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A Study on Village Landscape and the Layout of Habitat-embracing Fukugi Trees in Okinawa (II)

−A Case Study of Bise Village in Motobu Town, Okinawa−

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Abstract: Bise village is a planned, traditional village, which was established in the light of Feng Shui during the Ryukyu Kingdom Period. The village landscape features reticular veins of village roads with houses encircled by Fukugi trees. We chose to survey in Bise village in order to clarify the present structure of the habitat-embracing Fukugi trees in the Feng Shui village. The village consists of squares of different size embraced by Fukugi trees. In general, there were one to four parts inside the squares whose borders were delineated by Fukugi tree lines. Four types of residence units, Types 1 to 4 were categorized to refer to the residence units of 1 to 4 parts. Types 1, 2 and 3 were the most common cases, and Type 4 was the rarest cases. DBHs of all Fukugi trees surveyed ranged from 1cm to 66.5cm. The trees were estimated to range from 2 or 3 to 266 years old. The height of Fukugi trees which were taller than 1m was very diverse. We also found a lot of seedlings and quite a few stumps in the Fukugi tree lines. Thus, it might be assumed that the diversity of the sizes of Fukugi trees resulted from thinning of some mature trees and from some seedlings being kept during the hundreds of years since the village was established. From the size of the Fukugi trees, we could assume that the village was first settled in the center and then was extended to the coastal area with the increase of the population.

Key words: Feng Shui village, Fukugi (*Garcinia Subelliptica)* habitat-embracing trees, village landscape, Bise village in Okinawa

I. Introduction

The traditional village landscape of Fukugi habitat embracing trees in the Okinawa islands shapes the pleasant living environment in the subtropical monsoon regions which features the frequent occurrence of typhoons. The planned village landscape was first established in the Ryukyu Kingdom in the light of Feng Shui concept which originated in ancient China and influenced many aspects of the society, such as city planning, grave building, even afforestation etc. The roads in a planned village are laid out in a grid pattern. Houses are scattered in well-ordered blocks that were separated by intersecting roads. Circled with habitat-embracing Fukugi trees on the property, houses in Bise village are mostly south facing, and usually have open places in the front, which forms an ideal Feng Shui village structure. The Feng Shui village landscape embodies the harmony of nature and man. The Ryukyu Islands are constituted of lots of small islands, where the natural climate is somewhat inclement with frequent typhoon occurrence. The flat topography provides little protection from the strong northerly wind in winter. It is obvious that the widely planted Fukugi trees play a vital role in shaping habitable shelter in Okinawa. However, a lot of the habitat-embracing trees were lost during World War II or were cut recently with the change of life style. Some people have built concrete houses so habitat embracing trees were considered useless (Nakama et al., 2002). Thus, it is necessary to reevaluate the role of Fukugi trees in the village landscape and in people's life.

A lot of recent studies on the traditional village in the Okinawa islands are from the perspective of architecture. Some (Sakamoto 1989; Furuya 2006) reported on the layout and compass direction of the houses. Nakama and Koki (2002) studied the inhabitants' consciousness of habitat-embracing Fukugi trees in Bise village. However, the layout of village houses and the actual structure of the Fukugi trees enclosing the houses are little studied. We surveyed the habitat-embracing trees on Tonaki Island and summarized some features of the Fukugi layout in our last paper (Chen et al. 2005). Bise village in the northern part of Okinawa Island is the most typical case of the habitat-embracing trees. About 70% of the houses in Bise village were circled by Fukugi trees (Sakamoto 1989), compared to 80% of the houses being circled by Fukugi trees in 1970. We chose to survey the habitat-embracing Fukugi trees in Bise village to clarify the present structure (distribution, size, density, etc.) of the trees in the traditional planned Feng Shui village.

II. Study area and methods

Bise village (See Fig. 1and 2) is located in the northern part of Okinawa Island at lat. 26'42" North and long. 127'53" East. Bise village (See Photos 1 and 2) is an arc-like protruding part of Motobu peninsula, facing the ocean in the west. Bise village has a long coastline extending from southwest to northwest. The population of the village was 572 (October 2006). Among them, 180 were over 65 years old, accounting for about 1/3 of the total population. Major industries were agriculture and fishery.

