

# Satoyama – A place for preservation of biodiversity and environmental education

T. Miyaura

## Satoyama – Ein Ort für die Erhaltung der Biodiversität und für die Umwelterziehung

### 1 Satoyama landscape

“Satoyama” is a Japanese word (BROWN and YOKOHARI, 2003). “Sato” means village, and “yama” literally means “mountain”, however in combination with “sato” it has the meaning of “forest (utilized by humans)”. Thus, even if such a forest is situated on a flat land in this context we call it “yama”, a “forest near a village”.

Satoyama is a place where human beings have long coexisted with nature. Before the wide availability of fossile fuels, people in many countries obtained a variety of resources like firewood, brush wood, fallen leaves, nuts, and game from forests around their villages. During the long history of mankind, local cultures with ways of life that allowed coexistence with nature developed around the world. This may be an overstatement, and perhaps an oversimpli-

fication. Regardless, a place where people and nature have coexisted for long periods of time can be termed a satoyama. In other words, a satoyama is a place of sustainable ecosystem management, and many countries have a history of satoyama. Of course, natural environments differ from place to place, and forest types will also differ. These differences affect life styles and cultures of human populations inhabiting diverse regions, including the ways in which natural environments are utilized. The form of satoyama in each region of the planet reflects the diversities of nature and culture as well as regional human history.

Figure 1 shows the Tanakami village landscape near Ryukoku University’s Seta Campus (Japan). Seta Campus is located to the south of Lake Biwa, the largest lake in Japan. There are many records showing that people have lived in this village over millenia. Stone implements about 10,000

### Zusammenfassung

Satoyama ist ein japanischer Ausdruck für einen Ort an dem Menschen über einen sehr langen Zeitraum im Einklang mit der Natur gelebt haben. Es ist ein komplexes Ökosystem, dass aus Wäldern, Feldern, Grünland und anderen landwirtschaftlichen Bereichen besteht. Die Satoyama Umwelt umfasst beides, natürliche und kulturelle Vielfalt einer Region sowie die gegenseitige Beeinflussung der beiden über lange Zeiträume. Es kristallisiert sich auch immer mehr heraus, dass die Satoyama Landschaft eine bedeutende Rolle in der Erhaltung der Biodiversität einnimmt. In diesem Beitrag präsentiere ich einen kurzen Abriss der Geschichte von Satoyama in Japan, eine Beurteilung des gegenwärtigen Status, sowie einen Ausblick auf unsere wissenschaftliche Forschung in einem Satoyama-Wald der Ryukoku Universität.

**Schlagerworte:** Satoyama, Biodiversität, Umweltbildung, Lehr- und Versuchsforst.

### Summary

Satoyama is a Japanese word and an expression for a place where human beings have long coexisted with nature. It is a complex ecosystem comprising forests, crop fields, grasslands and other agricultural components. The satoyama environment encompasses both natural and cultural diversity of a region and the history of the interaction between the two. It is also becoming clear that the satoyama landscape maintains a significant biodiversity. Here, I present a brief history of satoyama in Japan, a review of its present status, and an outline of our research in a Ryukoku University satoyama forest.

**Key words:** Aatoyama, biodiversity, environmental education, University Forest.



Figure 1:  
Tanakami village  
Abbildung 1:  
Das Dorf Tanakami

years old have been discovered in this area. This is a typical satoyama landscape in the western parts of Japan. There are mountains, with dense human settlements in the foothills. Most of the flat land is used as paddy fields.

In earlier times without fossil fuels, peoples' lives were heavily dependent on satoyama. For example, they used firewood from the back hills for cooking or heating. After wood burning, ashes were utilized as fertilizer for agriculture. Fallen leaves in the forests were gathered and used in paddy fields as compost. Almost all matter and energy obtained from satoyama forests was finally incorporated into crop production (Figure 2).

Even within Japan, satoyama landscapes vary by region. Figure 3 shows farming land pioneered in 1694 in the Kanto region, eastern Japan. It is a 72 m by 675 m tract of land (ca. 5 ha). This satoyama comprises forest, crop fields

and houses. From the forest, firewood, brush wood and fallen leaves were collected, and used as fuels or fertilizers. The areas of crop fields and forest were similar. There was an empirical understanding that a productive harvest in crop fields required a similar area of forest.

