

Investigation of the Traditional Uses and Preservation of Mangrove Forests on Iriomote Island

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Abstract: The present research takes a utilization and preservation stance in its examination of how mangrove forests on Iriomote Island have been used by the residents of the region and the historical factors relating to this. Iriomote Island's mangrove forests are closely associated to general life on the islands and have been used for dyeing, lumber, food, recreation, and appear in folk songs. The natural use of these forests by the residents can be traced back to traditional common use customs in the Ryukyu Dynasty. The essence of this common use is recycled-use based upon a sustained yield principle for natural resources. This way of thinking survived among the people of the region throughout the war and is thought to have been a factor in maintaining sustainable, cyclical use and preservation of the mangrove forests.

1 Introduction

Mangrove forests are a plant colony that grows in brackish waters where seawater and fresh water mix. Their distribution is global and tends to concentrate in the tropical and sub-tropical areas around the equator. In Japan, the main concentrations of mangrove forests are found in the Ryukyu Archipelago, specifically on the island of Iriomote in Okinawa prefecture.

The mangrove forests of Iriomote Island provide attractive tropical scenery and are utilized for eco-tourism and environmental education. The only physical use of the mangrove forests are by a small part of the dyeing industry. In times past, the mangrove forests provided an important source of food and historically have always been deeply associated with local residents' lifestyle.

The Iriomote Island mangrove forests are now used for eco-tourism and environmental education. However, wave damage by high speed boats and the problems associated with the sheer volume of eco-tourists (trampled soil, littering, plant damage) over the past few years have helped speed up the physical changes to the Moreover, if we look at the eco-tourism system of Taketomi Town we see that the involvement of local residents is still very low and therefore the industry has not developed to incorporate active involvement of locals as eco-tourism guides. For that reason the environmental educators and eco-tourism guides who introduce the mangrove forests tend to focus on the ecological characteristics and their explanations lack the historical ties the mangrove forests have with the local residents. If, in fact, sustainable

growth in eco-tourism is being sort, the system must be structured to involve local residents. This is thought to be a key point to the success of the industry. To achieve this, it is essential that the relationship between the people and the mangrove forests to date and the historical facts relating to this are clarified.

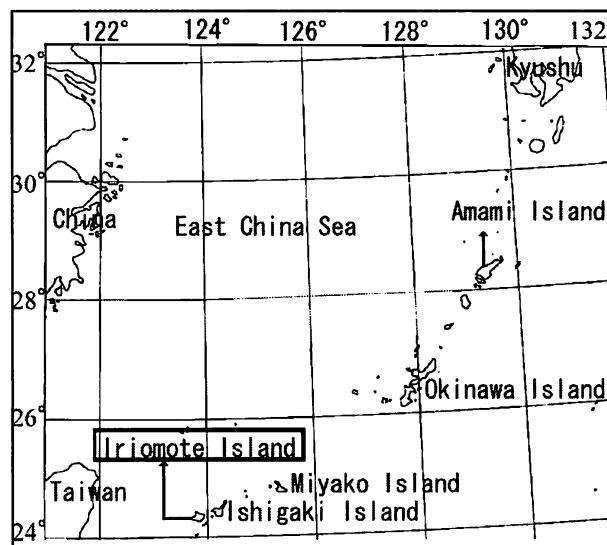


Figure 1. Map of Ryukyu Islands

By looking at past research on the mangrove forests of Iriomote Island we see that the majority of the studies have concerned forest distribution, composition, tree physiology, soil, and insects, etc (Research Institute for Subtropics, 2003).

However, in past research, the relationship between the mangrove forests and the lifestyle of local residents has only been outlined (Nakamura et al, 1998). There are very few monographic research examples of the lifestyles of the people of Iriomote Island that focus on the relationship between mangroves and people from a utilization and preservation point of view.

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In the near future, Iriomote Island's mangrove forests will become more and more popular as eco-tourism and environmental education resources.

On the other hand, there are also movements to re-evaluate the regions of mangrove forests and utilize them as a source of dye for textile goods etc. The question that will become more prevalent now in usage policy decisions is whether to prohibit human access to the mangroves completely, or to continue to use them to a certain extent as a resource and at the same time work to preserve them.