Bise village was built in blocks divided by a grid of roads. The roads are running north-south and east-west.

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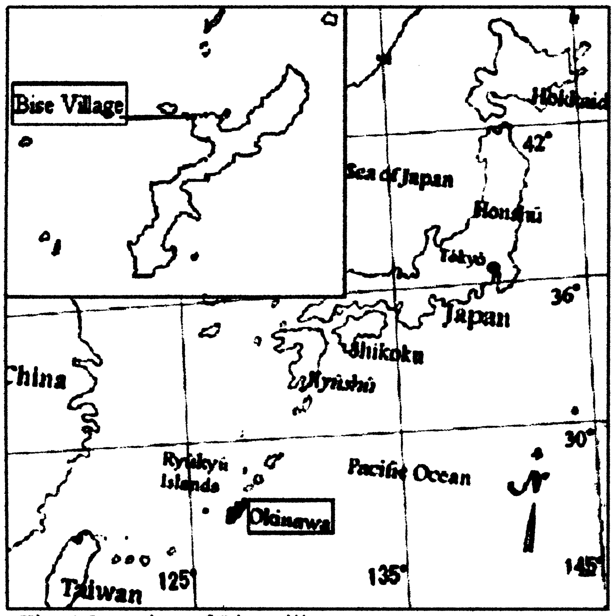

Fig. 1 Location of Bise village


Photo1: An aerial photo of Bise Village
Source: Google earth


Photo 2: An overview picture of Bise village

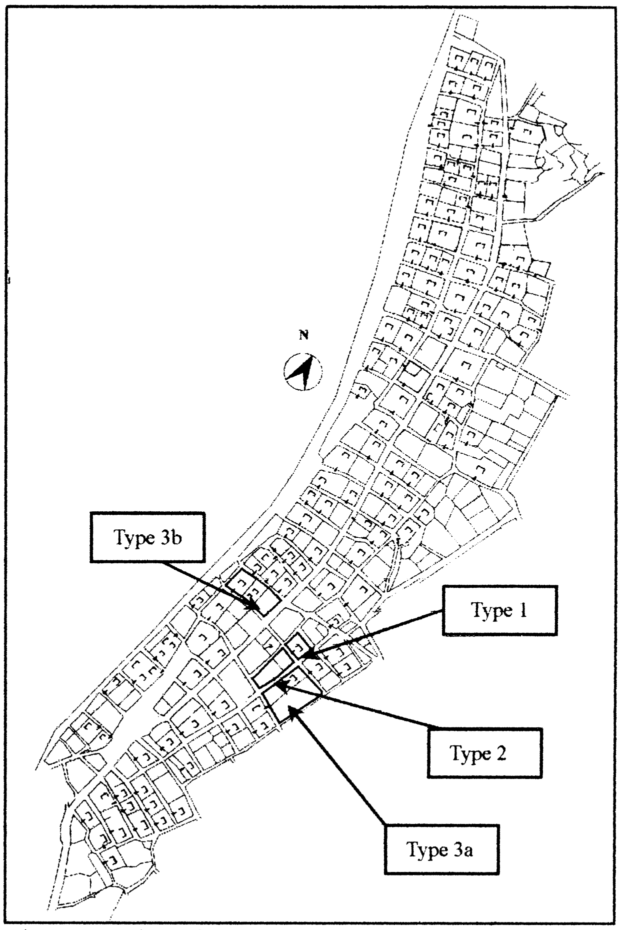

Fig. 2 Location of survey sites
Source: *Village landscape in Okinawa* (Sakamoto)

The roads intersect approximately at right angles. Houses are scattered in the blocks. Circled by Fukugi habitat-embracing trees on the property (see Photos 3 and 4), houses in Bise village are mostly south facing, and usually have an open place in the south. It is recorded that first the sandy soil was excavated to build a house. The excavated sand was piled surrounding the property and then stones were also laid to hold the sand. Then Fukugi trees began to be planted. It was said that the sand fence enclosed by the stones was very helpful to the growth of Fukugi trees. Thus, a view of a traditional house about 50cm lower than the roads came into being in the Okinawa Islands. The traditional village landscape embodies the harmony of nature and man.

