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13

Biodiversity Conservation Planning in Rural Landscapes in Japan: Integration of Ecological and Visual Perspectives

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1. Introduction

Conservationists worldwide have long been interested in rural landscapes (McNeely & Keeton, 1995; McNeely, 1995; Miller & Hobbs, 2002; Washitani, 2001; Yokohari et al., 2005), which can be characterized as semi-natural areas that are neither pristinely natural nor urban, maintained by appropriate level of human interventions. A great portion of the world's biodiversity is found in these landscapes (Pimentel et al., 1992). Such landscapes have gained an international attention as Satoyama, and an international partnership has been established in 2010 to promote sustainable use of human-influenced natural environment through the Satoyama Initiative (Convention on Biological Diversity Decision X/32). Japanese archipelago is one of the 34 Biodiversity Hotspots of the world (Mittermeier et al., 2004), and its biodiversity owe much to the quality of the human-influenced natural environment.

Rural landscapes are an important conservation challenge in Japan because they are being lost rapidly. The challenge is that the traditional conservation strategy of "setting aside" will not work because humans play important roles in maintaining biodiversity on such landscapes (e.g., Farina, 1995; McNeely, 1995; Melnick, 1983; Nakagoshi, 1995; Natori et al., 2005; Washitani, 2001). Conservation in rural environments faces difficulties also because the public tends to associate nature conservation with pristine, untouched nature (Miller & Hobbs, 2002). The conservation of rural environments would require approaches different from the traditional conservation strategies employed for pristine natural areas.

Many have suggested that the consideration of the sociocultural dimension is crucial to the success of the conservation of rural environments in particular, and the conservation of biodiversity in general (e.g., Miller & Hobbs, 2002; Phillips, 1995; Pimentel et al., 1992; Saunders, 1990; Yokohari et al., 1994). Naveh (2000; 2001) has explicitly included humans in his theoretical development of a holistic approach to landscape studies. Born and Sonzogni (1995) and Margerum and Born (1995) have articulated a more pragmatic means to deal with environmental problems in the framework of integrated environmental management. Trauger (1999) calls for a shift from a traditional discipline-based approach to a problem-based approach. Accordingly, transdisciplinary research is being advocated in recent years

for rural landscape research (Tress et al., 2005). This chapter focuses on the problem of rural landscape conservation. One way of considering people and nature simultaneously is to incorporate the visual perspectives into ecological conservation planning (Makhzoumi & Pungetti, 1999; Natori et al., 2005). Here we define "landscape" as the collective surface features of the study area in which the spatial (biosphere and geosphere), mental (noosphere), and temporal dimensions interact under influences of natural and cultural forces (the interaction in the sense as in Tress and Tress, 2001).

We hypothesize that: *Agricultural intensification and marginalization have had effects on local biodiversity via altering habitat amount and quality for species that occur on rural landscapes. The same changes have been perceived differently by different groups of people.* In the research conducted in the Arai-Keinan Region, Niigata, Japan, we asked the following set of questions in our attempt to incorporate human perceptions and values in ecological conservation planning for rural landscapes.

1. How has the rural landscape changed in terms of land use and land cover since the 1940s?
2. Considering the habitat associations of species dependent on the rural landscapes, what are the consequences of the observed landscape changes on the area's biodiversity?
3. Do people with different relationships with rural landscapes differ in terms of their landscape preferences and perceptions? How do the people perceive the landscape changes? What characteristics of landscape account for people's landscape preferences?

2. Underlying concepts of the study

We briefly discuss the key concepts of this Arai-Keinan study to illustrate the considerations and assumptions that have gone into our approach.

2.1 Biodiversity

Biodiversity encompasses multi-dimensional, interdisciplinary concepts. There is a multitude of definitions for what biodiversity is (e.g., Kaennel, 1998). Biodiversity conservation requires clear operationalization of the abstract concept of biodiversity, which has to be considered within the frame of the purpose and spatio-temporal scale of the conservation mission.

Species- or taxa-focused approaches are popular in conservation because they are measurable (Duelli & Obrist, 2003) and have high accountability backed by a long implementation history (Clark, 1999). However, these approaches have been criticized because 1) there are too many species on any given landscapes (Franklin, 1993); 2) it is cost-ineffective in that the amount of money spent for saving a few near-extinct species may be better spent for saving many less threatened species for a larger return in biodiversity conservation (Possingham et al., 2002); 3) the habitat manipulation specifically designed for a single species can have, although unintended, negative consequences to other species in the same community (Caughley & Sinclair, 1994; De Leo & Levin, 1997); 4) many species can go extinct unnoticed while conservation attention is given to saving one species, because saving that species does little to improve factors that are affecting other species (Caro et al., 2004; Prendergast et al., 1993); and 5) the time lags between habitat deterioration (or loss) and species loss (Brooks et al., 1999; Fry, 1998; Löfvenhaft et al., 2004) may confound the problem. The species-based approach might not be a good conservation tool, especially if saving particular species is considered as an end in itself (Meffe & Carroll, 1994).

In this study, our focus is on the landscape/habitat level characteristics of biodiversity on the basis for the coarse-filter approach (Haufler, 1999; Hunter, 1991; Noss & Cooperrider, 1994). The coarse-filter approach assumes that, if habitat types are available, the species associated with them, including those about which we know little, will persist on the landscape. This approach is effective and cost-efficient, especially when information and resources are limited (Noss & Scott, 1997). Using carefully selected species as surrogates of ecological integrity is a more effective conservation tool than considering specific species themselves as conservation targets (Johnson & Hill, 2002; Noss, 1990, 1991). We will use certain species to understand the ecological implication of land-use and land-cover changes, but quantifying species richness/diversity is outside the scope of this study.
Considering the preceding discussion, this chapter considers biodiversity in the context of nature conservation, and operationally defines that to conserve biodiversity is to secure habitats for groups of species traditionally associated with the area of interest.

2.2 Rural landscapes in biodiversity conservation

Rural landscapes are important for the conservation of biodiversity for two reasons: 1) as a buffer to the protected areas; and 2) as habitat that supports biodiversity by themselves. These should hold true globally. Most discussions of biodiversity conservation planning have focused on "natural areas," and essentially treated rural environments, including agricultural areas, as inhospitable surroundings (e.g., Lambeck, 1997; Meffe & Carroll, 1994; Peck, 1998; Trauger, 1999). Recent landscape ecological studies, however, consider such environments as matrix, and argue that their quality as habitat is important for maintenance of biodiversity (e.g., Andrén, 1994; Fahrig, 2001; Franklin, 1993). Fahrig (2001) reports that a promising and practically feasible conservation strategy is to improve the quality of the matrix (i.e., the survival probability in non-habitat areas).
The buffer zone concept, as in UNESCO's Man and Biosphere Programme (MAB), also considers rural areas as one of the layers of protection around protected areas (Lynagh & Urich, 2002; Wells & Brandon, 1993). The notion of rural areas as buffers to designated reserves carries a connotation that the reserves are primary and rural areas are secondary, but MAB's Madrid Action Plan for Biosphere Reserves (2008-2013) now recognizes clearly that buffer zones also have their own stand-alone ecological and cultural values. It is not too much of stretch to argue that the similar applies to "buffer areas" inside and outside of any protected areas. It has been recognized that protected areas established to date alone cannot adequately secure habitat for the growing number of endangered species, and cannot encompass all important ecosystem types (e.g., McNeely, 1995; Miller, 1996; Scott et al., 2001). Thus, much biodiversity depends on areas outside of protected areas (e.g., Peck, 1998; Pimentel et al., 1992). A recent gap analysis revealed that this holds true for Japan (Natori et al., in review).
Not only do rural landscapes supplement the lack of protected areas, but also they provide habitats for groups of species that would not be as abundant otherwise. An example is wetland environment that rice paddies provide to frogs, in place of natural wetlands rice paddies replaced (most likely they provide more than what naturally existed). People have been the primary disturbance agents in rural landscapes and have been maintaining systems at intermediate levels in ecological succession (Washitani, 2001). The focus of this chapter is based on the importance of rural landscapes as habitat that inherently supports biodiversity by themselves.

In Japan, rice cultivation has a history of over two thousand years (Hasegawa & Tabuchi, 1995). In many parts of Japan, it is the primary form of rural land use. Agricultural land and secondary forests, which have received human influence, covered 42% of the land in Japan according to a survey conducted during 1993-1998 (Nature Conservation Bureau & Asia Air Survey, 1999). The long history of human interaction with their natural environments has created various types of ecosystems that are different from the ecosystems from which they were originally derived (Nature Conservation Bureau, 2002). For example, many frog species have adapted to traditional rice cultivation practices that are phenologically synchronized (Washitani, 2001). Rural landscapes contribute to Japan's biodiversity not only because they occupy a large proportion of the territory, but also because they have come to serve as suitable habitats for many species (Kato, 2001). The traditional agricultural systems in Japan maintained their ecological integrity (in the sense defined by Regier, 1993); i.e., they were resilient systems, rather than the state of being unaltered. Due to the adoption of new technology, the traditional, close relations among humans, agricultural land, and the coppice have grown weaker. The 1960s, the period in which Japan experienced rapid economic growth, is often cited as a turning point for human use of rural environments (e.g., Ishii et al., 1993; Kamada et al., 1991; Tsunekawa, 2003; Washitani, 2001).

In recent years, much attention has been drawn to the multiple environmental functions of rice cultivation; the conservation of biodiversity being one of them (Takeuchi et al., 2003; Washitani, 2001). There is a concern that these functions might be lost as a higher production efficiency is sought (agricultural intensification) or as less efficient lands are abandoned (agricultural marginalization). Physical land modifications to allow mechanized agriculture (Hasegawa & Tabuchi, 1995) have had negative consequences on diversity of plants (Okubo & Maenaka, 1995), frogs (Fujioka & Lane, 1997), birds (Lane & Fujioka, 1998), freshwater fish (Katano et al., 2003), and other groups (e.g., see Ezaki & Tanaka, 1998; Kato, 2001). On the other hand, the management of coppices and grasslands, which had been practiced to obtain fuel or green manure, ceased, affecting many species of plants (Washitani, 2001) and butterflies (Higuma, 1998; Ishii et al., 1993). The traditional agricultural systems are arguably among the most threatened ecosystems in Japan today.

