A HISTORICAL REVIEW OF CONSERVATION EFFORTS IN JAPAN *

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1. Introduction

In Japan, the Tokugawa Shogunate was initiated as a feudal system separated from the emperor system in 1603. Under the shogunate (a military government headed by a field martial called "Shogun") there were many feudal lords (daimyos). Nature conservation and wildlife management were implemented by these feudal lords until 1867. In 1867, the feudal system was abandoned, and the original emperor system was revived under Emperor Meiji in 1868. Western-style modernization commenced with the invitation of foreign experts in various fields, and young able students were sent to European (particularly to German) universities to study modern science and technology, law, economics, philosophy and literature, etc.

In the beginning of the Meiji Era there were no laws related to nature conservation to replace the abandoned regulations of the previous Tokugawa Shogunate Era. However, the idea of natural monument came from Germany, and a proposal for the preservation of the historic sites and natural monuments was submitted to the House of Peers in 1911. The Historic Sites, Scenic Beauty and Natural Monument Preservation

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Law was promulgated eight years later (1919). It was included in the Law for the Protection of Cultural Properties issued in 1950.

The National Parks Law was issued in 1931, and it was incorporated into the Natural Parks Law (1957) which covers National, Quasi-National, Prefectural and Municipal Natural Parks (which are different from City Parks). In addition to this, the Nature Conservation Law was issued in 1972. Under it, nature conservation areas in a broad sense include wilderness areas and nature conservation areas.

Besides these, Protected Forests for Science were designated based on guidelines in a circular from the Forestry Agency in 1915.

Next, ecological problems related to nature conservation in Japan will be discussed.

2. Construction of Roads in Mountainous Areas

In 1973, the possibility of construction of a mountain motorway in the Mt. Daisetsu National Park in Hokkaido was discussed in the Natural Environment Conservation Council. At that time, the chairman of the Council proposed that the construction of mountain motorways in alpine and subalpine zones should not be permitted.

The extension of the Venus Line (a subalpine highway on Utsukushi-gahara Heights in central Japan) was also debated in the Council. The Environment Minister stopped the extension, however the construction of the highway was later permitted. The logic behined this permission was that the degree of naturalness along the route of the highway is low. The reason was that the *Abies veitchii* forest along the route is a secondary forest felled in the Meiji Era, and the *Festuca ovina* pasture is a semi-natural vegetation under the grazing pressure. However, the *Abies veitchii* forest is very similar to a natural forest with its rich wildlife fauna, and the *Festuca ovina* pasture is an indigenous grassland type particularly in the subalpine zone. If a motorway passes through such a forest, the wildlife habitat is divided into two sections. In that case, a specialist proposed a bridge for animals. Though the degree of naturalness from

the standpoint of succession is not so high in the forest and pasture along the highway route, the necessity for their conservation is still very high. The degree of naturalness is similar to the degree of succession (Numata 1969) from the pioneer to the climax stage, but it has no value concept, however, the necessity for conservation is a value-ladened judgment. Therefore, the importance of various vegetation types should be judged from the necessity for conservation, not by the degree of naturalness. The Utsukushigahara Heights (Tsuchida and Numata 1979) belong to a quasi-national park because of the beautiful scenery of grasslands with *Rhododendron japonicum* which are a result of cattle-raising. Beautiful spots in national parks with various rhododendrons (*Rhododendron brachycarpum* on Mt. Donden of Sado Island, *Rhododendron kiusianum* on Mt. Kirishima in Kyushu, etc.) are all products of grazing in natural stands. In the Utsukushigahara Heights, some grasslands having rhododendrons were denuded by bulldozers, and European forage grasses and legumes were sown for milk-cow grazing. One cannot deny animal husbandry in the subalpine zone, however, one must reject it in the core area of a national park. The *Festuca ovina* pasture is an indigenous type of grassland, however, the orchard grasstimothy-ladino clover sown pasture is an exotic vegetation which is not fit for the landscape of a national park. Recently biosphere reserves are being designated by the UNESCO/MAB. The reserve has the core, buffer and cultural zones. In the above case, the core area includes cultural spots which are not fit for national parks nor for reserves.