However, a lot of the habitat-embracing trees were lost during World War II. Recently the inhabitants cut the trees with the change of life style. Some people have built concrete houses and habitat-embracing trees are now considered useless. A large number of young people left their homes in the Okinawa Islands to work in the big cities since the return of Okinawa to Japan in 1972. The difficulty of woodland maintenance is another major reason for these aged to cut trees.

Concerning the layout of village houses, we found that one to four adjacent houses form a block inside interlacing village roads. We classified house layout into four types according to the number of parts separated by Fukugi tree lines in a block. In order to clarify the actual stand structure of the habitat-embracing trees, first every stand tree taller than 1m was numbered, and then height and diameter at breast height (DBH) were measured and recorded. We also recorded the location of every tree in the woodland. We reproduced the actual layout of the trees with HO CAD software in the figures. On the basis of their DBH, the size of every tree was drawn in circles of different size.

III. Results and discussion

3.1 The general layout

A grid of roads and the habitat-embracing trees are the most distinct features in Bise village. It is assumed that such a grid planned village did not appear until 1737 (Nakamatsu, 1977). Some other researchers also argued that such a grid village might have existed before 1737. We accepted Nakamatsu's assumption in this paper.

The breadths of habitat woodlands were different. We found most habitat woodlands inside the village are in a well ordered line. In contrast, Fukugi woodlands near the coastline are usually laid out in two or more lines. It may be because the houses near the coast suffer from much stronger seasonal winds than those inside the village.