2.3 Visual perspectives

Rural landscapes are under varying degrees of human influence. Thus, how people behave in a landscape has much bearing on rural conservation. The habitat/landscape-based approach to biodiversity conservation helps integration of the ecological dimensions with visual dimensions. The people-landscape interaction model (Tress & Tress, 2001) conceptualizes the structure of interactions between people and rural landscapes. Landscapes influence people's perceptions, which, in turn, influence people's action toward the landscapes. We expect that visual aspects of landscapes play a very strong role in formation of perceptions, which eventually manifest as management, alteration, or conservation of landscapes. For this reason, the visual aspects of the landscape can be tightly related to the state of biodiversity, especially on rural landscapes.

In rural landscape management, those who work the land and those with naturalist/ecologist-orientations may not have the same inclinations toward the landscape and yet may have to work together. Differences in their way of looking at rural landscapes should be of great interest for planners. The degrees of landscape stewardship may be more important for farmers than for non-farmers (Nassauer, 1988). This aspect of landscape's

visual quality has not been addressed in previous studies in Japan (Inose et al., 2002; Kanno et al., 1998; Shinji, 1981; Suzuki & Hori, 1989; Tanokura et al., 1999), while the dimensions of scenic quality and naturalness have been given attention. Thus, it is possible that important factors in landscape perceptions for farmers have not been studied.

3. Study site

This chapter focuses on the Arai-Keinan region located in the southwestern part of the prefecture of Niigata, on the Japan Sea side of Honshu Island, Japan (Fig. 1). This region has an area of 555.58 km^2 and elevation ranges from 10 m to 2,462 m above sea level. The region has a population of approximately 50,000 people, who mostly reside below 800 m above the sea level. A plain area is surrounded by mountains, the western part of which is designated as national park. In the east, the landscape exhibits varied topography with terrace-type rice paddies interspersed among woodlands. The central plain is gently sloped to the north, where the majority of residential and industrial activities occur. Rice cultivation agriculture is a major land use in the region, even in the mountainous areas. The climate of the region is characterized by high levels of precipitation in winter, most of which falls as snow.
Woodlands at low elevations are dominated by *Quercus serrata*, characteristic of coppice vegetation in Japan. Other major species include *Magnolia obovata*, *Prunus* spp., and *Acer* spp. At higher elevations, *Q. mongolica* var. *grosseserrata*, *Betula ermanii*, and *Fagus crenata* become dominant. Most of the plantations are those of *Cryptomeria japonica*.

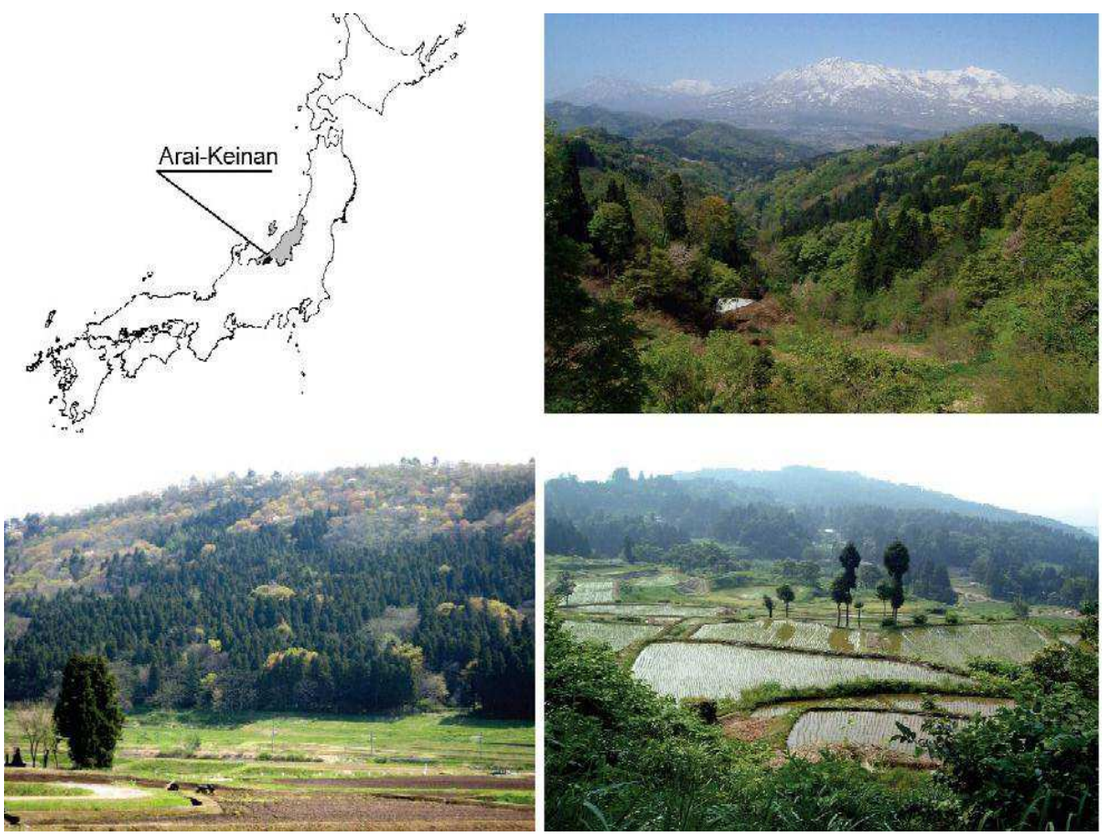


Fig. 1. The location of the study sites in Japan and representative landscapes

4. Methods and results

4.1 Land use transitions

We documented changes in rural landscapes from time series aerial photographs between 1947 and 1999 for four landscapes: Itakura (3 km × 3 km; average elevation: 37 m; average slope: 0.8°), Sarukuyoji (3 km × 3 km; 277 m; 10.5°), Suibara (4 km × 4 km; 423 m; 17.5°), and Takatoko (6 km × 5 km; 250 m; 8.7°). Orthophotos, produced using OrthoMapper (Image Processing Software Inc., Madison, Wisconsin, USA), were interpreted in a 50-m grid into ten categories of land-use and land-cover (LULC, Table 1). Hereinafter, this is referred to as the "LULC study".

Large proportions of the four landscapes underwent conversions during 1947-1999 (Fig. 2). By 1999, irregular rice paddies on flat areas mostly had been converted to regular paddies. LULC conversions on slope areas occurred in smaller spatial units; rice paddy abandonment in small spatial units caused the marginalized landscape to become more heterogeneous, in terms of landscape patterns defined by the LULC types. Cutting pressure on coppices for fuel use was found to have been strong in 1947, indicated by the extensive areas of grassland or shrub land. By 1999, these areas had undergone plant succession in the absence of cutting pressure, and woodlands had become a dominant cover type. Using the resultant maps as base data, we interpreted landscape transitions between two different years, and identified the cells that underwent agricultural intensification, reclamation, agricultural marginalization, and ecological succession.

LULC Types	Descriptions
1. Irregular rice paddies	Irregularly shaped paddies; rice paddies not as 2.
2. Regular rice paddies	Rice paddies that are rectangular, that have boundaries meeting at right angle, or at least whose longer sides are parallel if surrounded by other land types.
3. Dry farms	Agricultural land producing crops other than rice.
4. Developed area	Areas not considered appropriate for habitat, including residential, roads, railroads, and other areas covered with concrete or asphalt.
5. Woodland	Collection of tall, broadleaved trees.
6. Cedar plantation	Collection of *Cryptomeria japonica* (and other conifers), including plantation.
7. Shrub land	Areas with trees of low statures (taller than grasslands, but shorter than woodlands): shrubs and re-sprouting broadleaved trees, including post-logging woodlands.
8. Grassland	Vegetated areas without tree crowns or shrubs.
9. Open water	Rivers and ponds, including non-vegetated floodplains.
10. Bare ground	Areas of bare soil, with little vegetation; including fallow rice paddies, aftermath of landslides.

Table 1. Land-use and land-cover (LULC) classification scheme

To establish theoretical grounds for future habitat outlook, the associations between the LULC changes and steepness of slopes were tested statistically using Jacobs' electivity index (Jacobs, 1974; Pastor & Broschart, 1990). The tests indicated statistically significant associations

between agricultural marginalization and the slopes steeper than 6 degrees. Thus, although irregular rice paddies remained on sloped lands, they are expected be reduced further.

