living at Echang travel to their respective island to collect food, or send requests to relatives to ship food back to Koror.

UNUSED AND UNDERUTILIZED RESOURCES

Coconut trees are not utilized as they used to. This resource could once again bring in a great deal of income to the islands. Coconut trees thrive very well in the islands' sandy and porous soil. Betelnut trees and pepper leaves (*kebui*) could also be grown for markets in the future.

The seawater is a big natural resource that could be tapped for future use. The seawater could be used to make salt. It could be a major income generating activity in these islands. The seawater surrounding these islands is very clean. Southwest Islands are ideal places to take up this business because other income generating activities are not possible because of the islands' location and distance.

INFORMATION GAPS AND NEEDS

People from Sonsorol were interested in learning how they could produce and sell salt from seawater.

Conclusion

This chapter summarizes the findings of the community consultations. Tables are provided that compile the responses to the major objectives outlined in the introduction: extent of resource use, changes in resource use patterns, threats to the resources, sustainability of resource uses, distribution of benefits from resource uses, and information gaps and needs. While Palau is a relatively small country, there is much variability in resource use from state to state. Some major themes and trends are apparent countrywide. However, it is important to remember that individual states are dealing with unique problems and issues as well.

The community consultations have confirmed that throughout Palau, people are still very dependent upon the rich marine and terrestrial resources of the country. Marine resources, in particular, are heavily used and every area in the nearshore marine environment is important to local resource collection activities. Terrestrial resources are not as heavily exploited as they were in the past, although taro patches and small-scale family farms continue to provide vegetables and starches to people throughout Palau.

Changes have occurred in the ways resources are used, why they are used and who uses them. People are collecting the resources, especially in the marine environment with new and more effective gear. They rarely follow traditional methods that tended to limit catch. More and more, people are collecting or harvesting resources for monetary income rather than solely for local subsistence uses. In addition, projects such as road building, mangrove filling, and dredging have altered the habitats in many areas to such a degree that once abundant marine species are now hard to find and taro patches are not as productive as they once were. Some resources, especially marine fish and invertebrates, are not being used sustainably in most states, and people are concerned about the changes they have observed. However, other resources (farmed crops) are sustainably used in most places and appear to be healthy and thriving.

EXTENT OF RESOURCE USES

Table 1 outlines the main resources mentioned as being important to people in each state. Farmed crops (such as tapioca, fruits and vegetables), marine fish and invertebrates, taro and mangrove trees are the most widely used resources in Palau. Other important resources that people mentioned are forest trees, medicinal plants from a variety of habitats, and fresh water. Certain resources are important to people in particular states. For example, mangrove crabs were mentioned specifically in seven states. This does not mean that mangrove crabs are not collected elsewhere, they just were not mentioned specifically in the interviews.

Medicinal plants, fruit and nut trees (agroforestry) and plants that are used for weaving materials were also mentioned as important resources in many states.

In general, resources are used for food and drink, betelnut chewing, building materials, handicrafts, medicines and cultural and recreational sites. Locally harvested and made building materials, utensils and other essential items were more important in the past than they are today. Now the

primary use for most natural resources in the communities is to provide a fresh supply of local food items, either for daily meals, customs or for commercial sale. Some essential items such as baskets and *toluk* are still made from local materials and some small buildings (especially summer houses) are constructed from local timber. However, today imported materials and items have replaced the traditionally used natural resources in most instances, as will be described more fully in the following section.

TABLE 1. Main resources mentioned	total # states	Aimeliik	Airai	Angaur	Hatohobei	Kayangel	Koror	Melekeok	Ngaraard	Ngarchelong	Ngardmau	Ngaremlengui	Ngatpang	Ngchesar	Ngiwal	Peleliu	Sonsorol
farm crops	16	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
marine fish	16	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
marine invertebrates	14	x	x	x		x	x	x	x	x	x	x	x	x	x		x
Taro	14	x	x	x	x	x	x	x	x		x		x	x	x	x	x
mangroves and mangrove trees	11	x	x	x			x	x	x	x	x		x			x	x
forest trees	9	x	x				x	x	x		x	x	x				x
medicinal plants	9	x	x		x		x	x	x		x	x	x				
fresh water	8	x	x					x	x		x	x	x				x
birds (includes bats)	7	x			x	x					x		x	x			x
mangrove crabs	7		x								x	x	x	x	x	x	
land crabs	6			x	x		x		x	x						x	
Turtles	6			x	x	x				x			x				x
fruit and nut trees	5							x				x	x			x	x
mangrove clams	5		x								x	x	x			x	
non-medicinal plants (includes Pandanus)	5	x				x	x							x	x		
recreational site(s)	3						x				x	x					
crabs (includes coconut crabs)	2			x	x												
Land	2		x	x													
lime (*aus*)	2	x				x											
cultural site(s)	1	x															