Photo 3: A well ordered tree line inside the village

Photo 4: The view of Fukugi habitat-embracing trees from the entrance to a house

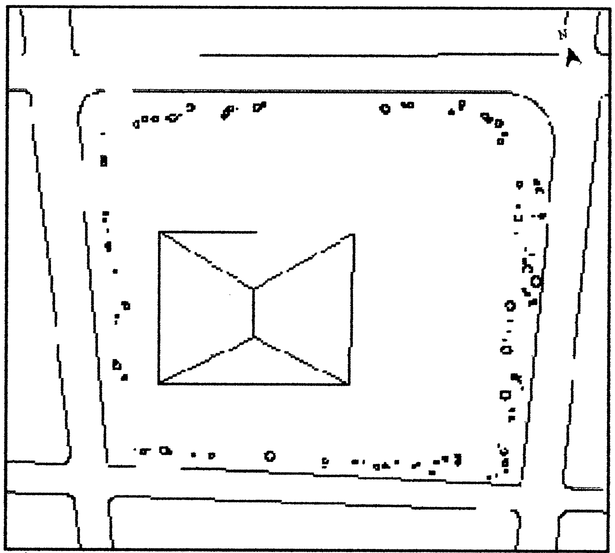

Fig. 3 Tree distribution in Type 1

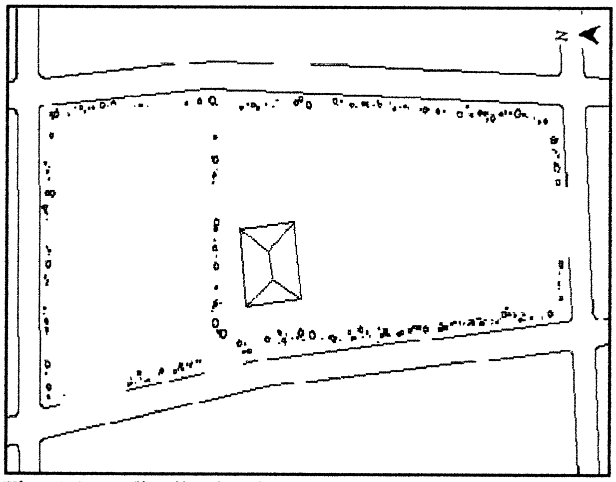

Fig. 4 Tree distribution in Type 2

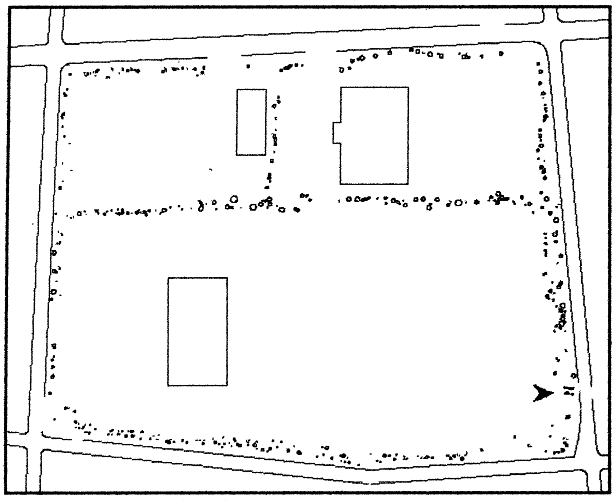

Fig. 5 Tree distribution in Type 3a

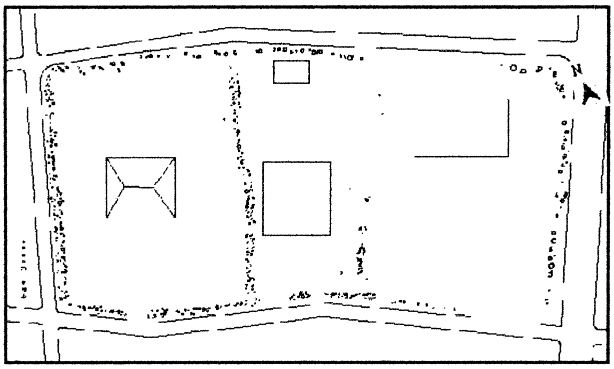

Fig. 6 Tree distribution in Type 3b

In order to clarify the actual layout of Fukugi trees,we considered the houses inside a block, which is surrounded by roads as a residence unit. Most residence units were shaped like a square or a trapezium. We must point out that all blocks in the so-called Go Board Pattern roads differ very much in size. In general, there were one to four parts inside a residence unit. Four types of residence units were categorized according to the number of parts inside a residence unit. Type 1 (see Fig. 3) refers to a residence unit which had only one part. Types 2 (see Fig. 4), 3 (see Figs. 5 and 6), and 4 refer to the residence units which had two, three, and four parts, respectively. The number of the parts was only counted for those that were separated by currently existing Fukugi tree lines.

It was said that sometimes a branch family was established nearby when a son was married, but no trees were built as a separating line (see type 2, in which the part in the south is much bigger than that in the north). We found that Types 1, 2 and 3 were the most common cases in Bise village. For example, we counted Type 3a as three parts that were separated by the existing tree lines, no matter how many branch parts there were before. In contrast, Type 4 was relatively rare. We chose to survey Types 1, 2 and 3. We neglected Type 4 since Type 4 was very rare.

3.2 Analysis by type

The general features of all four residence units surveyed are shown as Tables 1 and 2. We surveyed all 1,763 stand trees in four residence units. We know from table

Table 1 Descriptive Data by Types

	Total Amount	Height (cm)		DBH (cm)		Estimated Age of the Tree (year)	
		Mean	Maximum	Mean	Maximum	Mean	Maximum
Type 1	137	626.7	1470	16.5	53.1	66	212
Type 2	300	560.8	1830	14.7	55.5	59	222
Type 3a	547	587	1760	14	66.5	56	266
Type 3b	779	432.9	1280	8.9	60.3	36	241
Total	1763	517.5	1730	12	66.5	48	266

Table 2 Density of Embracing Trees

	Area (m^2)①	Perimeter (m)②	Tree Number ③	Density ④	Number of Sprouts	Number of Seedlings	Number of Stumps	Number of Sprouts from Stumps
Type 1	518.8	87	137	1.6	195	17	1	6
Type 2	855.3	127.5	263	2.1	345	88	18	123
Type 3a	2094.6	177.2	392	2.2	260	169	25	163
Type 3b	1465.9	154.7	551	3.6	415	213	34	74
Total	-	546.4	1343	2.5	-	-	-	-

Note: ①is the area of each residence unit surveyed. ②is the perimeter of each residence unit.
③refers to the number of trees taller than 1m. ④= Tree number③÷the perimeter(m)②

1 that the total number of Fukugi trees differs a lot because the size of the residence units differs. Among all residence units we surveyed, Type 1 had the smallest area of 518.8m². And Type 3a had the largest area of 2094.6 m². Types 1, 2, 3a. and 3b had the total tree numbers of 137, 300, 457, and 779, respectively.