The hypothesis of this paper is that a balance of utilization and preservation of the mangrove forests can be maintained providing the usage is within the bounds of traditional utilization by the regions residents. The aim of this paper is to investigate the way in which local residents have used the mangrove forests on Iriomote Island to date and the historical factors involved in this.

Interviews were carried out with elderly residents of Komi, Sonai and Hoshitate villages which have a long tradition of mangrove forest use.

The present research has summarized all relevant research conducted after September 1993, and plans to continue gathering information from the entire Ryukyu Archipelago so as to present a very detailed set of research results on this topic.

The data resulting from the interviews in this research spans a period from the 1930's to the 1960's.

2 Outline of the Natural Environment

Iriomote Island is located in the southern area of the East China Sea. It has a land area of 28,400ha, of which approximately 90% is forests and fields. Residential and pastoral areas are located around the coast of the island.

The average temperature of the island is 23.4 degrees celcius with a yearly rainfall of 2,406mm. The island has a comparatively temperate rainy subtropical oceanic climate.

The peaks of Komi (469m), Haterumamori (447m), Tedou (441m), and Goza (420m) tower in the centre of the island. These mountains form the borders that define a number of large and small rivers. Among these rivers and tributaries are the largest rivers in the prefecture, Urauchi River, and Nakama River which provide a home for some unique mangrove forests of Japan and give the area a very tropical vista.

The world's total area of mangrove forests is some 16.3 million ha of which 42% are located in

the Asian Pacific region. America is host to 38%, while Africa is home to 20% of the world's mangrove forests. Of the 553ha of mangrove forests in Japan, 96% (531ha) are located in Okinawa. Iriomote Island is home to 77% (424ha) of all the mangrove forests located in Okinawa (Nakamura et al, 1998).

There are said to be 58~78 different species of mangroves in the world (Nakamura et al, 1998). The following seven varieties are found in Japan: From the Hirugi(Rhizophoraceae) family are; Ohirugi (*Bruguiera gymnorhiza*), Mehirugi (*Candelia candel*), Yaeyamahirugi(*Rhizophora stylosa*). From the Shikunshi(Combretaceae) family is; Hirugimodoki (*Lumnitzera racemosa*). From the Hamazakuro (Sonneratiaceae) family is; Mayapushigi (*Sonneratia alba*). From the Kumatsutzura (Verbenaceae) family is; Hirugidamashi (*Avicennia marina*). From the Yashi (Palmae) family is; Nippayashi (*Nypa fruticans*). All of these varieties may be found on Iriomote Island.

3 Socio-economic situation

According to the homepage of Taketomi Town, there are 17 villages on Iriomote Island and as at November, 2004, there were 2,236 people living on the island. Of the total population of the island, 29% are employed in primary industry, 10% in secondary industry, and 61% in tertiary industry. The main element of the tertiary industry is service.

The core industries on the island are agriculture and tourism. Agricultural activities include the mainstays of sugar cane and pineapple cultivation and some rice production and livestock rearing. In May 1995, the "Iriomote Island Eco-tourism Association", the first of its kind in Japan, was established. Through this, the eco-tour sight seeing with mangrove forests as a featured attraction has gained in popularity over recent years. There is an increasing trend in the numbers of tourists traveling to Iriomote Island. In 2003, that number reached 366,105 people.

4 Mangrove Forest Folklore Documents

4.1 Dialect Names for Mangrove Forests

One of the clues to establishing the link between people and the mangrove forests is by exploring the dialect names given to the mangrove plants.

The information available of the dialect names of the mangrove forests has been summarized in table 1.