Figure 4 shows a kunugi (*Quercus acutissima*) forest where coppicing for firewood and charcoal production has been conducted for about 300 years. The practice of coppicing has created an open canopy, allowing solar radiation to reach the forest floor, with a concomitantly high floral and faunal diversity.

Katakuri (fawn lily, *Erythronium japonicum*) may grow on the floor of coppiced kunugi forest. Katakuri is a spring ephemeral that needs open canopy conditions, especially in March and April, which are the only months when above-ground shoots sprout from belowground parts that stores

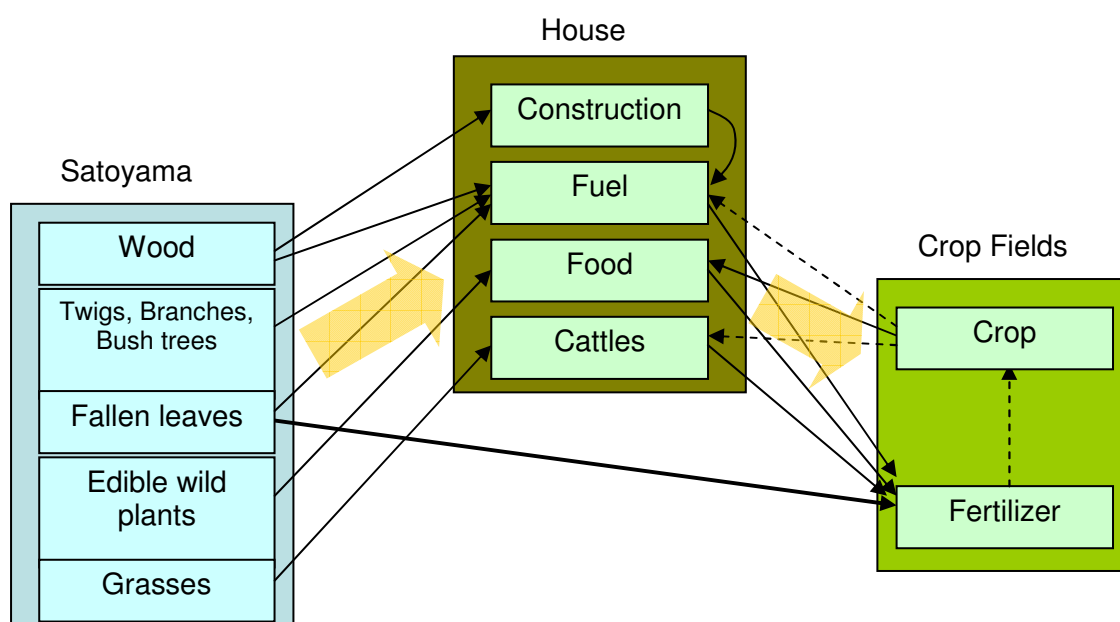


Figure 2. Schematic diagram showing flows of matter and energy in a satoyama landscape  
Abbildung 2: Schematische Darstellung der Stoff- und Energieflüsse in einer Satoyama Landschaft

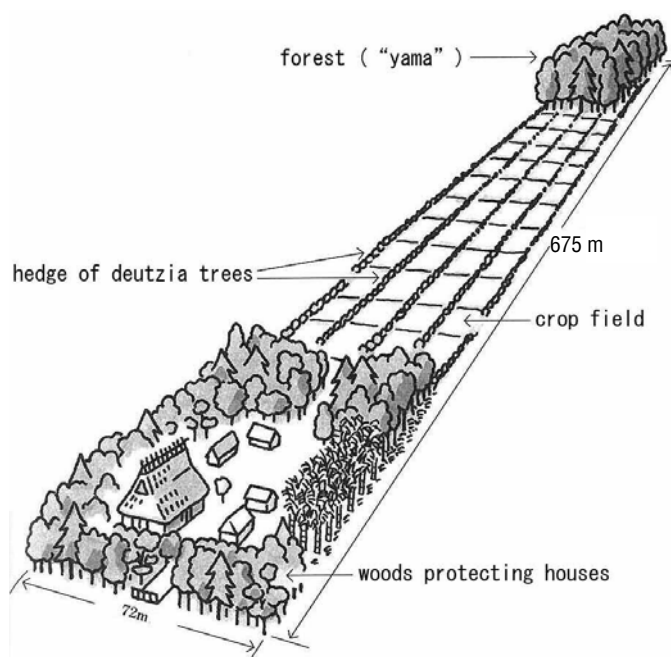


Figure 3: Santome-Shinden, agricultural fields, pioneered in Kanto area in 1694 (after INUI, 2002)