Table 1 also shows the size of trees in every surveyed residence unit. Mean heights for Types 1, 2, 3a, and 3b were 626.7cm, 560.8cm, 587cm and 432.9cm, respectively. The maximum height for all four survey units were 1470cm, 1830cm, 1760cm, and 1280cm, respectively. The mean DBHs were 16.5cm, 14.7cm, 14cm, and 8.9cm respectively. The maximum DBHs were 53.1cm, 55.5cm, 66.5cm, and 60.3cm respectively. We know from table 1 that the size of trees in Types 1, 2 and 3a were not very different. But the trees in Type 3b were relatively younger. Types 1, 2, and 3a are located in the center of the village, where the village was first established. But the eastern part of Type 3b is close to the coast, which is newly developed. In a word, the trees were of different size not only among the woodlands in the same residence unit, but also among the different residence units.

We can also infer the origin of the village through the sizes of Fukugi trees. The area with the oldest existing Fukugi trees in the centre could be assumed as the origin of the village. With the increase of the population, the village extended to the area nearby the coastline. Our survey results on the height and DBH of the Fukugi trees could prove the above-mentioned assertion.

3.3 Density and Regeneration

The tree number in every meter of the Fukugi tree line was calculated and shown as the density of trees in table 2. There were about 1.6, 2.1 2.2, and 3.6 trees in every meter of the woodlands in Types 1, 2, 3a and 3b, respectively. The mean density for all four surveyed residence units was about 2.5. We find that the density in Type 3b is about 1.5 times the average value. This is because the eastern side of Type 3b is nearby the coast, the trees were relatively young, and the tree lines are thick.

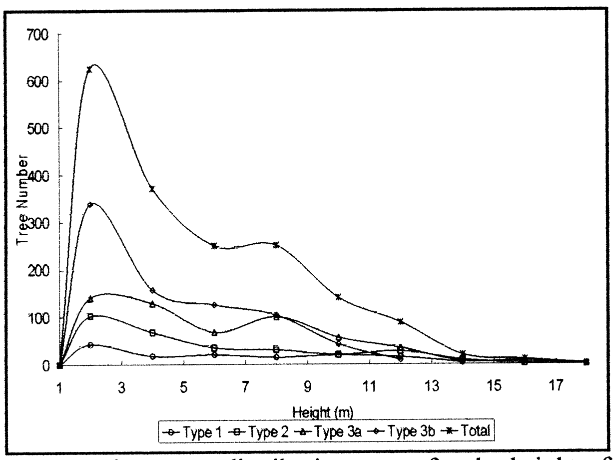

Fig. 7 A frequency distribution curve for the height of habitat-embracing trees

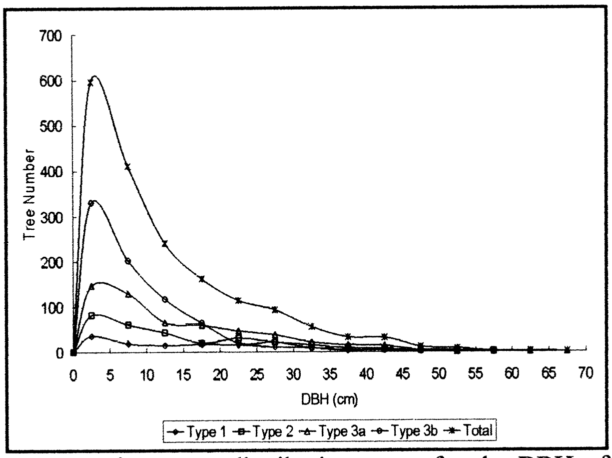

Fig. 8 A frequency distribution curve for the DBH of habitat-embracing trees

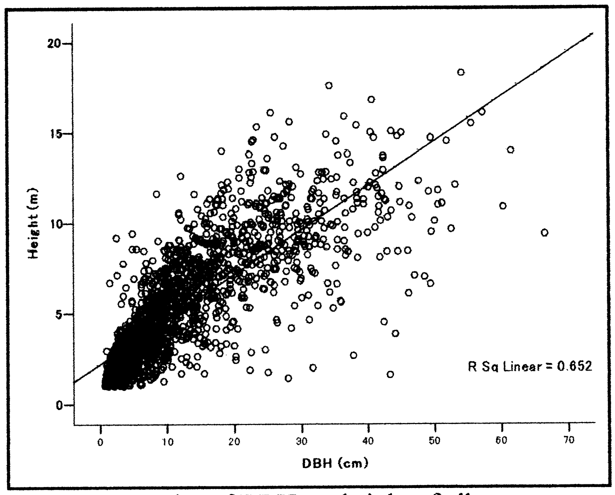

Fig. 9 Scatter plot of DBH vs. height of all survey trees taller than 1m overlaid by the fitted line