One more striking example is the Southern Alps Super-Forestry Motorway in Central Japan. The so-called Super-Forestry Motorway is a multipurpose highway mainly for tourism. The highway passing through high places in the subalpine zone is not necessary if not considered as a forestry road. In fact, Forestry Agency has said that there was no plan to fell the subalpine natural forest nor to make plantations. Also, it is not considered to be an effective way to prevent village depopulation. The period of usage of the road is limited to from-May-to-October. The Ecological Society of Japan recommended the Preservation Plan

of Natural Forests to the Science Council of Japan in 1964 including the preserve area of Southern Alps covered by natural coniferous forests. In spite of that recommendation, the route of the Super-Forestry Motorway passing through the Southern Alps National Park was planned and construction begun. After that, Environment Minister requested the temporary stoppage of construction of the road because of geological unstability. At that time, 160m remained to complete the Motorway and I proposed leaving that last 160m as a monumental reserve. However, the agreement to connect the last part of 160m was obtained in the Council, and the Motorway was completed. Land slides and erosion have occured there every year particularly in the typhoon season after completion. The villages along the road now have the heavy burden of repairing areas damaged by land slides every year.

As I mentioned earlier, a bridge between the two parts of the forest separated by the highway was proposed, but the only animals utilizing the bridge may be dogs, voles, and the like. When a route of the highway was planned to pass through a wetland including a rich flora of insectivorous plants, the construction authorities recommended us to transplant those plants to paddy fields. The ideas of bridges and transplantation, etc. are dangerous alternatives for nature conservation. It appears to some to be nature conservation, but it is in fact anti-conservation.

3. Expansive Afforestation Policy and Large-Scale Grassland Establishment

Forestry is usually considered as a tool to increase forested areas. However, it has contributed to great destruction of nature in Japan after the war. During the war time, forests were felled for the purpose of war. After the war, the Forestry Agency adopted the policy of extensive plantation, such as *Larix kaempferi* in the north or high altitudes, and *Cryptomeria japonica* and *Chamaeciparis obtusa* in the south or low altitudes. To do that, natural forests of *Fagus crenata* were felled all over the country.

In addition to this, the budget of the Forestry Agency was separated

from the Governmental budget, and Forestry Agency must now pay all of its own expenses including salaries, facilities and so on by selling the timbers of natural forests. To do that, most of the natural beech forests have been felled. Recently, some natural stands left in Aomori and Akita Prefectures, etc. have become the most important objectives of the conservation movement. The Nature Conservation Society of Japan has "the Beech Forests Conservation Funds" to which many people have contributed. The natural forest of *Fagus crenata* is the most representative of summer green forests in the cool-temperate zone in Japan, which is closely related to the beech forests in China, Eurasia and North America. After the war, the directors of Regional Forestry Bureaus were said to have had upper positions because of the cutting and depletion of natural beech forests.

In Hokkaido, there were good stands of conifers such as *Abies sachalinensis* and *Pices jezoensis* which are typical shade trees. The seedlings of those trees must be kept at the nursery covered by screens for several years. The natural forests and plantations of *Abies* and *Picea* in Hokkaido and natural beech forests in northeastern part of Honshu and in the mountainous zone in Honshu were replaced by plantations of *Larix kaempferi* after the war. However, the growth of the larch plantations is not always good, and the larch timber is also not so good. In conifer plantations particularly those of *Chamaecyparis obtusa*, Japanese serow has increased as has its browsing damage. However, Japanese serow is a special national monument, and people cannot kill or seize it without governmental permission. In some villages where browsing damage due to serow took place, people have fought against the authorities. This is mainly caused by the change in tree species from the *Fagus crenata* of natural forests to *Chamaecyparis obtusa* of plantations which is preferred by serow.

As a result, the expansive afforestation policy adopted by the Forestry Agency after the war has recently been criticized. This expansive afforestation programme has ultimately been the equivalent of an expansive nature-destruction programme.

The most important guideline for forestry must be a balanced allocation in area of natural, semi-natural and artificial forests (not so extensive). A policy aimed only at extensive plantations is not desirable.