CHANGES IN USES

Subsistence living, which requires the use of natural resources, has changed considerably over the years. Locally made items such as cooking utensils, gardening tools, fishing gear, containers (for syrup, water, etc.), baskets, mats, thatch roofs, handicrafts, arts, fish and wild rooster traps, canoes and rafts, housing, ropes and strings to tie building materials, small tools, and pottery, have all been replaced by imported utensils, tools, and building materials. Much of the detailed knowledge and skills used to make these essential things are no longer practiced and are being lost. In addition, the roles that these essential items played are disappearing.

Many people in Palau still regularly eat locally grown and caught food. When people living elsewhere in Palau visit their relatives in Koror, they normally bring produce and seafood for their relatives. However, today most produce and seafood are sold. Any of the catch that is left over is consumed by the family. Farm and *mesei* (taro patch) produce continue to be available because there is an effort to replant taro, tapioca, and other farmed crops. However, in many places little or no effort is put into planting betelnut trees, pepper leaves and coconuts. So people often supplement their harvest by buying such items in the local stores.

The traditional times to collect, fish and plant are no longer followed by most people. To meet the market demand in Koror, collecting invertebrates, fishing and planting take place anytime, regardless of spawning time, or of flowering and harvesting seasons. Selling produce and marine species is the only way for some families to earn money, especially in the states farther from Koror. Money is necessary for school supplies, cooking fuel, electricity and other items. Whatever a family needs to buy, depends on the sale of their produce and their catch.

In some states, residents believe that there are more users from outside the state.

THREATS TO THE RESOURCES

Table 3 outlines the resource use issues and threats that were mentioned by the people interviewed. The threats that were mentioned in the most states throughout Palau were the overharvest of marine resources (13 states), increasing non-resident users (11 states), the loss of traditional knowledge and practices (10 states), sedimentation (10 states), pests (9 states) and technological changes in gear (9 states). The threats affect both marine and terrestrial resources, although marine resources seem to be the most heavily threatened.

Many of the issues that were mentioned as threats are closely related to overharvest and probably contribute significantly to the problem. For instance, the loss of traditional methods, technological changes in gear, increased market demand, and an increased number of users all contribute to overharvest of resources. In addition, habitat changes have occurred (such as sedimentation in nearshore areas and mangrove filling) that have changed the health of the resource base or decreased the available collection areas. Habitat changes that affect nearshore seagrass beds and mangrove areas can have far-reaching impacts since they damage important areas for the early life stages of many marine fish and invertebrate species. Destroyed or damaged habitat combined with the changes in the ways resources are used, can increase the likelihood of overharvest by forcing people to harvest in smaller and smaller areas. This increases the pressure on a smaller resource base, so that the species being harvested have no chance to reproduce to replenish the population.

The loss of traditional knowledge and practices has influenced how people behave in the environment. For instance, traditional fishing methods were often coordinated group activities that were under the control of the chiefs or other knowledgeable people. These people directed what the group did, when the fish were caught, how much fish was caught, and what was done with the catch. There was no means of long-term storage for extra catch, and no real incentive to catch everything. In addition, the locally made gear was not as efficient as modern gear and boats were not as fast or far-ranging.

Other impacts are being seen from the loss of traditional communal activities. In some areas the mangroves are slowly blocking access to mangrove channels because they are no longer cleared regularly.

Terrestrial resources are also threatened. In particular, people mentioned pests (especially fruit flies and crocodiles), diseased crops, habitat destruction, invasive species, pollution and increased market demand as threats in the terrestrial environment. Loss of traditional practices for farming taro was also mentioned as a problem in some states.