Figs. 7 and 8 show the distribution of height and DBH of habitat-embracing trees. The frequency distribution tendency of height is not very different from that of DBH. The majority of habitat Fukugi trees were under 9m in height, and 15cm in DBH. In Fig. 7, we can see a peak in the height distribution curve of 1-3m. In Fig. 8, there is a peak of the DBH distribution curve of 0-5cm. In a word, there are a large number of lower storey trees inside the habitat woods; although the habitat-embracing Fukugi trees have the appearance of being 9m in height since an overwhelming majority was less than 9m.

We find that the height and DBH distribution curves of Fukugi trees are smoother in Type 1, which means that the trees are almost equally distributed. It maybe because Type 1 is located in the center of the village and other neighboring Fukugi trees also provide Type 1 house with a good protection from typhoons and winter winds. Good maintenance of the woodlands attributes to the few lower storey trees.

In contrast, habitat-embracing trees in Types 3a and 3b both have a frequency distribution peak in 1-3m of height and 0-5cm in DBH. The frequency peak suggests a dense distribution of lower storey trees both in Type 3a and 3b. The locations of these two houses might be a good explanation for such a distribution peak. As is shown in Fig. 2, the northeast side of Type 3a is in the borderline of the village and is exposed to the strong chilly winter. Our field survey also found very thick Fuguki woods, in particular in the northeast side. As is mentioned above, the east side of Type 3b is facing the ocean, a thick woods of several lines seems necessary to protect the houses from strong typhoons.

As is shown in Figs. 7 and 8, distribution curves for Type 2 are not as smooth as for Type 1. But it is obvious that the share of lower storey trees lower than 3m and smaller than 5cm of DBH is not as large as that of Types 3a and 3b. It may be because Type 2 is also in the center of the village and under the protection of neighboring woods. But being abandoned by the owners and lacking of routine maintenance may account for the large number of lower storey trees. But the maintenance from time to time by visiting owners keeps Type 2 in better condition than Types 3a and 3b.

Fig. 9 shows the correlation between height and DBH for trees taller than 1m (R=0.652). From Fig. 9, we can see a very large number of lower storey trees in all surveyed woodlands. The correlation is not so strong, maybe because of the thinning of Fukugi trees in history.

The numbers of sprouts and seedlings (See table 2) were also counted to analyze tree regeneration. Sprouts refer to those from the rootstock of trees taller than 1m and from stumps (see photo 5). Sprouts from the rootstock and the stumps were counted, respectively. Small trees less than 1m were counted as seedlings (see photo 6).

We found a lot of seedlings in the Fukugi woodlands in Types 2, 3a and 3b. There were only 17 seedlings in Type 1; but there were 88, 169, 213 seedlings in Types 2, 3a, and 3b, respectively. A family still lives in Type 1, and the housewife cleans the grounds almost every day. The frequent cleaning might explain the reason for few seedlings. In most parts of Types 2, 3a and 3b, the grounds were seldom cleaned due to the following reasons: the houses did not exist; the houses were abandoned; the houses were leased or visited only a few days in a year. Quite a few stumps were also found. The number of stumps we found in Types 1, 2, 3a and 3b were 1, 18, 25 and 34, respectively. The sprouts from the stumps for the four surveyed residence units were 6, 123, 163 and 74, respectively. It might be because the stumps in Types 2, and 3a were generally bigger. It could be assumed that the mature trees were cut in the woodlands of Types 2 and 3a. In contrast, the stumps in Type 3b were small. It could be assumed that selective cutting was done when the woods were young. People practiced thinning and cut some mature trees and some seedlings were kept to grow up.