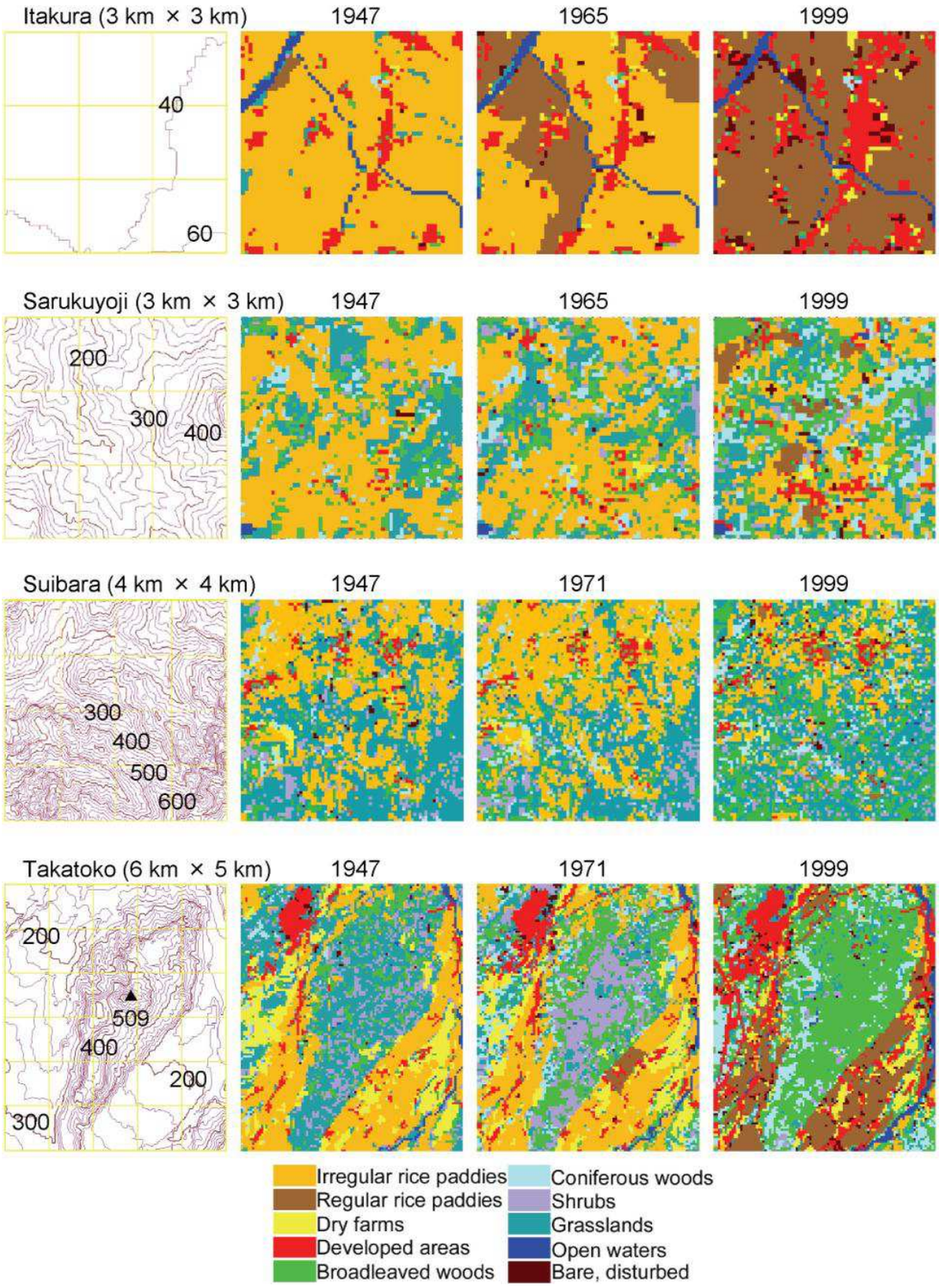


Fig. 2. Land-use and land-cover changes between 1947 and 1999 in four selected landscapes

We are then interested in the ecological and visual consequences of these changes. We addressed the hypotheses by collection of three inter-related studies: first on finer-scale ecological consequences, second on a broader scale consequences (details in Natori & Porter, 2007) and third on the visual aspects (details in Natori & Chenoweth, 2008).

4.2 Fine-scale ecological consequences: Frog habitat conditions

We investigated the ecological consequences of observed LULC changes at a fine scale, in terms of habitat quality for native frog species. Frogs were chosen as the indicator since the frog diversity characterizes the traditional rural landscapes in Japan (Hasegawa, 1998; Ministry of the Environment, 2002). From the literature, the presence of water in spring and soil ditches around the paddies were identified as the necessary conditions for suitable habitats for paddies-dependent frog species, such as *Rana japonica*, *R. ornativentris*, *R. nigromaculata*, and *R. rugosa*. These features were recorded on 96 sites (59 irregular rice paddies and 37 regular rice paddies) by repeated visits in the spring of 2005. The results confirmed that irregular rice paddies were generally wet in the spring *and* had at least some soil ditches around them (41 sites out of 59 or 70%); thus, suitable as frog habitat. Regular rice paddies tended to be dry in the spring and were irrigated by concrete ditches (25 sites out of 37 or 68%); thus, unsuitable. With this confirmation, landscape quality information (i.e., suitable or unsuitable as habitat) was associated with visual assessment of landscapes (i.e., irregular or regular rice paddies). Agricultural statistics (e.g., Statistics Department, 2005) and vegetation mapping (e.g., Nature Conservation Bureau, 1999) miss capturing the material changes in habitat quality (or habitat conversion) that takes place in rural landscapes, because they do not distinguish different types of rice paddies.

We analyzed further the effects of the LULC changes on habitat conditions for native frogs by considering the pattern of the LULC changes. The landscape patterns in the LULC maps presented above were quantified by two landscape metrics: proportion of landscape (PLAND) by LULC type and contrast-weighted edge density (CWED) between irregular rice paddies and other LULC types (McGarigal et al., 2002). The PLAND quantitatively estimated the amount of habitat for species whose life cycles complete within rice paddies and irrigation ditches; i.e., *R. nigromaculata* and *R. rugosa*. The CWED, measured in the meters of interfaces between different LULC types in a hectare, quantitatively estimated the amount of habitat for species that resides in woodlands and grasslands and come to rice paddies in springs to spawn; i.e., *R. japonica* and *R. ornativentris*. Considering the difference in habitat suitability, irregular rice paddy interface with woodland was weighted by 1.0, with grassland by 0.5, and with others by 0.0. The relative increase/decline in the CWED through time indicated the increase/decline in suitable habitat for these species.

Given the drastic decline in the amount of irregular rice paddies (Fig. 3), *Rana nigromaculata* and *R. rugosa* are expected to have lost a significant portion of their habitat. On the other hand, *R. japonica* and *R. ornativentris* may have gained more habitat during intermediate years, due to the pattern of LULC conversions from irregular rice paddies, but their habitats too are on a declining trend now.

In sum, habitat conditions for native frogs have deteriorated during 1947-1999 and will likely continue to deteriorate at the fine scale. For rice paddies to support biodiversity, efforts beyond simply continuing farming are needed. Finding and coordinating a social system that can provide key features of irregular rice paddies (i.e., standing water in the spring, and non-concrete ditches or streams) should be considered as an alternative strategy for rural conservation.

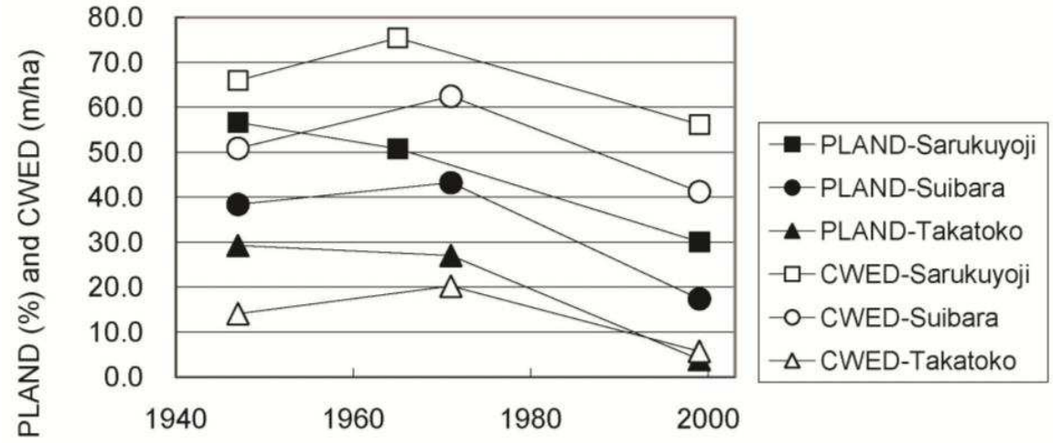


Fig. 3. Changes in proportions of landscape occupied by irregular rice paddies (PLAND) and contrast-weighted edge density between irregular rice paddies and deciduous woodlands, cedar plantation, shrubs, or grasslands (CWED)

4.3 Broad-scale ecological consequences: The Japanese serow

The Japanese serow (*Capricornis crispus*) is a medium-sized, territorial bovid (an average adult weighing 36 kg) and its habitat assessment needs to consider much larger area. Natori and Porter (2007) addressed the ecological consequences of land use changes from a broader scale to define the context in which the study area was situated. To understand the effects of the LULC changes on habitat conditions for large mammals, it assessed habitat suitability by simulating the energy budget of the Japanese serow using the energetics model (Porter et al. 1994; 2000; 2002). The energetics model determines the metabolic energy costs required to maintain homeostasis from the directly measurable properties of the environment (such as air temperature, wind speed, amount of shade, vegetation, etc.) and those of the animal (such as size, body temperature, fur density, etc.). The animal's ambient environment, modeled from weather data, was modified by vegetation. The LULC maps from Arai-Keinan Region provided time series vegetation data and the national level surveys (Nature Conservation Bureau, 2005) provided the vegetation information of 1990s for the surrounding area. Any particular locations were considered uninhabitable where the serow should not be present (urban or agricultural) or unsuitable if the animal was not able to maintain homeostasis either because of overheating because it was unable to dissipate heat efficiently enough in the summer or because the serow was unable to obtain sufficient food to sustain the level of metabolism needed in the winter.

The results of the energetics model simulation using the LULC changes described above (Fig. 2) indicated that the changes were favorable for the serow to inhabit a larger area within the region (Fig. 4). Figure 4 only shows the results for the summer because winter conditions did not limit the habitat suitability in two landscapes in Arai-Keinan Region. The forest cover, which provides shade in summer that prevents the serow from being overheated in the summer and provide thermal cover and wind moderation in the winter, is an important determinant of the suitability of landscapes as serow habitat. In winter, snow reduces the amount of forage available to the serow, but forest covers are expected to provide more forage in snow than other, more open vegetations. Thus, the increase in forested areas in the Arai-Keinan region observed during 1947-1999 is expected to have

increased the amount of suitable habitat for the serow. Natori and Porter (2007) also showed, based on the simulation for the larger area, that the Arai-Keinan region, which may have been isolated when the forest cover was limited, is now a part of a contiguous patch of suitable habitat. This makes this region even a better habitat for the serow. Thus, unlike the case of the frogs, the landscape changes in the Arai-Keinan Region have been in favor of the serow.