TABLE 2. Resource use issues and threats	total # states	Aimeliik	Airai	Angaur	Hatohobei	Kayangel	Koror	Melekeok	Ngaraard	Ngarche-long	Ngardmau	Ngarem-lengui	Ngatpang	Ngchesar	Ngiwal	Peleliu	Sonsorol
overharvest (in marine environment)	13		x		x	x	x	x	x	x		x	x	x	x	x	x
increased non-resident users	11	x				x	x		x	x	x	x	x	x	x	x	
loss of traditional knowledge and practices	10		x		x		x	x		x	x	x	x		x		x
Sedimentation	10	x	x				x	x	x	x	x		x	x	x		
Pests	9	x		x	x	x	x	x	x		x						x
technological changes (increased efficiency)	9	x	x				x	x	x			x	x		x	x	
diseased crops	8		x	x		x		x	x		x	x			x		
increased boat use	7	x	x				x				x	x	x			x	
increased users	7	x	x				x		x			x		x		x	
coral bleaching/death	5				x		x			x	x				x		
development / habitat destruction	5	x	x				x	x					x				
Dredging	5	x						x		x				x	x		
invasive species	5	x	x	x			x			x							
sea level rise	5			x	x			x	x								x
"shallowing" of nearshore areas	5							x		x				x	x	x	
dangerous animals (crocodiles or wild pigs)	4	x						x			x	x					
increased market demand/sales	4		x				x				x	x					
filling of mangroves	3		x				x	x									
poaching; foreign fishing	3			x	x												x
Pollution	3	x					x		x								
destructive fishing methods	2		x													x	
increased accessibility to resources	2										x	x					
loss of traditional conservation ethic	2											x	x				
mangrove growth	2	x	x														
poor compliance with regulations	2											x				x	
crown-of-thorns starfish	1				x												
fires; burning	1		x														
land sales	1												x				
loss of traditional control of resources	1						x										
poor soil	1																x
Quarry	1												x				
tree cutting	1										x						

SUSTAINABILITY OF RESOURCE USE PATTERNS

Overall, many marine collection activities in many states appear to be unsustainable at their current rates. At least one person from each state thought that the abundance of marine fish had declined. Striking declines in the fish catches in several states were mentioned during the interviews. These are outlined in Table 2. The numbers are estimates given by the fishermen and not accurately measured weights. However, they indicate that there is an impression that fish catches have changed throughout Palau over the last decade.

TABLE 4. Changes in fish catches

		8-10 years ago	now
Kayangel		500-700 lbs/day	100/200 lbs/day
Ngarchelong		300-400 lbs/day	100-150 lbs/day
Ngardmau	*chum*	4000 lbs/day (*chum*)	1000 lbs/day
Ngaremlengui		80-90 lbs (minumum)	80 lbs maximum
Ngchesar	*kesokes*	200-300 lbs/day	50 lbs/day
	reef fish	100 lbs/ trip	<100 lbs/trip
Ngiwal	gillnets (1980)	500 lbs/day	10-20 lbs
Peleliu	*kesokes*	300 lbs/day (maximum)	25 lbs/day maximum
	spearfishing	50 fish/ trip	15 fish/trip

However, in some states (Angaur, Hatohobei and Sonsorol) that are far from large numbers of fishermen, the fishing activities may be more sustainable. Fish catches appear to be sustainable in Melekeok, as well, where the traditional and local controls on fishing activities appear to be relatively strong.

Invertebrates such as sea cucumbers, clams, and many kinds of crabs appear to be harvested unsustainably in many states as well. Mangrove crabs and coconut crabs, in particular, are heavily harvested for commercial sale. Land crabs are also under commercial fishing pressure in the states where they are common. Mangrove clams are being harvested more sustainably in most areas, although there are fears that increasing commercial demand and habitat changes may put added pressure onto the clam populations.

Pigeons and turtles are possibly being harvested unsustainably, although both species are under some form of legislative protection. Enforcement is insufficient and the demand for turtle meat and eggs and pigeon is enough to make their collection quite profitable.

Land-based resources are not as heavily exploited as marine resources, and are thus being used at more sustainable levels. Forest resources are underused in most areas, especially since imported and

alternative building materials have become more commonly used. Other land-based activities, such as mahogany use, taro and farm crop cultivation, Pandanus use for baskets, are sustainable because the resource is usually replanted to maintain a sufficient supply. Some agroforestry resources (such as coconuts, betelnut, and fruit trees) are not being replanted in all areas, while in other places they are abundant.

Mangroves are both sustainably used and non-sustainably used, depending on where you look. In some states, the mangroves are rapidly being filled in to create new land. In other states, the mangroves are used as a source of wood for small building projects, and are not being heavily used. However, mangroves may be growing seaward because sedimentation levels have increased in the nearshore waters.

While people noted that many of the more heavily exploited species have declined in abundance, some species are showing signs of increase: in particular, people mentioned crocodiles, mangroves growing seaward into the *lalou*, seabirds in Sonsorol, and mangrove crabs in some areas in Koror where they are not collected.