Except for Nippayashi, all the mangrove forests are called Pushiki. They are separated

Table 1: Dialect Names of Mangrove Forests on Iriomote Island

Scientific name	Dialect name (Village)
<i>Bruguiera gymnorrhiza</i>	Bigipushi (Komi) , Biipushiki (Hoshitate) Madapushiki (Hoshitate)
<i>Rhizophora stylosa</i>	Matsuapushiki (Hoshitate, Sonai) Miipushi (Komi) , Meepushi (Komi) Miipushiki (Komi) Mayapushiki (Sonai, Hoshitate)
<i>Sonneratia alba</i>	Tundapushi (Komi)
<i>Lumnitzera racemosa</i>	Kanyaakii (Hoshitate)

in the male mangroves, Ohirugi (*Bruguiera gymnorrhiza*) ,and the female mangroves, Yaeyamahirugi (*Rhizophora stylosa*). In Komi Village men are called Bigidun, and women are called Miidun in local dialect. Corresponding to this, Ohirugi are called Bigipushi (male mangrove), and Yaeyamahirugi are called Miipushi (female mangrove). The reason the mangroves are called this is unclear but, from the results of interviews, it is thought that the names of the mangroves were decided upon from the appearance of the plants.

The Mada of Madapushiki (Ohirugi) means “real” or “genuine” and being the most prevalent, it is representative of the mangrove varieties. The Matsua in Matsuapushiki is the name of a person who only harvested that variety of mangrove.

The Maya in Mayapushiki (Yaeyamahirugi) means cat and it appears that the mangrove got its name because the roots resemble the paws of a cat.

The Tunda in Tundapushi (Hamazakuro) means pointed and apparently the mangrove was named for the needle like roots it puts out underground.

Upon reviewing the above information it is apparent that the dialect names given to the mangroves are mainly derived from their physical appearance and characteristics.

4.2 Use of Mangrove Forests

4.2.1 Use for Dyeing

In the period prior to and following the war, the main use of the mangroves on Iriomote Island was for dyeing. The bark of the Yaeyamahirugi and the Ohirugi were used. While the bark of the Ohirugi is quite thin, the bark of the Yaeyamahirugi is thick and the quality is good for dyeing purposes.

The mangrove forests that were felled were located inside a national forest and while before the war people could freely harvest the lumber, this changed after the war and those wishing to fell the mangroves were required to obtain permission. Much of the lumber collected from

the mangrove forests was done so without permission.

In Hoshitate Village when the bark for the mangroves was harvested Aihisaa · Ayahitsuaa · Arishitsuaa (Wooden hammer) and a Yamakatana (Woodman’s hachet) were used. Aihisaa means to strike. It is made from the trunk of the Hirugi. When the bark was peeled off, firstly the Yamakatana was used to remove the rough outer bark from the mangrove trunk (if this was not done extraction was difficult). Next the Aihisaa was used and, while the tree was still standing, the trunk was beaten and the bark stripped off. Tall trees were stripped of their bark using scaffolds. On occasion, a saw was used to first cut the tree down so as the bark could be stripped.

Those people who owned boats would load the felled mangroves onto the boat and transport them to the Kacchiikooba (Dye Factory) where they then sold them. The bark was stripped at the factory and the remaining timber was used as firewood. Those people who didn’t have boats would strip the bark off in the mangrove forests and take it to the factory to sell. Stripping bark from the mangroves was mainly the work of women. According to a woman in Hoshitate Village, she would strip approximately 60kg of bark a day. With her child on her back and the bark balanced on her head, she would make her way to the factory to sell her harvest.

In Komi Village, the Kacchiikooba mainly hired males per diem to work as porters. Women would strip the bark from the mangrove lumber that was brought into the factory by the men. The women were also hired per diem. Mangrove harvesting and bark stripping were activities that were normally carried out after the rice fields had been tended to.

Kacchi is the hardened mould of the essence taken from the mangrove bark and the factory that produced it was known as a Kacchiikooba. There was a mangrove essence factory located in Arakawa Village on Ishigaki Island before and

after the war. There was a Kacchiikooba located in Hoshitate Village between 1937 ~ 1953 and while there was a branch factory from Ishigaki Island located in Komi Village just after the war ended, it closed down after approximately 2 years.

Mangrove trees and bark harvested on Iriomote Island and Ishigaki Island were transported to the Kacchiikooba on Ishigaki Island. The harvested trees and bark were carried to the Arakawa factory on Ishigaki Island by sail boat where they were then made into finished products. For the people of Iriomote Island this was a good source of cash revenues.