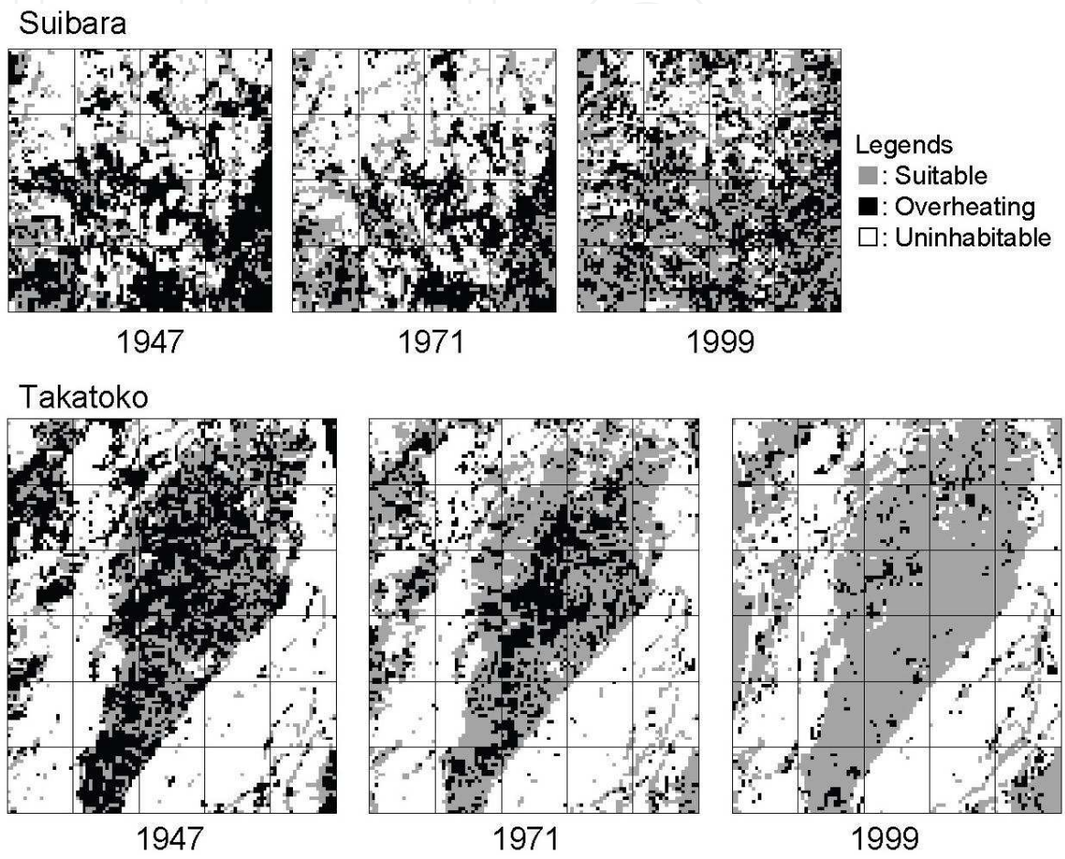


Fig. 4. Expansion of suitable habitat area in summer for the Japanese serow over the period from 1947 to 1999.

4.4 Landscape aesthetics

Natori and Chenoweth (2008) investigated the visual aspect of rural landscapes, and compared landscape preferences and perceptions among people having very different relationships to rice-paddy and woodland landscapes. The study had particular interest in revealing how local farmers (n = 41) and naturalists (non-farmers with conservation interests; n = 44) differ in their perceptions toward different states of rice-paddy and woodland landscapes. Photograph-based semantic differential (SD) surveys were conducted. Rice-paddy landscapes were represented by 2 × 3 factorial design (Fig. 5), and woodland landscapes, by 2 × 2 factorial design (Fig. 6). The SD variables quantified the participants' perceptions of naturalness, openness, stewardship, peacefulness, biodiversity and preference on seven-point scales. Observer difference was dummy-coded, and stepwise linear regressions were performed to test if farmers and naturalists differ in landscape preference and perception.

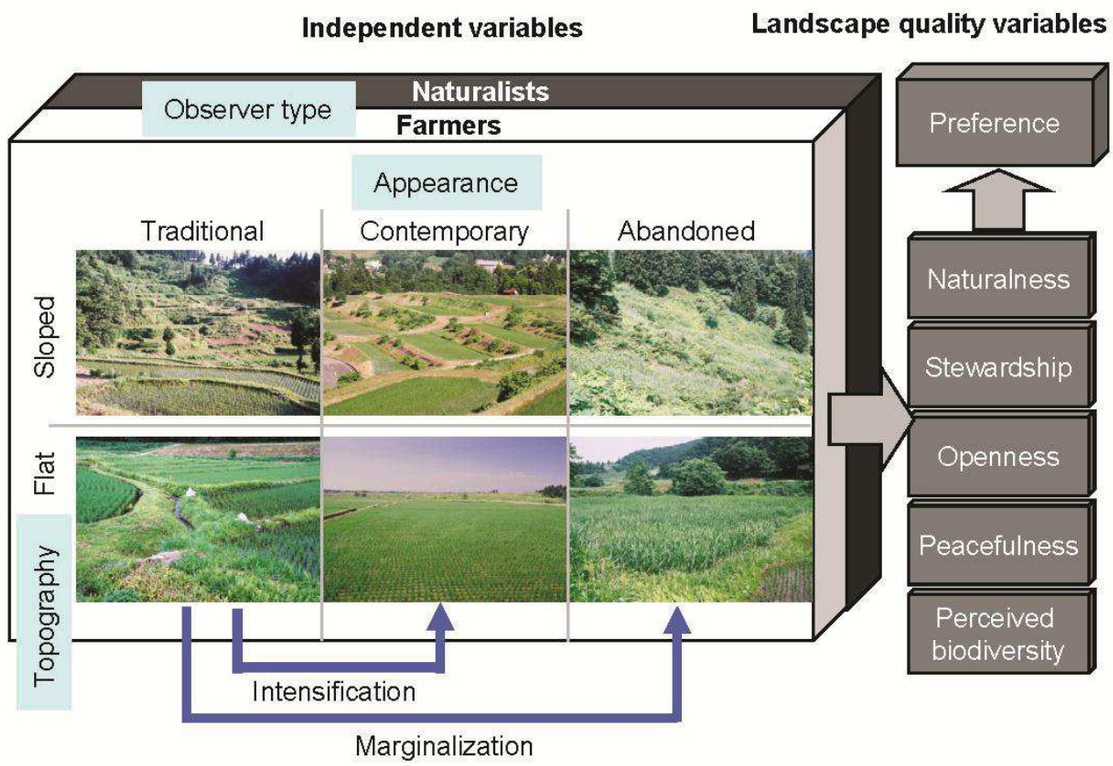


Fig. 5. Experimental design for perception survey on rice-paddy landscape

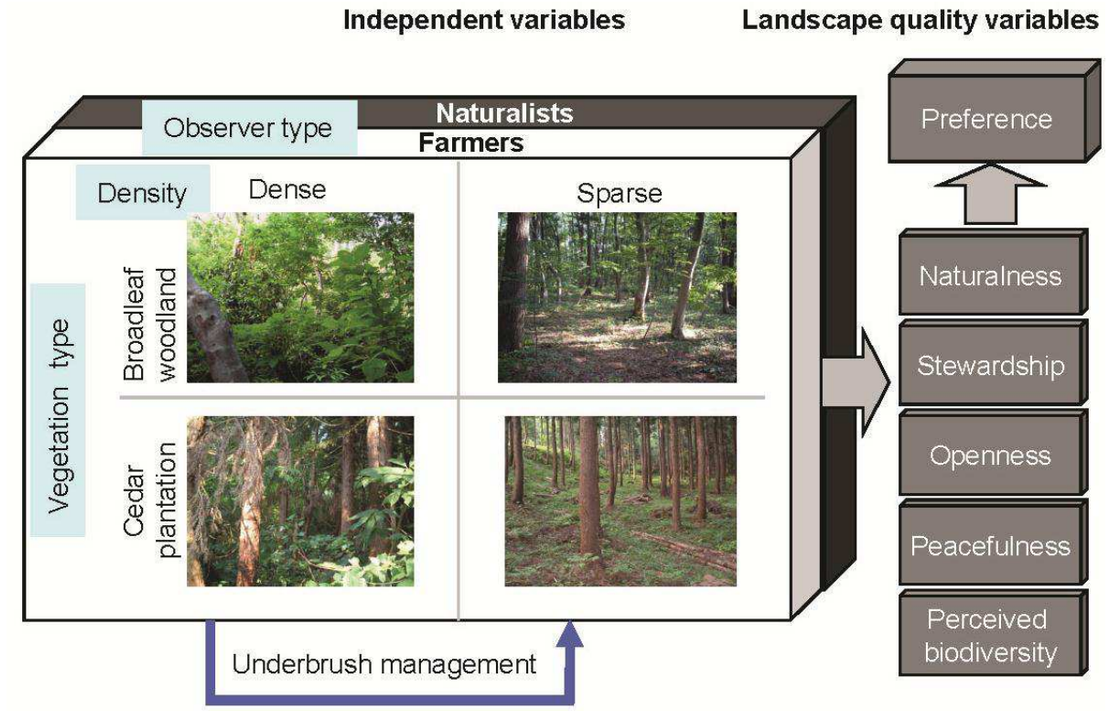


Fig. 6. Experimental design for perception survey on woodland landscape

It also investigated people's perceptions and preferences of landscape changes typical of rural landscapes in contemporary Japan inferred by comparing ratings to two different landscape types (Figs. 5 and 6). The comparison of ratings to contemporary rice paddies to those of traditional implied agricultural intensification, whereas the comparison of ratings to abandoned rice paddies to those of traditional implied agricultural marginalization. Similarly for woodlands landscapes, comparison of the ratings to sparse underbrush to those of dense implied underbrush management.