Japan is characterized by forest climate and semi-natural grasslands exist under biotic pressures of mowing, grazing and burning. Such kinds of grassland were easily found everywhere before the war. However, the utilization of herbage decreased after the war, because village people did not breed horses and cattle, animal husbandry was performed under cover, people did not use grasses for thatch, and so on. There were many national and quasi-national parks with grassland landscape just after the war, such as the *Festuca ovina* pastures and *Calamagrostis longiseta* meadows of central Honshu, the *Zoysia japonica* pastures of northeasten Honshu, the dwarf bamboo (*Pleioblastus variegatus* var. *viridis*) pastures and meadows of Kyushu and so forth. Some semi-natural grasslands found in national parks are changing their physiognomy, structure and composition because biotic factors are weakened.

Besides those reserved areas, large-scale grassland establishment was recommended in relationship to the land development programme of the Government. Following this guideline, the land surface was denuded, and seeds and fertilizer were distributed by airplane. After denudation on slopes, large-scale landslides occurred, after which rows of trees were planted along the contour line. These had been originally woodlands which were clear cut by agricultural machines. Some fragments of woodland should be left, but technicians do not like to leave woodlands because of technological diffculties.

From the viewpoint of the environmental conservation of lands, a proper allocation of urbanized areas, industrial areas and rural areas as well as croplands, grasslands, woodlands, natural forests, national parks, etc. is important. This is an ecosystem viewpoint of land use. If it is limited to grasslands, semi-natural, improved, and sown grasslands (pastures and meadows) should be properly allocated.

4. Sustained Yield and Conservation.

There was a workshop on sustained yield forestry at the East-West Center (the Environment and Policy Institute) in 1978. The concept of yield of forests means not only timber production, but also other forest products including mushrooms, twigs and leaves as fodder, carrying capacity for recreation, water holding capacity, wildlife, and others.

In Japan, there is a system of protection forests designated by the Forestry Agency with the purposes of protecting water resources, preventing landslides, and controlling erosion, etc. Such functions of forests are also part of the concept of yield as well as timber production. There is a Nature Study Park in Tokyo which permits less than 300 visitors per 20 ha at one time. If more visitors come, they must wait sitting on the benches at the entrance until some of the visitors who have already entered come out. The limit of 300 visitors per 20 ha is considered to be the carrying capacity of the Park. The carrying capacity as a stocking rate was originally a basic concept of animal husbandry. If a cow grazes in a one-ha pasture, the grazing intensity and the growth of grasses are balanced. If ten cows graze in a pasture of the same area, the pasture is overgrazed and becomes bare ground. In this example, the carrying capacity of the pasture is 1 cow/ha. In relationship to this idea, various animal grazing equivalents and animal units are proposed (Brown 1954).

The sustained yield means that the productivity of a pasture continues to maintain an appropriate balance between the grazing intensity and the growth of grasses.

At the workshop in Hawaii mentioned above, the objective of sustained yield forestry was sustainability in forest ecosystems in a broad sense. This is a leading principle for forest production and conservation.

In the Fifth Tropical Ecology Symposium held in 1979 in Kuala Lumpur, Malaysia, the proceedings were published in 1980, and the main theme was "Ecology and Development". In this symposium, research, education and strategies for ecodevelopment, land use policy and planning,

etc, were discussed. For ecodevelopment, minimizing the industrialized areas and distributing small-scale industries, according to the concept of carrying capacity for industrial development are very important. The co-existence of man and his environment with appropriate technology is also important. The "World Conservation Strategy" developed by the IUCN／UNEP／WWF also has a strong philosophy of ecocevelopment balanced with conservation. In the Tokyo Declaration of the World Special Committee on Environment and Development (Tokyo, 1987), the concept of sustainable development was stressed. However, sustainable utilization on the basis of appropriate technology is better than sustainable development.

5. Condition and Trend Diagnosis of Pastures and Meadows

Pastures and meadows are widely used for animal husbandry in the grassland climax region as well as in the forest climax region. Even in the grassland climax region, pastures and meadows are usually separated from climax grassland by an ecological distance. In the forest climax region, pastures and meadows are semi-natural or man-made. Semi-natural pastures and meadows are the results of the destruction of forests and the continuation of mowing, grazing and burning. Pastures and meadows cover various stages of secondary succession which have ranges in the degree of succession (DS). The biomass-DS curve has a range and mode (peak) in which a pasture is situated having an ecological distance from the mode (Numata 1982). Therefore, the ecological distance is measured from the climax in the grassland climax region, and from the mode in the semi-natural grassland region.