The Kacchiikooba facilities and production process were as follows:

The facilities were the same as the old Okinawa brown sugar production facilities. Three pots were placed atop of an oven made from piling up red clay and stones. The oven was equipped with an opening to build a fire, and a chimney. The pots were separated into number one, number two, and number three. In pot number one, finely cut bark was placed to boil. Little by little the concentrated essence that was produced was transferred to pot number two and pot number three where finally lime was added to solidify it. The essence was molded into squares 10~15cm with a height of 4~5cm which were allowed to dry naturally.

The final product was sold throughout Okinawa where it was used to dye sails and fishing nets. By dyeing paper mulberry cloth with Kacchi-essence the material was made tough and waterproof. Fishing nets dyed with the essence were also stronger, lasted longer and were not weathered by the sea.

When weaving thread was dyed, mangrove bark was also used. According to interviews in Komi Village the dyeing process was as follows: Water was placed in a large domestic pot and Yaeyamahirugi bark was put into the water to boil. When a sufficient amount of colour had been produced the remainder of the bark was removed from the water and the thread was placed in the water to boil. The dyed thread was then placed in lye to fix the colour. To produce a thread with a deeper colour, the thread was placed in the colouring essence to be boiled again and then placed in the lye. This process was repeated over and over allowing for desired shades to be produced. After one use of the lye it would become cloudy and needed to be replaced.

Lye is a dye mordant that is produced from wood ash. It was produced using the following process: The ash from the kitchen stoves in

people houses was used. First the ash was placed in an earthenware jug where it was mixed with well water and left to settle on the bottom of the jar. The reason well water was used was that it produced a better colour than regular tap water. The mixture was stirred a number of times and then left until the ash had completely settled on the bottom. The preparation was tested by placing a finger in the liquid after the ash had settled. It was judged to be ready if it had a slimy feel. Once the ash had completely settled the alkaline liquid was ready. This liquid was used as a dye mordant. Although there were a number of types of ash in the jars, the ash from the Yuuna (*Hibiscus tiliaceus*) was reportedly very good.

4.2.2 Lumber Use

The lumber uses for the mangrove forests include rafter logs for roofs, posts, cross beams, laundry poles, fences to protect from wild boars, charcoal, and firewood etc.

Bruguiera gymnorrhiza is used for thatched roof rafter logs, posts, and cross beams. Rafter logs, posts, and cross beams are first buried in the sand of a shoaling beach for approximately one month before being dug up and put to use. This is called Suukan in the local dialect. The meaning of Suukan is to place in seawater and by doing so the timber becomes so hard that it is difficult to drive in nails and can't be eaten by insects. This method of Suukan is the same as for other types of lumber.

To make laundry poles dead straight *Bruguiera gymnorrhiza* tree were used.

On Iriomote Island wild boars are called Kamai in the local dialect. In order to protect rice crops from damage from the animals, living fences were erected around the perimeter of the fields. These living fences used *Bruguiera gymnorrhiza* in their construction. Small *Bruguiera gymnorrhiza* trees of approximately 5-6cm in diameter were tied together to make the fences.

Both *Bruguiera gymnorrhiza* and *Rhizophora stylosa* were used to make domestic use charcoal. Both of these trees produce a charcoal that burns very hot making them a valued source for the product. As winter approached these trees were often felled to make charcoal.

Firewood was sourced from *Bruguiera gymnorrhiza*, *Rhizophora stylosa*, *Sonneratia alba*, and *Lumnitzera racemosa* etc.

4.2.3 Use as a Food Source

The mangrove forests were also a source of food gathering for the local residents. The mangrove forests yielded such edibles as crabs, shellfish, prawns, and eels.

The Assangayaa (Komi Village dialect) is one variety of crab. This type of crab is small and as the tide comes in it climbs up the mangrove trees. Locals waited for this before they took them. The crabs were used for making broth and were also eaten as an ingredient of soup.