The results showed that farmers and naturalists differed in the way they look at rural landscapes. Perceptions of stewardship appeared more important for farmers, and perceptions of 'naturalness' appeared more important for naturalists with statistical significance in case of rice-paddy landscapes. With regard to changes in rice paddies, farmers disliked agricultural marginalization more strongly than naturalists did (with statistical significance), which may be attributed to farmers' stronger normative criteria for rice paddies. Farmers and naturalists disagreed about how they wanted rice paddies on sloped topography to be. Farmers preferred contemporary paddies, which the frogs study suggests to provide lesser quality habitat, while naturalists preferred traditional paddies, which provide more biodiversity benefits. This difference could be a point of conflict in biodiversity conservation as they represent two major stakeholder groups in rural landscapes.

Unlike the case of rice-paddy landscapes, differential influence of the perception of stewardship and naturalness was not apparent for woodland landscapes. This lack of difference could be because people viewed woodlands more from a third person's perspective resulting from having the lesser interaction with woodlands than with rice paddies. As for changes in woodlands, the clearing of underbrush has positive effects on both set of participants' preferences with regard to woodland landscapes. Managing underbrush in strategic locations could have a far-reaching conservation benefit by raising people's overall appreciation of woodlands, by providing an "orderly frame" (Nassauer, 1995).

The results suggested that farmers probably have stronger normative criteria for how the rural landscapes should look, and their emphasis is placed on stewardship or management. This study did not present enough variation in management to identify properties of "right" degrees and types of management and their interaction with sense of naturalness. Together with the advancement of ecological understanding on biodiversity of rural landscapes, such investigation will provide further insights for the conservation of landscapes in which natural ecosystems and human activities can sustainably coexist in today's societal conditions.

5. Discussion

The series of studies demonstrate that the LULC changes are not merely the changes in how people use the land, but that they also have consequences in ecological communities and people's perceptions. Agricultural intensification reduces habitat amount for native frogs, but it significantly increases farmers' preferences for rice paddies on sloped landscapes. Agricultural marginalization, which is significantly associated with rice paddies on sloped landscapes, reduces habitat amount for native frogs. At the same time, agricultural marginalization increases the landscape's suitability for the Japanese serow habitat because resultant forest covers provide the serow with favorable habitat conditions and the more heterogeneous landscape patterns provide more options for the serow to choose favorable environmental conditions. Agricultural marginalization, however, causes a decline in

people's preference for the landscape. Increased woodland area in the rural landscape favors the Japanese serow's occurrence. Both farmers and naturalists preferred deciduous woodlands to cedar plantations, and both were in favor of underbrush management.

The two ecological studies clearly indicated that strong ecological consequences accompanied the LULC changes observed during 1947-1999, and provided support for the first hypothesis: *Agricultural intensification and marginalization have had effects on local biodiversity via altering habitat amount and quality for species that occur on rural landscapes.* The strength of support for the second hypothesis (*The same changes have been perceived differently by different groups of people*) depended on the context (e.g., rice paddies vs. woodlands).

We believe the following three mutually complementary issues to be important for biodiversity conservation in rural landscapes. This study was designed to provide concrete examples and further insights for these issues. They constitute key ingredients for identifying important areas for conservation, even in the absence of issues/projects that threaten the conservation values of landscapes. If this identification is performed, a more proactive approach, the "preemptive conservation" (Natori et al., 2005), becomes possible.

5.1 Multiple perspectives to view landscapes

If ecological considerations lacked linkages to people's landscape preferences, resultant conservation projects might not gain public support. Similarly, if only human perspectives were considered, ecological values of the rural landscape might suffer, such as in rural area development projects in which only farmers' priorities are considered.

Agricultural marginalization is more likely on sloped landscapes (the LULC study), which leads to reduction in habitat amount suitable for frogs such as *Rana nigromaculata* and *R. rugosa* (the frogs study). Depending on how agricultural marginalization occurs (especially with respect to landscape configuration), its effects on the habitat amount for *R. japonica* and *R. ornativentris* vary (the frogs study). The aesthetics study suggested that agricultural marginalization would be disliked by both farmers and naturalists, but for different reasons, which suggests that different approaches to resolve the problem might be needed. Although agricultural marginalization is viewed as unfavorable based on both ecological perspectives focused on frogs and people's landscape preferences, the serow modeling study suggested that the same change might benefit the serows by providing shade or thermal cover, especially if accompanied by plant succession to canopy forests. One may not be able to find a perfect land-use solution that satisfies all issues regarding rural landscapes, but including as many perspectives as feasible likely leads to improved efficacy of conservation measures (Born & Sonzogni, 1995; Margerum & Born, 1995).

We provide two examples to further illustrate the importance of multiple perspectives. First, current policies, such as the "direct payment system in hilly and mountainous areas," assume that multiple functions of rural landscapes will be secured if rice cultivation continues on sloped landscapes. Given that rice cultivation is the key process that supported the biodiversity in rural landscapes, and abandoning the cultivation is a threat to biodiversity conservation in Japan, maintaining rice cultivation appears to be consistent with the interest of biodiversity conservation. However, emphasis on only the continuation of agricultural production can undermine the goal of protecting multiple functions of the landscapes, because new agricultural practices may not be able to provide the functions that traditional agriculture provided (Yokohari, 2000). For rice cultivation to be economically viable, Zhou (2001) advocates that the enlargement of farm sizes, with mechanical work

replacing human labor, would be the future direction for (economically) sustainable agriculture. To allow mechanization, small, irregular paddies must be converted to large, regular paddies. This conversion will result in decline of rice paddies' quality as habitat for many species that depend on traditional rice paddy landscapes. The aesthetics study considered such alteration of rice paddies from the perspective of people's landscape preferences, and revealed that it could lead to a conflict between farmers and naturalists, resulting from their different views about rice paddies on slopes.

Second, current methods of agricultural statistical record-keeping and vegetation mapping may not capture the substantial alterations of rural landscapes because they do not make a distinction between types of rice paddies. Among the environmental functions most recognized for rice paddies are flood control and groundwater recharge (Hasegawa & Tabuchi, 1995; Tabuchi & Ogawa, 1995; The Japan Environmental Council, 2005; Yokohari, 2000). For these functions, the type of rice paddy does not make a difference, though the type of rice paddy does make a difference for the conservation of biodiversity (the LULC and frogs studies). The inclusion of ecological aspects into rural development plans is critical to the effective conservation of biodiversity in rural landscapes. New agricultural policy since 1999, under the Basic Law on Food, Agriculture, and Rural Areas, can accommodate such considerations, but its focus is still on protection of farmers, rather than the environment (Yokohari, 2000). Concrete and convincing arguments from an ecological perspective are necessary for genuine inclusion of ecological considerations to happen on the ground.

Many functions that rural landscapes provide have been brought about by the process of rice cultivation, but this process is changing. We can no longer focus only on this process (i.e., continuing rice cultivation) and expect that other functions recognized for rural landscapes will be automatically provided. Thus, multiple perspectives on the same landscape must be considered.

5.2 Landscape-focused approaches and maps facilitate integration

In this chapter we conceptualized landscape as a space in which mental and ecological/physical dimensions interact under influences of natural and cultural factors (the people-landscape interaction model; Tress & Tress, 2001). Our operational definition of the conservation of biodiversity has been to secure habitats, rather than individual species. This framework helped integrate the ecological and visual aspects of rural landscapes in biodiversity conservation. The integration of ecological and visual aspects of landscapes brings us closer to reconciling nature and culture (i.e., people). Actions with spatial components can be linked to other functions if they are considered in the spatial expanse of landscapes. For example, as we demonstrated in the LULC study, one can see that patterns of association can emerge from consideration of the LULC changes and landscape features, such as steepness of slope.

Mapping is inseparably related to landscape-focused approaches; it is a tool for landscape visualization and landscape change analysis. Maps allow spatially-specific changes and properties to be visualized and understood better. Comparisons between both locations and times are also possible, and landscape metrics can facilitate quantitative comparisons (the LULC study). Maps linked the analyses of land use and land cover in the LULC study to ecological analysis in the frogs and serow modeling studies. Maps provided specificity to descriptions of changes. This is a key feature when multiple functions of rural landscapes are considered, because they are linked by landscapes. The visual features of maps are also effective in conveying information to the public (Nassauer & Corry, 2004; Rookwood, 1995),

which may constitute one venue to foster cooperation and to close communication gaps that exist among ecologists and planners, policy-makers, and the public (August et al., 2002; Holdgate, 1984).

5.3 Temporal considerations are important

Knowing past changes provides information for the future. Even though we might not be able to revert to the past, we can recreate conditions that approximate the past. Multiple functions of rural landscapes (e.g., support for biodiversity, provision of scenery, etc.) can be maintained only if we know about the past. The trends observed historically in relation to physical features of the landscapes such as slopes, may allow future predictions. A caveat, which was also provided by temporal considerations, is that landscape changes have not always been unidirectional. Thus, although science cannot state what the reference for conservation should be, the dynamic nature of landscapes necessitates understanding the range of possible conditions conducive to target species or goals.

For example, our landscape assessment using aerial photograph interpretation indicated that the coppicing pressure on woodlands was strong in 1947. Some questions still require further research. Had the coppicing pressure always been at this level, or did it escalate during the World War II? Was such a land use sustainable in terms of maintenance of the ecological communities on rural landscapes as described in the literature? A more meaningful question for practical conservationists might be: what level of coppice management would it take to sustain the biodiversity of traditional rural landscapes within the modern landscapes? Answering these questions is important for the conservation of rural landscapes and requires an understanding of historic landscape conditions and dynamics. Such research could be considered in the framework of adaptive management (Holling et al., 1998; Walters & Holling, 1990).