Sustainability will be affected considerably by factors that damage habitats (sedimentation, mangrove filling, and development). In addition, accessibility to resources on Babeldaob will increase dramatically once the Compact Road is completed. Not only will local resource users have greater access to resources and to the markets in Koror, but non-residents will be able to move much more easily to previously inaccessible sites, especially forested areas. The road will also increase the availability of heavy equipment that can be used to remove large trees from remote areas.

Many recreational (non-extractive) uses of the resources appear to be at sustainable levels. However, community residents generally spoke about their own resource uses, not those of others, so tourist and recreational activities were not often discussed during the interviews. Some tourist activities or businesses may be damaging or disturbing to some areas (for instance the Rock Islands in Nikko Bay that have been cleared for tourist uses without the knowledge of the local residents).

TABLE 4. Resources or species showing signs of increase	total # states	Aimeliik	Airai	Angaur	Hatohobei	Kayangel	Koror	Melekeok	Ngaraard	Ngarche-long	Ngardmau	Ngarem-lengui	Ngatpang	Ngchesar	Ngiwal	Peleliu	Sonsorol
mangroves (seaward, *lalou* side, or in channels)	4		x				x			x				x			
Crocodiles	3	x						x						x			
Birds	1																x
mangrove crabs	1						x										
Stingrays	1													x			

TABLE 5. Resources showing signs of depletion or damage	total # states	Aimeliik	Airai	Angaur	Hatohobei	Kayangel	Koror	Melekeok	Ngaraard	Ngarche-long	Ngardmau	Ngarem-lengui	Ngatpang	Ngchesar	Ngiwal	Peleliu	Sonsorol
marine fish	16	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Birds	5	x				x			x				x	x			
mangrove crabs	5						x					x		x	x	x	
marine invertebrates	5	x	x					x	x		x						
Taro	5		x	x			x			x		x					
sea urchins	4									x	x		x	x			
coconut crabs	3			x	x	x											
giant clams	3				x					x	x						
sea cucumbers	3									x	x			x			
Dugongs	2	x								x							
land crabs	2			x												x	
mangrove clams	2						x					x					
Mangroves	2		x				x										
medicinal plants	2		x				x										
Turtles	2					x				x							
farm crops	1			x													
forest trees	1		x														

TABLE 6. Sustainably used resources	total # states	Aimeliik	Airai	Angaur	Hatohobei	Kayangel	Koror	Melekeok	Ngaraard	Ngarchelong	Ngardmau	Ngaremlengui	Ngatpang	Ngchesar	Ngiwal	Peleliu	Sonsorol
forest trees	7	x		x	x	x		x		x				x			
farm crops	5	x				x	x	x									x
Taro	4					x	x	x									x
Mangroves (trees)	3			x						x				x			
Pandanus for weaving	3					x	x								x		
marine fish	2							x	x								
marine invertebrates	2			x				x									
giant clams	1									x							
Mahogany	1						x										
mangrove clams	1											x					
mangrove crabs	1							x									
medicinal plants	1											x					
produced food items	1				x												

TABLE 7. Unsustainably used or threatened resources	total # states	Aimeliik	Airai	Angaur	Hatohobei	Kayangel	Koror	Melekeok	Ngaraard	Ngarchelong	Ngardmau	Ngaremlengui	Ngatpang	Ngchesar	Ngiwal	Peleliu	Sonsorol
marine fish	10	x	x	x		x	x			x	x	x		x	x		
marine invertebrates	7	x				x				x	x	x		x	x		
mangrove crabs	4		x							x		x			x		
mangrove clams	3		x				x			x							
Pigeons	2	x												x			
coconut crabs	1			x													
giant clams	1									x							
land crabs	1			x													
Turtles	1				x												

DISTRIBUTION OF BENEFITS

Overall, most people thought that locals receive most of the benefits from the local resources. However, this was often a difficult question for people to answer. The difficulty arises because there is so much variability in the ways resources are used and distributed in Palau. Some are caught and consumed locally by many people, others are raised for commercial sale outside of the state by a few people, and others are collected or used only occasionally when there is a large custom or request. The population of the country is relatively small, so often relatives who do not live in the state share in the benefit of the state's resources. In addition, each state is different and there is much variability over time.

Much of the fish and invertebrate catch, and the taro and farm crops are used by the local communities. Even if a person sells a particular resource, a portion of the production is kept for the family. This keeps benefits within the community.

The benefits from some resources leave the state or are received by only a handful of people for such commercially sold species as mangrove crabs and fish.

Occasionally the benefits are shared with non-residents and non-Palauans who use the resources of a particular state. This sharing is not always acceptable to the local residents, however, they do not know how to effectively restrict access to their resources.