During the IBP Period, a comparison of the productivity of the world's grasslands was attempted. However, in my opinion, comparisons must be done at an equal stage and phase of succession or at an equal ecological distance from the modal DS of a seral stage. There is no problem in the comparison of the productivity of climax forests in different regions, however in comparing semi-natural seral grasslands, the criteria should be given on the DS axis.

If we add the grazing rate to the formula DS, we get the index of grassland condition (IGC) to judge the pastures and meadows as being good or not. Besides this, p(0～1)* and F%** are used for judging the condition and trend of pastures and meadows. To avoid overgrazing and maintain good condition, those measures as well as other measures devised should be used for grassland conservation (Numata 1986). I have also proposed the progressive rate ($\vec{RS}$) and the retrogressive rate of succession ($\overleftarrow{RS}$) to understand the ecological status of grasslands, from the dynamic viewpoint (Numata 1987a).

6. Wildlife Conservation

There are problems of overpopulation and damage caused by the Japanese monkey, Japanese serow, Japanese deer, etc. In Chiba Prefecture where I am living now, there are more than 100 troops of Japanese monkey designated as a national natural monument. Before the war, there were many stands of coppice for fuel and charcoal where the Japanese monkey lived. Coppices have a felling cycle of 20-30 years, therefore the area has a variety of coppices from young (just after felling) to old (20-30 year old stands) which is very suitable for the monkey's daily life (nomadism and nomadic range of a troop).

After the war, coppices (deciduous broad-leaved forests) for fuel and charcoal were not useful in the energy revolution. Coppices in the central part of the Boso Peninsula (Chiba Prefecture) were almost completely felled, and replaced by coniferous plantations (*Chamaecyparis obtusa* and *Cryptomeria japonica*) where the monkey cannot live, because there is no food nor open ground. On the other hand, researchers tried to feed a troop of monkeys to follow their behaviour and sociological structure, and village people wanted to utilize the monkey for their tourist industry. Meanwhile, monkeys increased their population by feeding, and

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* p is the palatalibity or grazing rate.

** Forage (F)% is (the sum total of SDR of grazed species)／(the sum total of SDR of all constituent species)×100.

they extended their home range to paddy fields, vegetable fields, and the orchards of villages. This resulted in so-called "monkey's damage". Radical conservationists insisted that village people should retreat, because people deprived the monkey's home ground. On the other hand, village people asked the Governor for permission to seize or kill the monkeys. Thus, the conflict between conservationists and the village people became serious. After a conflict of about 25 years, a new direction was taken. It involves driving monkeys into designated areas with the cooperation of the village people, researchers, conservationists and prefectural officials with the financial support by the Cultural Agency. It is an attempt to limit the living area of a troop of monkeys to the area designated by the Government. However, since monkeys do not know the border of the designated area, electric fences, fireworks, and catapult were used to help them becoming aware of the limits of the designated area. Prefectural coniferous plantations (*Cryptomeria japonica*, 40 years old) are in the area, but these do not suit the monkeys' life style. Then the Prefectural Forestry Section decided not to replant conifers, but to plant wild fruit trees which monkeys like, and deciduous broad-leaved trees in coppices. This was a drastic decision for the foresters, but when the coppices regenerate as before the war, wildlife and man will again be able to be co-existence. The monkey in Chiba Prefecture is a local problem, however problems in the relationship between wildlife and man are found all over the world. In this sense, the relationship between wild monkeys and man in Chiba Prefecture is a kind of global environmental problem. Not only wildlife but also natural biota are very important gene pools. We must preserve the gene pools for our descendants.

UNEP proposed GEMS (the Global Environment Monitoring System) including health-related monitoring networks, climate-related monitoring networks and renewable natural resources monitoring networks. The preservation of biota including wildlife will be included in the renewable natural resources monitoring networks.