Temporal depth is important in understanding the trajectory of changes in landscapes. In this LULC study, we demonstrated that landscape imagery, such as aerial photographs, can effectively be used to track changes in land use and land cover since 1947 (see also Ihse, 1995; Kurita & Yokohari, 2001; Yokohari & Kurita, 2003). It will be difficult to discriminate types of rice paddies in satellite imagery. Aerial photographs and other landscape imagery can effectively provide temporal depth of information on land use and land cover. For these reasons, aerial photographs will continue to be a valuable tool for rural conservation planning, even in this age of the remarkable development of satellite remote sensing technologies (e.g., Lillesand & Kiefer, 2000).

5.4 Conservation planning

These three issues just discussed can be placed in the context of conservation planning and implementation as in Fig. 7. In rural conservation planning, the direct stakeholders and the public in general need to be included in the process. Sharing a clear common goal among stakeholders is key for collaboration despite differences (Norton, 1991). The “spatial narrative” (Silbernagel, 2005), a framework that synthesize multiple perspectives, such as objective geographic space and subjective experiential place, will be particularly effective. Temporal consideration can inform what the conservation goals can be. Information is the key for effective conservation measures, but there is a limit to what can be known with the resource available. The concept of adaptive management (Walters & Holling, 1990), which considers policies as hypotheses and their implementation as experiments, would enhance the approach for biodiversity conservation. Conservation planning can start with coarse-

filter approach and using surrogates, and specific measures can be refined as more information is collected through the course of the conservation activities.

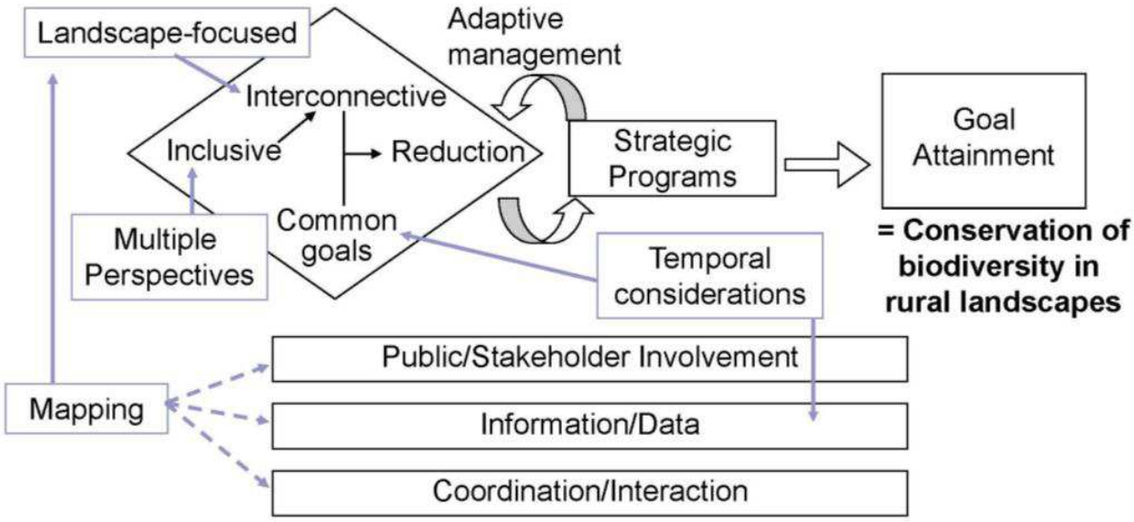


Fig. 7. A model for holistic approach to landscape management

6. Conclusion

Landscape changes observed in aerial photographs during 1947-1999 were shown to have had substantial ecological impact in the rural landscape of the study area. However, the assessment of whether the changes were positive or negative differed greatly depending on what part of biodiversity was used for the assessment; in our example, the native frogs vs. the Japanese serow. Furthermore, the human dimension, which should always be considered in rural conservation, was demonstrated to be also diverse, and a single preferred conservation direction may not automatically exist. These findings suggest that an effective conservation planning will require a transdisciplinary approach (Tress et al., 2005), in which interdisciplinary approach is combined with participation, to bring a long-lasting success to rural conservation.

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8. References

Andrén, H. (1994). Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. O*ikos,* Vol.71, pp. 355-366, ISSN 0030-1299

August, P., Iverson, L. and Nugranad, J. (2002). Human conversion of terrestrial habitats. In: *Applying Landscape Ecology in Biological Conservation,* Gutzwiller, K. J. (Ed.), pp. 198-224, Springer, ISBN 0-387-95322-1, New York

Born, S. M. and Sonzogni, W. C. (1995). Integrated environmental management: strengthening the conceptualization. *Environmental Management,* Vol.19, pp. 167-181, ISSN 0364-152X

Brooks, T. M., Pimm, S. L. and Oyugi, J. O. (1999). Time lag between deforestation and bird extinction in tropical forest fragments. *Conservation Biology,* Vol.13, pp. 1140-1150, ISSN 0888-8892

Caro, T., Engilis, A., Fitzherbert, E. and Gardner, T. (2004). Preliminary assessment of the flagship species concept at a small scale. *Animal Conservation,* Vol.7, pp. 63-70, ISSN: 1367-9430

Caughley, G. and Sinclair, A. R. E. (1994). *Wildlife Ecology and Management.* Blackwell Scientific Publications, ISBN 0-86542-144-7, Boston

Clark, J. R. (1999). The ecosystem approach from a practical point of view. *Conservation Biology,* Vol.13, pp. 679-681, ISSN 0888-8892

De Leo, G. and Levin, S. (1997). The multifaceted aspects of ecosystem integrity. *Conservation Ecology,* Vol. 1, pp. 3. Retrieved from http://www.consecol.org/vol1/iss1/art3

Duelli, P. and Obrist, M. K. (2003). Biodiversity indicators: the choice of values and measures. *Agriculture, Ecosystems and Environment,* Vol.98, pp. 87-98, ISSN: 0167-8809

Ezaki, Y. and Tanaka, T. (Eds.) (1998). *Mizube Kankyo no Hozen--Seibutsu Gunshu no Shiten kara.* Asakura-Shoten, ISBN 4-254-10154-6, Tokyo

Fahrig, L. (2001). How much habitat is enough? *Biological Conservation*, Vol.100, pp. 65-74, ISSN 0006-3207

Farina, A. (1995). Cultural landscapes and fauna. In: *Cultural Landscapes of Universal Value*, Droste, B. v., Plachter, H. and Rossler, M. (Eds.), pp. 60-77, Gustav Fischer, ISBN 3-334-61022-5, Jena

Franklin, J. F. (1993). Preserving biodiversity: species, ecosystems, or landscapes? *Ecological Applications*, Vol.3, pp. 202-205, ISSN 1051-0761

Fry, G. L. A. (1998). Changes in landscape structure and its impact on biodiversity and landscape values; a Norwegian perspective. In: *Key Concepts in Landscape Ecology: Proceedings of the 1998 European Congress of the International Association for Landscape Ecology, Held at the Myerscough College, 3rd-5th September 1998* Dover, J. W. and Bunce, R. G. H. (Eds.), pp. 81-92, IALE (UK), ISBN 0-9524263-5-8, Aberdeen, Scotland

Fujioka, M. and Lane, S. J. (1997). The impact of changing irrigation practices in rice fields on frog populations of the Kanto Plain, central Japan. *Ecological Research,* Vol.12, pp. 101-108, ISSN 0912-3814

Hasegawa, M. (1998). Suiden kosaku ni izon suru kaeru-rui gunshu. In: *Mizube Kankyo no Hozen (Conservation of Biological Communities in Rivers, Ponds and Paddy Fields)*, Ezaki, Y. and Tanaka, T. (Eds.), pp. 53-66, Asakura-Sheten, ISBN 4-254-10154-6, Tokyo

Hasegawa, S. and Tabuchi, T. (1995). Well facilitated paddy fields in Japan. In: *Paddy Fields in the World*, Tabuchi, T. and Hasegawa, S. (Eds.), pp. 103-124, Japanese Society of Irrigation, Drainage and Reclamation Engineering, ISBN 4-88980-077-8, Tokyo

Haufler, J. B. (1999). Strategies for conserving terrestrial biological diversity. In: *Practical Approaches to the Conservation of Biological Diversity*, Baydack, R. K., Campa, H., III and Haufler, J. B. (Eds.), pp. 17-30, Island Press, ISBN 1-55963-544-4, Washington, D.C.

Higuma, S. (1998). Myoko-sankai no nantomen chiiki ni sumu cho-rui. *Transactions of Essa Entomological Society,* Vol.79, pp. 1-69, ISSN 0289-4289

Holdgate, M. W. (1984). Information needs for the decision-making process. In: *Ecology in Practice Part II: The Social Response*, Di Castri, F., Baker, F. W. G. and Hadley., M. (Eds.), pp. 249-263, Tycooly International, Dublin

Holling, C. S., Berkes, F. and Folke, C. (1998). Science, sustainability and resource management. In: *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*, Berkes, F., Folke, C. and Colding, J. (Eds.), pp. 342-363, Cambridge University Press, ISBN 0-52178-562-6, Cambridge

Hunter, M. L. (1991). Coping with ignorance: the coarse-filter strategy for maintaining biodiversity. In: *Balancing on the Brink of Extinction: The Endangered Species Act and Lessons for the Future*, Kohm, K. A. (Ed.), pp. 266-281, Island Press, ISBN 1-55963-006-X, Washington, D.C.