TABLE 8. Distribution of benefits	total # states	Aimeliik	Airai	Angaur	Hatohobei	Kayangel	Koror	Melekeok	Ngaraard	Ngarchelong	Ngardmau	Ngaremlengui	Ngatpang	Ngchesar	Ngiwal	Peleliu	Sonsorol
local subsistence uses and needs	14	x		x	x	x		x	x	x	x	x	x	x	x	x	x
source of income for a few residents	13		x	x	x	x	x	x	x	x		x	x	x		x	x
non-resident users	10	x				x	x		x	x	x	x	x	x		x	
most sold outside state	4		x								x			x	x		
sold locally	4		x	x			x	x									
other sources of income for most residents	3	x	x				x										
recreational uses	2	x					x										
special requests received for certain species	2	x			x												

UNUSED OR UNDERUSED RESOURCES

The resources that were mentioned as being un- or underused varied widely by state. They are listed in Table 9. However, people in many states mentioned agroforestry (fruit and nut trees) as a potential resource that is not currently tapped. Betelnut trees, in particular, were mentioned as the crop with the most potential. Other planted trees that could be planted and used more are coconuts, mahogany and fruit trees.

Aquaculture potential was mentioned by several states (Aimeliik - mangrove crabs, Kayangel, Ngarchelong, Ngchesar, Ngiwal, and Hatohobei - land crabs). People also mentioned the importance of finding ways to replenish some of the marine stocks that have been heavily harvested.

People in many states in Babeldaob mentioned the hardwood forest as a large underused resource. Local timber was used much more often in the past for canoe, house and *bai* building. Today imported and pre-fabricated materials such as plywood, cinderblocks and cement is used more often in construction. Boats are all made of fiberglass. Care should be taken so that the forests of Babeldaob are not quickly overharvested in a big rush to make money from cutting trees. There is an imminent danger of this as the road makes more forested areas accessible to people and large machinery.

Other resources that people mentioned as being underused were a variety of specialty foods, medicinal plants, and traditional paint supplies.

Finally, sites that could be used as recreational sites for tourists were mentioned in Angaur, Kayangel and Ngiwal. Kayangel residents also noted the potential to develop the sportfishing industry in their state.

TABLE 9. Unused or underutilized resources with potential for development	total # states	Aimeliik	Airai	Angaur	Hatohobei	Kayangel	Koror	Melekeok	Ngaraard	Ngarche-long	Ngardmau	Ngarem-lengui	Ngatpang	Ngchesar	Ngiwal	Peleliu	Sonsorol
planted fruit and nut trees	7	x	x	x			x	x			x						x
Aquaculture	4					x				x				x	x		
hardwood forest	4								x	x				x	x		
tourism sites	3			x		x									x		
Bauxite	2		x								x						
coconut trees	2				x												x
edible seaweeds	1	x															
fresh water	1										x						
kerngimes (for weaving)	1						x										
land crabs (if farmed)	1				x												
Mahogany	1	x															
mangrove crabs (if farmed)	1	x															
mangrove trees	1											x					
marine fish (migratory)	1				x												
marine invertebrates	1						x										
medicinal plants	1	x															
Pandanus	1					x											
Phosphate	1															x	
seawater (salt)	1																x
soils for paint pigments	1								x								
specialty foods	1			x													
Sportfishing	1					x											

INFORMATION GAPS AND NEEDS

The information gaps and needs are listed in Table 8. They are quite variable by state, and in general, reflect local needs. They fall into three general categories: information that the interviewers were not able to find in sufficient detail, questions that arose from the information given during the interviews (for instance, the extent and impacts of certain activities believed to be causing resource declines) and questions and needs that the community people themselves had.

Information that the interviewers had difficulty finding included:

- specifics about the status of forest birds, coconut crabs, giant clams, dugong, turtles and other species
- extent of toluk and jewelry made from hawksbill turtle shell
- extent of local timber harvest by and for the sawmills
- amount of income that people make from different resources
- extent of non-commercial resource uses (how does commercial use compare to non-commercial use for different resources)
- extent of illegal hunting and collection activities
- details on medicinal plants
- egg collection activities
- private businesses

Some people believe the declines in resource abundance of some species or damage in some habitats have very particular causes. However, these causes are not always straightforward and the direct impacts have not been proven (or disproved). These uncertain cause and effect relationships are thus listed below as information gaps:

- impact of boat traffic on marine larvae and egg survival
- extent and impacts of pesticide, fertilizer and nutrient runoff
- extent and impacts of non-Palauan resource users
- impacts of lifestyle and socioeconomic changes on resource uses