Photo 5: Sprouts from a stump

Photo 6: Seedlings in the woodland

3.4 The reasons for having selected Fukugi trees

The Ryukyu Islands belong to a subtropical climate, and are endowed with a large number of tree species. But why have people chosen Fukugi trees to plant around their houses in the Ryukyu Islands? The historical record of formation of such a Fukugi village landscape is unclear.

Thus, we can only assume that the natural features may be the reason for their use as habitat-embracing woods. The scientific name for Fukugi is *Garcinia Subelleptica*. Its trunk is straight with dense thick leaves, which is why it is well known to be wind resistant and fire resistant. The trunk has been used to build the traditional timber houses. A high-quality yellow dye can be extracted from its bark. The thick lubricous leaves were used as toilet paper. The fallen leaves were used as important fuel to the island people. The various uses of Fukugi trees can be explained as the reason for their standing around the habitat.

When the fruits of Fukugi trees become ripen during July to September, thousands of bats come to the woodlands and feed on the ripe fruits. A Fukugi tree is suitable to the sandy soil in the coastal area, thus, Fukugi woodland becomes a habitat of biodiversity.

3.5 Estimated Age of Trees

It is obvious that the ages of Fukugi trees relate strongly to the history of the village. The annual rings of a Fukugi tree are very hard to count. But the oral and literature records lack precision. Here we used the formula [Age of a tree (year) = DBH (cm) ÷ 2 × 8] by Hirata (2006) to estimate the age of surveyed trees. According to the formula by Hirata, the mean ages of Types 1, 2, 3a, and 3b were estimated to be 66, 59, 56, and 36, respectively; the maximum ages were 212, 222, 266, and 241 respectively. The estimated ages of the Fukugi trees also prove that the trees were not of the same size as assumed, but of different tree age. Such a structure of different sizes of trees has formed as a result of continuous use and regeneration in the history.

IV. Conclusion

Well ordered intersecting roads and Fukugi habitat-embracing trees are the most distinct features in Bise village. Circled with *Garcinia subelliptica* habitat-embracing trees on the property, houses in Bise village are mostly south facing, which forms an ideal Feng Shui village structure.

We found most habitat woodlands inside the village are in well ordered lines. In contrast, *Garcinia subelliptica* woodlands near the coastline are usually laid out in two or more lines. It may be because the houses near the coast suffered from much stronger seasonal winds than those inside the village.

Four types of residence units were categorized according to the numbers of the parts inside a residence unit. We found that Type 2 and Type 3 were the most common cases in Bise village. In contrast, Type 4 was relatively rare.

We know that the total numbers of *Garcinia subelliptica* trees range from 137 to 779 because the size of the residence units differs. There were about 1.6, 2.1 2.2, and 3.6 trees in every meter of the woodlands in Types 1, 2, 3a and 3b, respectively. The mean density for all four surveyed residence units was about 2.5.

DBH of all surveyed trees ranged from 1cm to 66.5cm with a mean value of 12cm. The mean DBHs in Types 1, 2, 3a and 3b were 16.5cm, 14.7cm, 14cm, and 8.9cm, respectively. The maximum DBHs were 53.1cm, 55.5cm, 66.5cm, and 60.3cm, respectively. DBH of the oldest tree surveyed was 66.5cm, which was estimated to be 266 years old. The mean ages of Types 1, 2, 3a, and 3b were estimated to be 66, 59, 56, and 36, respectively. The height of Fukugi trees which were taller than 1m varied greatly. We also found a lot of seedlings that were less than 1m and quite a few stumps in the Fukugi tree lines.

Thus, it might be assumed that people practiced thinning and cut some mature trees, and some seedlings were kept to grow up. The area with the oldest existing Fukugi trees in the centre could be assumed as the origin of the village. With the increase of the population, the village extended to the area nearby the coastline.

Concerning the maintenance, the Association of Youth in the village was in charge of regular pruning before World War II. It was customary for the pupils to clean the roads before school. At present, a local group of women cleans in the village twice a year. Cleaning inside a habitat is the responsibility of the owner. In a word, habitat-embracing Fukugi trees have been under collective maintenance. However, such a collective maintenance system collapsed with the advent of an ageing society and the increase of abandoned houses. Thus, further discussion on the proper maintenance of habitat-embracing Fukugi trees in the traditional village is an issue for future research.

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