Abbildung 3: Santome-Shinden, landwirtschaftliche Felder, wie sie erstmals 1694 im Kanto-Gebiet angelegt wurden (nach INUI, 2002)

starch. The beautiful flowers of katakuri provided aesthetic enjoyment, and until recent decades the starchy roots were an important food in Japan. In many abandoned satoyamas, brush grew thickly, and suppressed the katakuri lilies.

It is gradually becoming clear that a substantial biodiversity has been maintained in satoyama landscapes.

Satoyama landscapes comprise forests, paddy fields, ponds, streams, roads, houses, etc. Some species in the satoyama landscape use two or more ecosystem components during their life cycles. Figure 5 shows the life cycle of water stick insects (*Ranatra chinensis*; “Mizukamakiri” in Japanese). It is an aquatic insect whose forelegs resemble those of the mantis.

This insect lays eggs in paddy fields in spring when water is introduced for the cultivation of rice. Hatched juveniles grow in the paddy field, which is made nutrient rich through application of compost. Adults migrate from paddy field to ponds in summer when the water level of the paddy field is lowered to control growth of rice. Adult animals overwinter in ponds, and migrate to paddy fields again in the following spring. The paddy field is an artificial and temporary wetland, and the water stick insect has adapted its life cycle to the water management system.



Figure 4: Coppice forest of kunugi (*Quercus acutissima*)

Abbildung 4: Ausschlagwald mit Kunugi (*Quercus acutissima*)

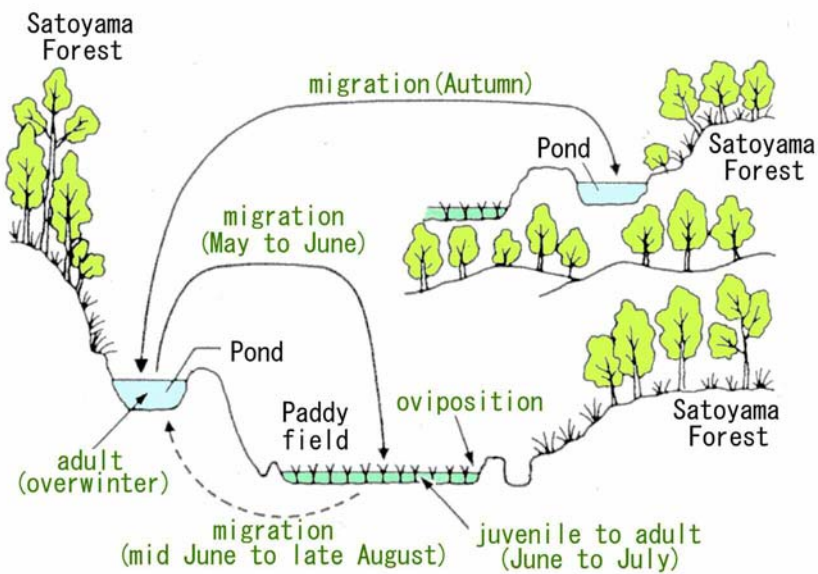


Figure 5: Life cycle of water stick insect "Mizukamakiri" (*Ranatra chinensis*) in a satoyama landscape (after HIBI and YAMAMOTO, 1997)

Abbildung 5: Lebenszyklus des Insekts „Mizukamakiri“ (*Ranatra chinensis*) in einer Satoyama Landschaft (nach HIBI und YAMAMOTO, 1997)

## 2 Present status of satoyama in Japan

The Japanese forest ecologist Tsunahide Shidei initiated active use of the term satoyama (SHIDEI, 1974). He emphasized the importance of the close relationship between satoyama and agriculture. He said that satoyama is a forest for agriculture. Thus, a satoyama is located near farming villages and the products from satoyama are eventually used for fertilizers etc. In the past, satoyamas played very important roles in Japanese agriculture. People collected twigs and shoots with young leaves, and plowed them into paddy fields as compost. Most of the people in a community shared the use of satoyama as common land. For long term equitable use of satoyama, there were many community agreements and rules, regulating, for example, the start day for gathering fallen leaves and the sizes of basket to carry leaves.