The information needs of the community includes:

- abundance and status of certain species (especially coconut crabs and land crabs)
- aquaculture potential
- education about
  - proper uses of resources
  - the importance of mangroves
  - animal life cycles and behaviors (Ngardmau)
  - mangrove clam life cycle (Koror)

- finite nature of resources (Ngaremlengui)

- causes of sedimentation and "shallowing" of nearshore reefs (Peleliu)
- reasons for mangrove decline (Angaur)
- impacts of algal bloom (Ngatpang)
- fruit fly control
- invasive plant control
- mangrove clam collecting area protection (Koror)
- crop yield improvement
- how to repopulate fish and crabs stocks
- how to make and sell salt from seawater (Sonsorol)
- future water and sewage disposal needs (Melekeok)

TABLE 10. Information gaps and needs	total # states	Aimeliik	Airai	Angaur	Hatohobei	Kayangel	Koror	Melekeok	Ngaraard	Ngarchelong	Ngardmau	Ngaremlengui	Ngatpang	Ngchesar	Ngiwal	Peleliu	Sonsorol
bird abundance	4				x	x				x				x			
forest use	4			x						x				x	x		
medicinal plant use	4				x	x								x	x		
biological and ecological knowledge	3						x				x	x					
bird use	3				x	x								x			
coconut crab status	3			x	x	x											
fresh water needs	3							x						x	x		
Mangrove functions and management	3		x	x								x					
status of local fisheries (fish and invertebrate)	3									x				x	x		
turtle populations	3			x	x	x											
better land, mangrove and ocean uses	2										x		x				
conservation areas (local understanding of)	2						x						x				
how to repopulate fish and crabs	2	x											x				
invasive plants	2			x			x										
land crab status	2			x	x												
marketing activities	2			x											x		
plant pests	2						x		x								
socioeconomics and changes in lifestyle	2									x				x			
aquaculture potential	1										x						
fishing permits	1					x											
forest species	1									x							
future sewage disposal	1							x									
how to improve regulations	1											x					
invertebrate use	1			x													
poor crop yields	1															x	
reasons for shallower reefs	1															x	
salt-making techniques	1				x												
sedimentation and construction impacts	1		x														
turtle use	1			x													

NEXT STEPS

- prioritize threats and information gaps
- create sustainable use / best practices guidelines for key resources
- follow-up on particular state needs
- increase effectiveness of education about conservation, conservation laws and conservation areas
- investigate farming, agroforestry and aquaculture possibilities
- determine impacts of sedimentation and pollution
- investigate extent and impacts of illegal hunting and collecting activities
- coordinate alternative income generation programs
- integrate local people into conservation planning activities to emphasize the importance of conservation to resource users

Glossary of Palauan Terms

amansis	tree, *Ormosia calavensis*
aus	lime; cooked clam shells and/or coral chewed with betelnut and pepper leaf
bai	meeting house
bakelungal	sea cucumber
beches	clean; new
bekai	Micronesian megapode
bekuu	Pandanus that is similar to *buuk*; leatherback turtle (in Kayangel *bekuu* is the same as *suisekull*)
belochel	Micronesian pigeon, *Ducula oceanica*
beng	stone fish trap
bentos	prepared lunch boxes
beokel	tree, *Vitex coffassus*
betik er reng	concern for others
bibrurk	papaya disease that turns the leaves yellow
bidekill	cast net
biib	Micronesian fruit dove
bisech	wild taro
biut	mangrove tree, *Ceriops tagal*
bkau	endemic tree, *Parinari corymbosa*
bkul a toachel	edge of a deep area
blacheos	tree, *Gmelina palauensis*
bobai	papaya
bokso	invasive grass, *Miscanthus floridulus*
bong	drainage ditch around a taro patch
bor	morning low tide
brak	giant taro, *Alocasia macrorrhiza*
brer	bamboo raft
brotong	transportation canoe
bsungel	mangrove snail
btaches	Alexandrian laurel tree, *Calophyllum inophyllum*
btachesked	type of laurel tree that grows in the savanna
bub	general term for a fish or crab trap that can also be used on land
budech	yellow-cheeked tuskfish, *Choerodon anchorago*