In a tale heard in Komi Village, it is said that there was a custom whereby women weren't to go to the sea during summer when the heads of rice appeared on the rice plants. This was known as Ishudumi. Ishu means sea and dumi means to stop. Around this time, if a strong wind blows the rice flowers will fall and won't produce rice. If a woman was to go to break the custom and go to the sea, the weather would turn and a strong wind would blow. During this time, women did not go to the sea for approximately one week. It was then that the women would go into the mangroves to gather crabs.

The Gasami (Komi Village dialect) is another variety of crab. This crab was made into surimi and used to make fish cakes. They were also eaten boiled, as a soup ingredient, and as tempura. When used to make tempura, the meat from the crab was covered in flour and shaped into a dumpling before being placed in hot oil to cook. Deep frying in oil is called Shinshu in the local dialect.

Shirenashijimi (*Geloina coaxans*) in Komi Village dialect is Gizjagu, while in Hoshitate Village it is called Kiizo. The meat is used in soup stir fried with the new shoots of the *Asplenium antiquum*. The dishes have a wonderful aroma.

There are both large and small species of prawn living in the mangrove forests. The large prawns are blanched and peeled before eating. The small prawns are caught during the cold months of winter. The small prawns that are caught are blanched, peeled, and dried and then boiled in sweet soy sauce. There is a species of prawn that is similar to krill. That is

called Saimaa in the Hoshitate Village dialect. They are scooped up in a net and prepared by baking them with salt.

Eels and the like were caught in the pools in the mangrove forests. They are not so easily caught today.

4.2.4 Use as a Playground for Children

The children of Hoshitate Village used the fruit from the mangrove as pencils. Short, fat fruit were called fountain pens while the long, slender fruit were named ball pens. They would use them to write letters in the sand as they babysat.

In Komi Village the young girls would pick the red flowers of the *Bruguiera gymnorrhiza* and line them up. The boys would take the leaves of the *Lumnitzera racemosa* and press them and then on cold days they would hit each other's feet delighting at causing the other person discomfort.

4.2.5 Mangroves of Folksongs

The Sonai Village is famous for its the events of preparatory celebrations for a bountiful year of the seed collecting festival which was held in February of the solar calendar. At the time of the seed collecting festival, villagers are required to be calm for its keeping the prosperous growth of crops.

In Sonai Village, at the time of entertainments such as the celebration of the sexagenary cycle year of birth, there was a verse of a song called "Shinatori Kyongin." The verse went like this: "pushiginu shitaranu kiizoogama ubutuuri giranaruke bagakeeranu iinuchi shimatutumiarashoori."

The meaning of the verse is: "Kiizo under the Pushigi, go to the open sea, and until you are as big as a giant clam, we will live in harmony."

Pushigi is the general name for mangrove. Kiizo is the Shirenashijimi (*Geloina coaxans*).

Apart from this song, there is a song from Komi Village called "Yakuzjama bushi" that also has a verse with words mentioning Hirugi and crabs.

Table 2: Main Uses of the Mangrove Forests on Iriomote Island

Species	Use
<i>Bruguiera gymnorrhiza</i>	Laundry poles. Thatched roof rafter logs. Cross beams, posts for houses. Charcoal. Firewood. Dyes for fishing nets, sails, and textiles.
<i>Rhizophora stylosa</i>	Dyes for sails, fishing nets and textiles. Charcoal. Firewood.
<i>Sonneratia alba</i>	Firewood. Rafter logs.
<i>Lumnitzera racemosa</i>	Firewood. decoration in the alcove.

5 Use and Preservation of Mangrove Forests

5.1 Brief History of Iriomote Island's Forestry Industry

The total land area of Iriomote Island is 28,400ha of which 86% is covered by national forests. Because the forestry resources on Iriomote Island are comparatively abundant the island was used as a supply for lumber for the Ryukyu Kingdom during the Ryukyu Dynasty and the island timber resources were frequently felled. Particularly in the case of Miyako Island, during the Ryukyu Dynasty, useful lumber was unavailable on the island and when a new ship needed to be built, public employees and ship builders would travel to Komi Village where they would fell the lumber needed and work to build the ship (Nakama, 2002).

During the Ryukyu Dynasty, forestry land was divided into wooded mountains and countryside forests. The wooded mountains made up the majority of the forestry land and were the main source of lumber (build materials, ship building lumber etc) for the Dynasty.