These agreements and rules made a great contribution to the formation of a culture in the local community. Satoyama was a significant core element of the community. Within the concepts presented here, there are no such satoyama forests in modern Japan. Even when forests are close to paddy fields, they are no longer used for agriculture. Following the introduction of chemical fertilizers, the satoyama lost its value as a fertilizer supply source. As new energies like oils, propane gas, as well as electricity were getting to be popularized, satoyamas' role as a fuel source became insignificant. These forests now have less use as common community land. As a result, the value of the satoyama in the community has declined remarkably. Satoyama agreements and rules of use and their cultural significance be-

came meaningless in the community. Satoyamas were left untended. People no longer collect firewood. This leads to a dense growth of brush and a darkening of the forest. Only shade tolerant tree species can germinate and survive on the dark forest floor.

Oak and red pine trees used to grow in satoyama forests in Japan. Red pine (*Pinus densiflora*) trees appear in the earlier stages of forest succession. Pines have vigorous growth, even on sterile soil. Traditional satoyama management practices (collecting leaves and firewood) impoverished soil nutrients, creating a favorable environment for red pine (because there were few competing species under such conditions). Utilization of satoyama arrests forest succession in an early stage. However, in an abandoned satoyama, fallen leaves accumulate, and nutrients in the soil increase. Succession proceeds to the next stage, and the forest floor becomes darker, preventing germination of pine trees. The vigor of the remaining pine trees declines because of overcrowding and competitive pressure from other tree species. Finally, the pines succumb to the pine wood nematode (*Bursaphelenchus xylophilus*), which causes mass mortalities.

Matsutake (*Tricholoma matsutake*) is the favorite mushroom of Japanese people. These fungi have a symbiotic relationship with roots of pine trees. The loss of pines leads to the loss of the delectable mushrooms.

In abandoned satoyamas, bamboos (*Phyllostachys pubescens*, *P. nigra* var. *henonis* and *P. bambusoides*) flourish. Originally, bamboos were planted near farmers' houses, and shoots were harvested every year. Nowadays, there are massive imports of cheaper bamboo shoots from China and

other countries. As a result, bamboo shoots are no longer harvested in Japan. Unchecked bamboo stands are now vigorously expanding in satoyama lands. Bamboo causes serious damage to biodiversity in the satoyama landscape, because a bamboo forest propagates clonally from underground parts. The perennial root system stores nutrients that are used for the production of new shoots, even under dark forest conditions. As bamboo stands expand, other tree species are driven out, and biodiversity of the satoyama declines.

In modern Japan major crop damages are caused by forest animals such as wild boar (*Sus scrofa*), bear (*Ursus thibetanus*), monkey (*Macaca fuscata*), deer (*Cervus Nippon*), and raccoon dog (*Nyctereutes procyonoides*). In some cases, people are injured or killed by bears, boars or monkeys. It is becoming clear that a part of the problem is related to changing conditions in former satoyama lands. The reduced visibility in abandoned satoyamas provides safe cover

for wild animals, and from this cover, they have easy access to crops and human settlements.

### 3 “Ryukoku Forest” – a university-owned satoyama

Former satoyama areas are losing ground to golf courses, residential housing, shopping centers, and factories. Some satoyama forests have been converted into plantations of cedars and cypresses. Traditional satoyama forests have no economic value in the modern world, because there is no requirement for the firewood and fallen leaves they provide.

Figure 6 shows an aerial view of Seta hill, south of Lake Biwa. Seta hill was once covered by a large area of forest formerly used as satoyama. Human population growth in this area is now the highest in Japan, because the location provides easy access to Kyoto and Osaka.



Figure 6:  
An aerial photograph of  
Seta hill, south of Lake  
Biwa, Japan in 2000  
Abbildung 6:  
Luftbild aus dem Jahr  
2000 von Seta hill, süd-  
lich des Lake Biwa, Japan

The Seta campus of Ryukoku University is located on the central of Seta hill. Ryukoku University owns the encircled forest in Figure 6, which is known as “Ryukoku Forest”. The area is about 38 ha, which is not large but, nevertheless, very important for maintaining local biodiversity.