bul	traditional prohibition/closure
buuch	betelnut, *Areca catechu*
buuk	Pandanus kanehirae, pandanus with wide leaves good for thatch
cdemeklachel	tree in nutmeg family, *Horsfieldia amklaal*
cheaol	mollusc
chebouch	tree, *Pinanga insignis*
chechoech	mangrove crab, *Eriphia sebana*
chechui	chiton
chei el beluu	community members fishing for the community
chelangel	tree, *Pouteria calcarea* or *oborvata*
chelebiobech	tree in Buckthorn family, *Alphitonia carolensis*
chelechil	killer whale
cheled	reef invertebrates collected for food
cheliuis	raised hills between taro patches
chelmoll	reefs
chelub	Indian monitor lizard
chemang	mangrove crab, *Scylla serrata*
chemang era lekes	mangrove crab found in lagoon
chemutii	sweet potato
cherabrukl	lobster
cherangel	orangespine unicornfish, *Callicarthus lituratus*
cheremall	tree in hibiscus family
cheremrou	mangrove shrimp, crayfish
cheremrum	sea cucumber, *Actinopyga miliaris* and *A. echinites*
cheritem	tree, *Parinari laurina*
chesechol	small clams found in edge of the beach, *Atactodea striata*
chesechuul	ghost crabs
chesemolech	tree in mangosteen family, *Calophyllum inophyllum var. wakamatsui*
chetermall	sea anemone
chis	areas of deeper water within the reef or seagrass areas
chiull	sea worm
choes	tree, *Rhus taitensis*
choltoir a ngikel	a fishing method where you "run after fish with a spear"
chum	unicorn fish, *Naso unicornis*
dait	leaves and stems of the taro plant *Colocasia esculenta*
deb	sugar cane
debar	gray duck

debuongel	clam
dechel	untended and overgrown areas that used to be taro patches
dekar	breadfruit with seeds
dekemerir	blue marble tree, *Elaeocarpus joga*
delalakar	plant used in many traditional medicines; also known as *ongael*
delbekai	clam
delodau	respectful, obedient, humble
delsangel	marine snail
demailei	palm tree, *Heterospathe elata var. palauensis*
demekegad	tree
derris	vine used to stun or kill fish
derutm	porcupine fish
desui	rainbow runner
diangel	canoe house
dilides	event when shocked and dying fish wash ashore
diokang	tapioca (cassava)
diong	well or river used for washing
dort	ironwood tree, *Intsia bijuga*
dub	dynamite; plant used to poison fish
duduomel	giant clam
ebakl	adze
eduib	mangrove clam
hats ra ngebard	introduced honeybees
iaml	medicinal plant, *Limnophila aromatica*
ibuchel	sea urchin
idungel	firewood
iedel	mango
imirchorch	honeycomb grouper
irimd	sea cucumber
kabekel	large sailing canoe used for transportation
kaeb	large sailing canoe
kalbasang	pumpkin
katsuobusi	dried tuna
kdor	clam, *Tellina virgata*
keam	Tahitian chestnut tree, Inocarpus
kebeas	vine, *Merrimia umbellata*
kebokeb	inner edge of mangroves near dry land

kebui pepper leaf vine
keburs mangrove area
kedam frigatebird
kelat mullet
kelel a charm endemic tree, *Campnosperma brevipetiolata*
kemedukl humphead parrotfish
kemokem vine in the legume family used in traditional medicines
kerdikes grass that grows in taro patches that is used for grass skirts
kerengimes swamp reed
kerkard small mosquito usually found in sandy areas
kerker shallow area out to the reef
kerkes plant disease
kesakou crab
kesebekuu vine used in traditional medicine, *Entada phaseoloides*; saltwater eel
kesiamel tree, *Osmoxylon pulcherrimum*
kesiamel small sand clam
kesokes stationary net that traps fish on the low tide
kesuar land crab, *Gecarcoidea lalandii*
ketat coconut crab, *Birgus latro*
kikoi ark shell, *Anadara sp.*
kim clams, especially *Tridacna sp.* and *Hippopus hippopus*
kirrai medicinal plant, *Scaevola sericea*
kiuri cucumber
klou a dolech high tide
klsebuul rabbitfish, *Siganus lineatus*
klsechedui shrub used in traditional medicine
kmai swimming crab, *Portunnus pelagicus*
kodenges mangrove tree, *Bruguiera gymnorhiza*
komud rudderfish,
kotiko mojarra, *Gerres oyenna*
kotraol small racing canoe
ksid endemic tree in Strychnine family, *Fragraea ksid*
ksull hairy sea crab
kual traditional crab trap made of bamboo
kuel red-footed booby
kukau tuber of the purple taro
laib pigeon