The actual administration of the wooded mountains was divided into district boundaries and each village was responsible. In return for each village administering the state lumber resource in the wooded mountains, under the rules of the village community, they were able to fell and use timber other than the state lumber (Nakama, 1984).

After the Meiji Period, the forestry on Iriomote Island was designated as a national forest and its administration became the responsibility of the Japanese government. The Kumamoto Forestry Management Bureau in Kyushu assumed direct control to the forest. While on paper the forest was property of the Japanese government, the local residents who had traditionally had common use of the forest, freely entered the forests to cut firewood and timber for construction purposes.

Following the end of WWII, control of the Iriomote Island forests passed to the U.S. military and was directly managed by the Ryukyu Administration. Immediately after the war and extending into the 1950's the Iriomote Island forests were extensively used to provide timber for the rebuilding effort and a great deal of trees were felled. In the 1960's private sector companies began felling trees for pulp.

In 1972, Okinawa was returned to Japanese control and once again the forests on Iriomote Island became national forests. Today the Okinawa Forestry Management Department, a branch of the Kyushu Forestry Management Department, directly manages the forests.

Iriomote Island is home to the Iriomote cat

(*Mayailurus iriomotensis*) and the Crested Serpent Eagle (*Spilornis cheela perplexus*) both of which are designated as special national treasures. Because of this, and in the interests of environmental conservation, very little logging of the island's forests has taken place since Okinawa's return to Japanese rule (Nakama, 2002).

The residents of Iriomote Island have, under the common use custom cut wood from the mangrove forests inside the national forests since the Ryukyu Dynasty era. This has continued throughout the Ryuyku Kingdom era, during Japanese rule prior to the war, during the Ryukyu Administration period following the war and since Okinawa has been returned to the Japanese Government.

5.2 Methods of Mangrove Forest Cutting and Environmental Changes

According to interviews conducted in Komi Village, the mangrove forest areas downriver from the Maira and Shiira rivers running through the western and eastern sides of the village have vastly changed. Nowadays there are mangrove forests on the beach and coastal areas in front of the village. Prior to the return of Okinawa to Mainland Japan however, there were virtually none. Areas running adjacent to the river have also seen mangrove forests increase and the width of the river has narrowed somewhat compared to days gone by. The mangrove forests themselves have also become less dense and it is now easier for people to move through them. Today however, the mangroves are closed to the public and it is difficult to enter. These landscape changes to the mangrove forests have brought about a complete change in the lifestyle of the local residents and the relationship between local people and the mangrove forests has all but disappeared.

Listening to local people talk about the mangrove forests, we have learnt that in the past a great deal of the mangroves were felled for dyeing and lumber purposes and that is why there are a lot of spaces and exposed areas in the forests today.

However, we must ask ourselves, if there was so much felling in the mangrove forests, how have they managed to survive and recover to the state they are now in today?

There are two reasons. One reason is the traditional common use custom and the second reason is the way in which the mangroves were cut.

The common use of the forest is the traditional method in which the mountains were used since the Ryukyu Dynasty. As is mentioned earlier, the use of the forests and

fields during the Ryukyu Dynasty was under district boundaries for each village. The fundamental structure of this was managed use of the forests and fields under the regulations laid down by the community body. On paper, the mountains were the kingdom's property, but collective practical management responsibility fell to the villages.

The regulations of the village community were restrictions placed on the use of the forests and fields, for example, limits to the amount of wood that could be cut, limits as to what could be taken into the forests, and prohibition of use by anyone outside of the community. The main purpose for these restrictions of use was sustainable preservation of the forestry resources. In other words, the common use custom was one of the traditional methods of sustainable, cyclical reuse of forest resources.

The second reason was the method in which the forests were cut. This was based on the traditional common use customs for logging. When local residents gathered mangrove bark they only took bark from the large trees never from smaller less established trees. This method left smaller trees untouched until they grew to the scale that placed them in the cutting range. It was not a policy of cutting each and every tree, but rather using those that were suitable, i.e. dead trees, and old trees, and only cutting what was necessary for the use intended.