Important plant species such as *Cephalanthera falcata* and *Lilium japonicum* are found in Ryukoku Forest. These two species are typical of satoyama forests, but are rarely encountered nowadays. *Cephalanthera falcata* is now categorized as a Threatened Species in the Japanese RED data book. Indeed, there are only few individuals in the Ryukoku Forest.

Ryukoku Forest has a rich mycoflora. Many interesting mushrooms, including new species have been found in the woods.

Ryukoku University intended to clear Ryukoku Forest for new playing fields and other facilities when it bought the land in 1994. However, in the environmental survey prior to construction, a goshawk (*Accipiter gentilis*, “otaka” in Japanese) now listed as “near threatened” in the Japanese RED data book was found nesting on the property and hunting in nearby crop fields. Small heron, doves, and many small mammals are hunted by otaka, and all of them inhabit satoyama landscape including that of Ryukoku Forest. The presence of otaka is indicative of the rich biodiversity maintained within the satoyama landscape. Ryukoku University changed its plans and decided to use the forest for environmental education and research on satoyama biodiversity.

We started the Satoyama Open Research Center (Satoyama ORC) in 2004, planning to make an integrated study of the satoyama landscape. Satoyama ORC is a Research project supported by Ryukoku University, and it also receives a grant from the Japanese Ministry of Education. Ecologist, sociologists, and many scientists from various disciplines are engaged in this research project; they examine mechanisms in the maintenance of biodiversity, the history of the interaction between community life and the satoyama ecosystem, and the importance of satoyama in modern society. Based on these studies, we aim to use satoyama as a model system to develop an integrated program for preserving biodiversity and conducting environmental education in the field. This plan involves partnerships among local residents, local governments and researchers.

Ryukoku Forest now has no value as an agricultural forest, but it is of great significance for education, for the maintenance of biodiversity in this region, and also as a place where local people can enjoy nature.

We began conservation activities in Ryukoku Forest recently, with researchers of Satoyama ORC leading the project. Many lay citizens participate, along with students of Ryukoku University. Pupils of elementary and junior high schools are also involved in taking care of the satoyama.

Ryukoku Forest is now gradually changing. Beautiful flowers of rhododendrons and many other plants can be seen in the well-lit woods that were formerly darkened by thick brush.

There are many problems for satoyama conservation in Japan. Most of them arise from abandonment. If satoyama land is used actively by the people, most of the problems are likely be solved. However the old way of using satoyamas is not applicable in modern society, and it is very important and necessary for us to find new ways to use this land effectively. The interest in satoyama conservation is increasing in several parts of the world, not only in Japan. I think we can learn much about ways of sustainable ecological management from the old satoyama system.

## Acknowledgement

The present paper is based on the presentation to the International Conference, Preservation of Biocultural Diversity – a Global Issue, held at the University of Natural Resources and Applied Life Sciences, Vienna in May 2008. I am very grateful to Prof. Wolfgang Holzner, Ms. Pia Kieninger, Mr. Bernhard Splechtana, and Ms. Monika Kriechbaum for giving me an opportunity to talk about the satoyama concept at the conference. I also thank the anonymous reviewers for their helpful suggestions and comments.

## References

- BROWN, R. D. and M. YOKOHARI (2003): Ideological Contribution of Satoyamas. In: K. TAKEUCHI, R.D. BROWN, I. WASHITANI, A. TSUNEKAWA and M. YOKOHARI (Eds.): Satoyama The Traditional Rural Landscape of Japan. Springer Verlag, Tokyo, 1–7.
- HIBI, N. and T. YAMAMOTO (1997): Aquatic Insects in Irrigation Ponds. In: H. TABATA (Ed.): Satoyama no shizen (Nature in Satoyama Landscape). Hoikusha, Osaka, 80–81.\*
- T. INUI (2002): Satoyama to hito no rireki (Satoyama and Human History). Shinshisakusha, Tokyo, 361.\*

T. SHIDEI (1974): *Mori ya hayashi – Nihon shinrin shi* (Forest and woods – History of Japanese forests). Chuokoronsha, Tokyo, 206.\*

\* Only in Japanese. The title is tentative translation from the original Japanese title by the author of this paper.

### **Adress of authors**

**Prof. Dr. Tomiyasu Miyaura**, Ryukoku University, Oe-cho, Seta, Otsu, Shiga 520-2194, Japan

Eingelangt am 30. Juni 2008

Angenommen am 18. Dezember 2008