lalou outer edge of the mangroves
laok varnish made from cheritem tree
las tree, *Pteroccupus indicus*
las tree, *Pterocarpus indicus*
lemau mud-bottomed passages
lius coconut palm
makit market
maml Napoleon wrasse, *Cheilinus undulatus*
matakui shrub, *Melastoma malabathricum*
meas rabbitfish, *Siganus canaliculatus* and *S. fuscescens*
mechas elder or titled woman
mechiuaiu giant sensitive plant, *Mimosa diplotricha*
medob sperm whale, *Physeter catadon*
meduu breadfruit tree
meduulokebong cannonball tree, *Xylocarpus granatum* that grows in the mangroves
mekebud sardine
mekekad mangrove tree, *Lumnitzera littorea*
melaok fatty
melebed net fishing
melibs type of giant clam, *Tridacna melibes*
melkesokl coral heads that rise in the deep lagoon areas
mellemau parrotfish
mellill disease affecting tapioca
mengereel line fishing
mengereker to collect medicinal plants from the forest or savanna; to earn money
mengesokes barrier net fishing
meradel orange
mesalou knead the soil in a taro patch
mesei taro patch
mesekiu dugong
miich Pacific almond tree
mngumll method for hunting pigeons using tame pigeons
molech sea cucumber, *Holothuria scabra*
murch clam
ngduul mangrove clam, *Anodontia sp.*
ngel medicinal plant, Indian mulberry
ngesngesil invasive plant

ngiaoch	parrotfish
ngims	sea cucumber
ngmui	tree, *Stemonurus ammui*
ngolm	medicinal plant
nguk	taro blight
ochab	place in the mangroves where mangrove crabs can be found
odimir ar meteet	fish for high clans
odoim	meat foods
olik	fruit bat, *Pteropus pelewensis*
oltoir	to chase fish with a spear
olukl	stick to which thatch is sewn on a roof
omalech	spearfishing
omeklochel	general term for fresh water swamps
omenged el buai	community fishing
omengesokes	net fishing
omesurch	cleansing ceremony for women after the first birth of a child
omond	to catch fish to sell
omrekongel	fresh water swamps where giant taro (*brak*) is grown
omult	turn over the dirt of a taro patch without kneading the soil
ongduoll	actively maintained areas where women collect mangrove clams
ongraol	starch foods
oruer	clam embedded in coral and rocks, *Tridacna crocea*
oruidel	trevally or bluefin jack
osib	tool for breaking ground
ramek	compost
rebotel	wax apple tree, *Eugenia javanica;* sea crab
rechiil	sea snail, *Strombus sp.*
rekung	land crab, *Cardisoma carnifex* and *Discoplax hirtipes*
renrak	invasive plant
rereek	crab
riamel	football fruit, *Pangiumn edule*
ribkungel	clam, *Tridacna squamosa*
rrull	stingray
rruul	coconut leaf fishing net
rubak	elder or titled man
seidai	sawmill
sekesaker	sea cucumber

semachel	sea snail, *Strombus sp.*
senges	mangrove crab, *Neoepisesarma lafondi?*
sers	garden
sesoseb	Polynesian arrowroot
sim	season
siukang	custom
smach	mackerel
such	Pandanus leaves used for weaving
suub el mengur	sweet soup made of young coconut
tatemai	time to put the framework of a house up with help from many other people
tebechel	mangrove tree, *Rhizophora sp.*
techou	small hand net used in torch fishing
telentund	wild tamarind, *Leucaena leucocephala*
telib	fermented wax apple
temang	gift of fish
temel a chum	time when *chum* is abundant
temetamel	sea cucumber
terekrik	mackerel, scad
tilol	wild garcinia, *Garcinia rumiyo*
tiuach	oyster, *Malleus sp.*
tochedulik	cat's claw, bush or vine with sharp thorns
toechel	Nipa palm, *Nypa fruticans*
toluk	women's money in the form of a tray made from hawksbill turtle shell
tuu	banana
udech	orangestripe emperor, *Lethrinus obsoletus*
udeuid	endemic tree, *Manilkara udoido*
uek	swamphen
uel	sea turtle
uet	deeper area surrounded by mangroves and seagrass bed that contains water at low tide found in Rock Islands, Choll and Ngkeklau; marine lakes in the Rock Islands
ukaeb	crab shell stuffed with crab meat and coconut
ukall	tree, *Serianthes kanehirae*
ulekelakl	medicinal plant
uleld	coconut candy
uluu	mullet

ureor beluu	village clean-up and other community activities
urrekerek-el-uasech	fish paste
urur	mangrove tree, *Sonneratia alba*
zaru	baskets made from very strong vines (*ngidech* or others), with nipa palm leaves for midribs