This type of cutting resembles the selection cutting system used in forestry. Using a repeating schedule of selection cutting, clean cutting, and thinning is a way to both preserve the forestry resources and produce an ideal forest. Using this system meant the seed trees in the mangrove forests were left untouched and after a few years they produced seeds that reproduced the forest. According to Iriomote Island residents the mangroves are a species that flourish and are able to regenerate even with this type of cutting system.

A similar system can be observed in the manner in which food was gathered within the mangrove forests. For example, when *Geloina coaxans* were taken, the smaller one were consciously weeded out and left for following year.

These methods did not simply happen; rather they are rooted in the traditional natural utilization consciousness of the past. Through such methods, a good balance of natural resource use and preservation can be maintained.

6 Conclusion

The mangrove forests on Iriomote Island were used by local residents as a source of

necessities for living such as dyes, construction materials, and food. They were also a source of recreation and had emotional ties to the people through folksongs. The mangrove forests and the local people had a very close relationship in all aspects of their life.

According to local residents the various relationships with the mangrove forests, and the strength of human presence on the forests has had a substantial impact on the vegetative vista. However, despite the human presence, the mangroves didn't disappear, and we must ask ourselves what explains the recovery of the vegetative vista of the mangroves today? The reason is thought to lie in the natural usage concept of traditional common use that extends back to the Ryukyu Dynasty.

The significance of this common use custom is the ability to achieve sustainable, cyclical reuse of the natural resources. This is represented by the utilization of cutting methods whereby the seed trees are left untouched in order to reproduce the mangrove forests. This way of thinking was present among the local residents prior to and following the war and is thought to be an important factor contributing to achieving and maintaining a balance between mangrove forest use and preservation.

When considering how the mangrove forests of Iriomote Island should be utilized in the future, rather than only calling for the strict preservation of the mangroves, more diverse methods of use should be considered. The traditional natural use know-how of the local residents will provide both practical and effective hints for such considerations.

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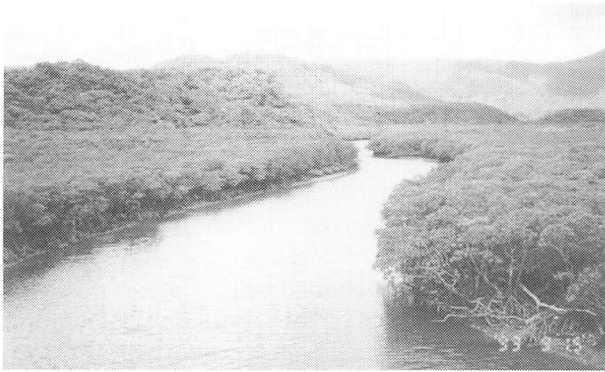


Photo 1: Mangrove forests in the Shiira river (Komi vil.)



Photo 4: Canoe eco-tourism in the Hinai river (Funaura bay)

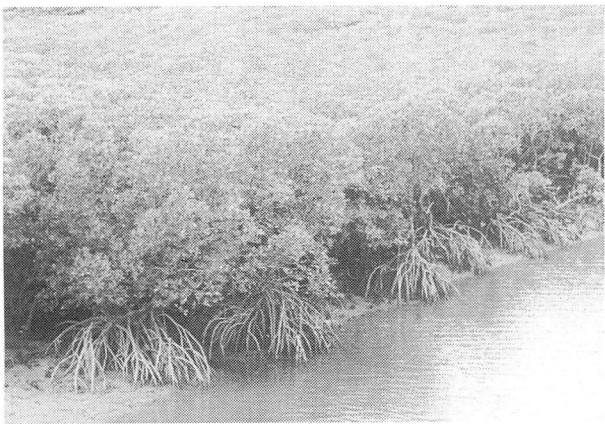


Photo 2: *Rhizophora stylosa* in the Shiira river (Komi vil.)



Photo 5: The knee-shaped air roots of the *Bruguiera gymnorrhiza*



Photo 3: Mangrove spreading out to the seashore area nearby Komi vil.



Photo 6: *Heritiera littoralis* inland the Mangrove forests (Komi vil.)

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