Ihse, M. (1995). Swedish agricultural landscapes--patterns and changes during the last 50 years, studied by aerial photos. *Landscape and Urban Planning*, Vol.31, pp. 21-37, ISSN 0169-2046

Inose, R., Kurita, K., Kuroyanagi, N. and Miyakawa, H. (2002). The categorization of grassland landscape features in the Mt. Aso Region of on Kyushu Island and characteristics of their public image. *Journal of the Japanese Institute of Landscape Architecture*, Vol.65, pp. 621-626, ISSN 1340-8984

Ishii, M., Ueda, K. and Shigematsu, T. (1993). S*atoyama no shizen wo mamoru.* Tsukiji Shokan, ISBN 4-8067-2346-0, Tokyo.

Jacobs, J. (1974). Quantitative measurement of food selection: a modification of the forage ratio and Ivlev's electivity index. *Oecologia*, Vol.14, pp. 413-417, ISSN 0029-8549

Johnson, B. and Hill, K. (2002). *Ecology and design : frameworks for learning*. Island Press, ISBN 1-55963-813-3, Washington, D.C.

Kaennel, M. (1998). Biodiversity: a diversity in definitions. In: *Assessment of Biodiversity for Improved Forest Planning: Proceedings of the Conference on Assessment of Biodiversity for Improved Planning, 7-11 October 1996, held in Monte Verità, Switzerland*, Bachmann, P., Köhl, M. and Päivinen, R. (Eds.), pp. 71-81, Kluwer Academic Publishers, ISBN 9780792348726, Dordrecht

Kamada, M., Nakagoshi, N. and Nehira, K. (1991). Pine forest ecology and landscape management: a comparative study in Japan and Korea. In: *Coniferous Forest Ecology from an International Perspective*, Nakagoshi, N. and Golley, F. B. (Eds.), pp. 43-62, SPB Academic Publishing, ISBN 9-05103-065-7, Hague, The Netherlands

Kanno, T., Fukuyama, M., Oku, T., Sasaki, H. and Nagamachi, M. (1998). A study of images and amenity of grassland landscape, using SD method. *Grassland Science,* Vol.44, pp. 127-137, ISSN 1744-6961

Katano, O., Hosoya, K., Iguchi, K. and Yamaguchi, M. (2003). Species diversity and abundance of freshwater fishes in irrigation ditches around rice fields. *Environmental Biology of Fishes,* Vol.66, pp. 107-121, ISSN 0378-1909

Kato, M. (2001). 'SATOYAMA' and biodiversity conservation: 'SATOYAMA' as important insect habitats. *Global Environmental Research*, Vol.5, pp. 135-149, ISSN 1343-8808

Kurita, H. and Yokohari, M. (2001). Ecological potentials of golf courses on hills for the conservation of satoyama landscapes. *Journal of the Japanese Institute of Landscape Architecture,* Vol.64, pp. 589-594, ISSN 1340-8984

Lambeck, R. J. (1997). Focal species: a multi-species umbrella for nature conservation. *Conservation Biology*, Vol.11, pp. 849-856, ISSN 0888-8892

Lane, S. J. and Fujioka, M. (1998). The impact of changes in irrigation practices on the distribution of foraging egrets and herons (Ardeidae) in the rice fields of central Japan. *Biological Conservation,* Vol.83, pp. 221-230, ISSN 0006-3207

Lillesand, T. M. and Kiefer, R. W. (2000). *Remote Sensing and Image Interpretation.* John Wiley & Sons, ISBN 0-471-25515-7, New York

Lynagh, F. M. and Urich, P. B. (2002). A critical review of buffer zone theory and practice: a Philippine case study. *Society and Natural Resources*, Vol.15, pp. 129-145, ISSN 0894-1920

Löfvenhaft, K., Runborg, S. and Sjögren-Gulve, P. (2004). Biotope patterns and amphibian distribution as assessment tools in urban landscape planning. *Landscape and Urban Planning,* Vol.68, pp. 403-427, ISSN 0169-2046

Makhzoumi, J. and Pungetti, G. (1999). *Ecological Landscape Design & Planning: The Mediterranean Context*. E & FN Spon, ISBN 0-419-23250-8, London

Margerum, R. D. and Born, S. M. (1995). Integrated environmental management: moving from theory to practice. *Journal of Environmental Planning and Management,* Vol.38, pp. 371-391, ISSN 0964-0568

McGarigal, K., Cushman, S. A., Neel, M. C. and Ene, E. (2002). *FRAGSTATS: Spatial Pattern Analysis Program for Categorical Maps.* University of Massachusetts, Amherst. Available from: http: www.umass.edu/landeco/research/fragstats/fragstats.html

McNeely, J. and Keeton, W. (1995). The interaction between biological and cultural diversity: Components of a Global Strategy. In: *Cultural Landscapes of Universal Value*, Droste, B. v., Plachter, H. and Rossler, M. (Eds.), pp. 25-37, Gustav Fischer, ISBN 3-334-61022-5, Jena

McNeely, J. A. (1995). How traditional agro-ecosystems can contribute to conserving biodiversity. In: Halladay, P. and Gilmour, D. A. (Eds.), *Conserving Biodiversity Outside Protected Areas: the Role of Traditional Agro-ecosystems*. IUCN, Gland, pp. 228.

Meffe, G. K. and Carroll, C. R. (1994). *Principles of Conservation Biology*. Sinauer Associates, Sunderland.

Melnick, R. Z. (1983). Protecting rural cultural landscapes: finding value in the countryside. *Landscape Journal*, Vol.2, pp. 85-97.

Miller, J. R. and Hobbs, R. J. (2002). Conservation where people live and work. *Conservation Biology*, Vol.16, pp. 330-337, ISSN 0888-8892.

Miller, K. R. (1996). Conserving biodiversity in managed landscapes. In: Szaro, R. C. and Johnston, D. W. (Eds.), *Biodiversity in Managed Landscapes.* Oxford University Press, New York, pp. 425-441.

Ministry of the Environment (2002). *Shin-Seibutsutayosei Kokka Senryaku*. *Gyose*i, Tokyo.

Mittermeier, R. A., Gil, P. R., Hoffman, M., Pilgrim, J., Brooks, T., Mittermeier, C. G., Lamoreux, J. and Fonseca, G. A. B. d. (2004). *Hotspots Revisited: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions.* Cemex, Mexico City, Mexico.

Nakagoshi, N. (1995). Changing cultural landscapes in Japan. In: *Cultural Landscapes of Universal Value*, Droste, B. v., Plachter, H. and Rossler, M. (Eds.), pp. 128-138, Gustav Fischer, ISBN 3-334-61022-5, Jena

Nassauer, J. I. (1988). Landscape care: perceptions of local people in landscape ecology and sustainable development. In: *Landscape/land use planning.* American Society of Landscape Architects (Ed.), pp. 27-41, ASLA, Washington, D.C.

Nassauer, J. I. (1995). Messy ecosystems, orderly frames. *Landscape Journal*, Vol.14, pp. 161-170, ISSN 0277-2426

Nassauer, J. I. and Corry, R. C. (2004). Using normative scenarios in landscape ecology. *Landscape Ecology*, Vol.19, pp. 343-356, ISSN 0921-2973

Natori, Y. and Chenoweth, R. (2008). Differences in landscape perceptions and preferences between farmers and naturalists. *Journal of Environmental Psychology,* Vol.28, pp. 250-267, ISSN 0272-4944

Natori, Y., Fukui, W. and Hikasa, M. (2005). Empowering nature conservation in Japanese rural areas: a planning strategy integrating visual and biological landscape perspectives. *Landscape and Urban Planning*, Vol.70, pp. 315-324, ISSN 0169-2046.

Natori, Y., Kohri, M., Hayama, S. and De Silva, N. (in review). Key Biodiversity Areas identification in Japan Hotspot. Journal of Threatened Taxa, ISSN 0974-7907.

Natori, Y. and Porter, W. P. (2007). Japanese Serow (*Capricornis crispus*) Energetics Landscape Modeling Predicts Distribution on Honshu, Japan. *Ecological Applications*, Vol.17, pp. 1441-1459, ISSN 1051-0761

Nature Conservation Bureau (1999). *The Dataset for GIS on the Natural Environment, Japan (Ver. 2) CD-ROM.* Nature Conservation Bureau, Environment Agency, Tokyo

Nature Conservation Bureau (2002). *Living with Nature: the National Biodiversity Strategy of Japan.* Nature Conservation Bureau, Ministry of the Environment, Tokyo

Nature Conservation Bureau (2005). *The Dataset for GIS on the Natural Environment, Japan (world geodetic system) CD-ROM.* Biodiversity Center, Ministry of the Environment, Yamanashi

Nature Conservation Bureau and Asia Air Survey (1999). *Shokusei Chosa Houkokusho (5th National Survey on the Natural Environment report).* Nature Conservation Bureau, Environment Agency, Tokyo

Naveh, Z. (2000). What is holistic landscape ecology? A conceptual introduction. *Landscape and Urban Planning,* Vol.50, pp. 7-26, ISSN 0169-2046

Naveh, Z. (2001). Ten major premises for a holistic conception of multifunctional landscapes. Landsc*ape and Urban Planning,* Vol.57, pp. 269-284, ISSN 0169-2046

Norton, B. G. (1991). *Toward Unity among Environmentalists.* Oxford University Press, New York

Noss, R. (1990). Indicators for monitoring biodiversity: a hierarchical approach. *Conservation Biology*, Vol.4, pp. 355-364, ISSN 0888-8892

Noss, R. (1991). From endangered species to biodiversity. In: *Balancing on the Brink of Extinction: The Endangered Species Act and Lessons for the Future*, Kohm, K. A. (Ed.), pp. 227-246, Island Press, ISBN 1-55963-006-X, Washington, D.C.

Noss, R. F. and Cooperrider, A. Y. (1994). *Saving Nature's Legacy: Protecting and Restoring Biodiversity.* Island Press, ISBN 1-55963-248-8, Washington, D.C.

Noss, R. F. and Scott, J. M. (1997). Ecosystem protection and restoration: the core of ecosystem management. In: *Ecosystem Management: Applications for Sustainable Forest and Wildlife Resources*, Boyce, M. S. and Haney, A. W. (Eds.), pp. 239-264, Yale University Press, ISBN 0-30007-858-7, New Haven

Okubo, K. and Maenaka, H. (1995). Effect of consolidation on paddy-side grassland communities and ecological niche in agro-ecosystem. *Journal of the Japanese Institute of Landscape Architecture*, Vol.58, pp. 109-112, ISSN 1340-8984

Pastor, J. and Broschart, M. (1990). The spatial pattern of a northern conifer-hardwood landscape. *Landscape Ecology*, Vol.4, pp. 55-68, ISSN 0921-2973

Peck, S. (1998). *Planning for Biodiversity: Issues and Examples. Isla*nd Press, Washington, D. C.

Phillips, A. (1995). Cultural landscapes: an IUCN perspective. In: *Cultural Landscapes of Universal Value* Droste, B. v., Plachter, H. and Rossler, M. (Eds.), pp. 380-392, Gustav Fischer, ISBN 3-334-61022-5, Jena

Pimentel, D., Stachow, U., Takacs, D. A., Brubaker, H. W., Dumas, A. R., Meaney, J. J., O'Neil, J. A. S., Onsi, D. E. and Corzilius, D. B. (1992). Conserving biological diversity in agricultural/forestry systems: most biological diversity exists in human-managed ecosystems. *BioScience*, Vol.42, pp. 354-362, ISSN 0006-3568

Porter, W. P., Budaraju, S., Stewart, W. E. and Ramankutty, N. (2000). Calculating climate effects on birds and mammals: impacts on biodiversity, conservation, population parameters, and global community structure. *American Zoologist*, Vol.40, pp. 597-630, ISSN 0003-1569

Porter, W. P., Munger, J. C., Stewart, W. E., Budaraju, S. and Jaeger, J. (1994). Endotherm energetics: From a scalable individual-based model to ecological applications. *Australian Journal of Zoology*, Vol.42, pp. 125-162, ISSN: 0004-959X

Porter, W. P., Sabo, J. L., Tracy, C. R., Reichman, O. J. and Ramankutty, N. (2002). Physiology on a landscape scale: plant-animal interactions. *Integrative and Comparative Biology*, Vol.42, pp. 431-453, ISSN 1540-7063

Possingham, H. P., Andelman, S. J., Burgman, M. A., Medellin, R. A., Master, L. L. and Keith, D. A. (2002). Limits to the use of threatened species lists. *Trends in ecology & evolution*, Vol.17, pp. 503-507, ISSN 0169-5347

Prendergast, J. R., Quinn, R. M., Lawton, J. H., Eversham, B. C. and Gibbons, D. W. (1993). Rare species: the coincidence of diversity hotspots and conservation strategies. *Nature,* Vol.365, pp. 335-337, ISSN: 0028-0836

Regier, H. A. (1993). The notion of natural and cultural integrity. In: *Ecological Integrity and the Management of Ecosystems*, Woodley, S. and Kay, J. (Eds.), pp. 3-18, St.Lucie Press, ISBN 0-96340-301-X, Delray Beach, FL

Rookwood, P. (1995). Landscape planning for biodiversity. *Landscape and Urban Planning*, Vol.31, pp. 379-385, ISSN 0169-2046

Saunders, D. A. (1990). The landscape approach to conservation: community involvement, the only practical solution. *Australian Zoologist*, Vol.26, pp. 49-53, ISSN 0067-2238

Scott, M., Davis, F. W., McGhie, R. G., Wright, R. G., Groves, C. and Estes, J. (2001). Nature reserves: do they capture the full range of America's biological diversity? *Ecological Applications*, Vol.11, pp. 999-1007, ISSN 1051-0761

Shinji, I. (1981). Shizenkeikanchi ni okeru shikisai kankyo kanri no kihonnmondai. In: *Shizenkeikanchi ni okeru Shikisaikijun ni kansuru Kenkyu Hokokusho*, Nagashima, M., Shinji, I., Aso, M., Kodama, A. and Nishikawa, I. (Eds.), pp. 16-54, Asesu, Tokyo

Silbernagel, J. (2005). Bio-regional patterns and spatial narratives for integrative landscape research and design. In: *From Landscape Research to Landscape Planning: Aspects of Integration, Education, and Application*, Tress, B., Tress, G., Fry, G. and Opdam, P. (Eds.), pp. 107-118, Springer, ISBN 1-40203-979-4, Dordrecht

Statistics Department (2005). *The 79th Statistical Yearbook of Ministry of Agriculture, Forestry and Fisheries.* Statistics Department, Ministry of the Agriculture, Forestry and Fisheries, Tokyo

Suzuki, S. and Hori, S. (1989). A study on the estimation of naturalness and the liking in forest landscapes. *Journal of the Japanese Institute of Landscape Architecture,* Vol.52, pp. 211-216, ISSN 1340-8984

Tabuchi, T. and Ogawa, Y. (1995). Environmental characteristics of paddy fields. In: *Paddy Fields in the World*, Tabuchi, T. and Hasegawa, S. (Eds.), pp. 327-340, Japanese Society of Irrigation, Drainage and Reclamation Engineering, ISBN 4-88980-077-8, Tokyo

Takeuchi, K., Brown, R. D., Washitani, I., Tsunekawa, A. and Yokohari, M. (Eds.) (2003). *Satoyama: The Traditional Rural Landscape of Japan.* Springer, ISBN 4-43100-007-0, Tokyo.

Tanokura, N., Yokohari, M., Yamamoto, S. and Kato, Y. (1999). Local residents' impressions and perceptions on paddy field landscapes: a case study in Hiki region, Saitama Prefecture, Japan. *Journal of the Japanese Institute of Landscape Architecture*, Vol.62, pp. 727-732, ISSN 1340-8984

The Japan Environmental Council (Ed.) (2005). *The State of the Environment in Asia 2005/2006.* Springer, ISBN 9784431250289, Tokyo.

Trauger, D. L. (1999). Can we manage for biological diversity in the absence of scientific certainty? In: Practi*cal Approaches to the Conservation of Biological Diversity*, Baydack, R. K., Campa, H., III and Haufler, J. B. (Eds.), pp. 195-202, Island Press, ISBN 1-55963-544-4, Washington, D.C.

Tress, B. and Tress, G. (2001). Capitalising on multiplicity: a transdisciplinary systems approach to landscape research. *Landscape and Urban Planning*, Vol.57, pp. 143-157, ISSN 0169-2046

Tress, B., Tress, G. and Fry, G. (2005). Integrative studies on rural landscapes: policy expectations and research practice. *Landscape and Urban Planning*, Vol.70, pp. 177-191, ISSN 0169-2046

Tsunekawa, A. (2003). Transition of satoyama landscapes in Japan. In: *Satoyama: The Traditional Rural Landscape of Japan*, Takeuchi, K., Brown, R. D., Washitani, I., Tsunekawa, A. and Yokohari, M. (Eds.), pp. 41-51, Springer, ISBN 4-43100-007-0, Tokyo

Walters, C. J. and Holling, C. S. (1990). Large-scale management experiments and learning by doing. *Ecology,* Vol. 71, pp. 2060-2068, ISSN 0012-9658

Washitani, I. (2001). Traditional sustainable ecosystem 'SATOYAMA' and biodiversity crisis in Japan: conservation ecological perspective. *Global Environmental Research*, Vol.5, pp. 119-133, ISSN 1343-8808

Wells, M. P. and Brandon, K. E. (1993). The principles and practice of buffer zones and local participation in biodiversity conservation. *Ambio*, Vol.*22,* pp. 157-162, ISSN 0044-7447

Yokohari, M. (2000). Agrienvironmental policies in North America, Europe and Japan. *Journal of the Japanese Institute of Landscape Architecture*, Vol.63, pp. 182-185, ISSN 1340-8984

Yokohari, M., Brown, R. D. and Takeuchi, K. (1994). A framework for the conservation of rural ecological landscapes in the urban fringe area in Japan. *Landscape and Urban Planning*, Vol.29, pp. 103-116, ISSN 0169-2046

Yokohari, M. and Kurita, H. (2003). Mechanisms of satoyama landscape transformation. In:, *Satoyama: The Rural Landscapes of Japan*, Takeuchi, K., Brown, R. D., Washitani, I., Tsunekawa, A. and Yokohari, M. (Eds.), pp. 71-79, Springer-Verlag, ISBN 4-43100-007-0, Tokyo

Yokohari, M., Morimoto, Y. and Nakagoshi, N. (2005). Editorial: Ecological dynamics of urban and rural landscapes in East Asia. *Landscape and Urban Planning*, Vol.70, pp. 193-194, ISSN 0169-2046

Zhou, J.-M. (2001). *Sustainable Development in Asia, America and Europe with Global Applications: A New Approach to Land Ownership.* Edward Elgar, ISBN 1-85898-965-5, Cheltenham, UK.



Research in Biodiversity - Models and Applications

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The book covers several topics of biodiversity researches and uses, containing 17 chapters grouped into 5 sections. It begins with an interesting chapter considering the ways in which the very biodiversity could be thought about. Noteworthy is the chapter expounding pretty original "creativity theory of ecosystem". There are several chapters concerning models describing relation between ecological niches and diversity maintenance, the factors underlying avian species imperilment, and diversity turnover rate of a local beetle group. Of special importance is the chapter outlining a theoretical model for morphological disparity in its most widened treatment. Several chapters consider regional aspects of biodiversity in Europe, Asia, Central and South America, among them an approach for monitoring conservation of the regional tropical phytodiversity in India is of special importance. Of interest is also a chapter considering the history of the very idea of biodiversity emergence in ecological researches.

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