7. The Application of Bio-indicators

The Ecological Society of Japan (1975) sent a proposal to the Environment Agency in connection with the Global Environmental Monitoring Programme of SCOPE. In the proposal, the Society requested the implementation of environmental monitoring not only with physico-chemical measurements but also with bio-indicators using various biological phenomena of each site. In particular, this includes observing species, the number of individuals, the biomass and the community dynamics of existing indicator organisms, and from these estimating past conditions. It is necessary to measure other aspects by bio-indicators when it is not possible to measure them by physico-chemical instruments.

Environmental evaluation using bio-indicators has disadvantages as well as advantages. To measure the momentary intensity of a single inorganic factor, the physico-chemical measurement is very useful. But to evaluate the average effect on organisms over a long period of time, or the mass effect of a complex of factors, it is not so useful. Such effects of environment on an organism or a community will be nicely measured by the response of those organisms used as indicators.

The indicators of urbanization cover a wide area of physico-chemical, biological, socio-economical, cultural, psychological and political phenomena. However, bio-(biological) indicators are mainly considered here.

The concept of bio-indicator originally meant to judge an environment by presently exising plants, animals, and microorganisms in the field. On the other hand, the biometer (Clements and Shelford 1939) is a method by which they measure environmental conditions using especially prepared plants and animals in the containers. The bio-indicator and biometer indicate a complex of factors as well as any single factor, including biotic factors as well as abiotic factors. The levels of indicator organisms are individuals, populations of a species, plant and animal communities, etc.

Plants and plant communities having indicator values were searched for using one environmental factor, such as pH, depth of water table,

temperature, etc. and an environmental complex, such as maturity and productivity of soils, a climatic type, etc. Clements and Goldsmith (1924) tried to measure those environments with especially prepared plants planted in containers. In any event, the methods of bio-indicator and biometer are applied in the field, while the method of environmental bioassay, such as the ratio of abnormal early development of sea urchins in polluted sea waters has been used in a laboratory. The bio-indicator method in a broad sense includes the aspects of biometer and bioassay as well as biological indicator in its original meaning.

Before so-called environmental problems appeared in 1960's, the bio-indicators were used almost exclusively for agriculture, forestry and grazing (Clements 1920). Recently, the method of bio-indicator has been used for judging the quality of various environments, such as the ocean, inland waters, air, soil and cities. Of these, the effect of the urbanization on the quality of the environment in terms of degradation is very great.

Some lichens, mosses and liverworts have been used as bio-indicators of air pollution, and some flowers indicate acid rain by their leaching. In Japan, some bryophytes used as bryometers and morning glories (*Pharbitis nil*) planted in pots were used as biometers for SO_2 pollution and photochemical smog, respectively (Numata 1987b). Besides these, crops such as rice, *Colocasia,* spinach, stone leek, radish, etc. show the characteristic chlorosis and necrosis in response to ozone. The limits of tolerance and practical utilization of indicator or phytometer plants are now studied.

The concept of bio-indicators has been discussed in detail earlier in my book *"Methodology of Ecology"* (1953). Generally it means to measure environmental conditions using biological instead of physico-chemical instruments.

It has been used to estimate macro-environmental as well as micro-environmental conditions. Raunkiaer (1934) tried to express climate on the basis of the statistics of life-forms. He called it "plant climate". Using the same guideline, we can use the expression: plant soil, plant water, plant temperature, plant air, animal climate, animal soil, human climate

(for example, sensible temperature and discomfort index), etc. From this point of view, the concept of bio-indicators is a biocentric environment concept.

Before so-called environmental problems appeared, the bio-indicators were almost exclusively used along the guideline of Clements (1920) and Ellenberg (1950). That is, plants and plant communities were used for judging suitable sites and suitable intensities for growing crops, trees, etc. For that, plants and plant communities having indicator values were searched for environmental complex. The biometer method became practical when they found some sensitive structural and functional responses to environmental changes.

After environmental problems appeared, the concept of bio-indicator methods has been changed and concentrated on the application of the methods to evaluate the degree of degradation of the human environment (Numata 1982).

8. Urbanization and Industrialization

The process of urbanization includes changes in land use patterns, distribution of the population, forms and levels of industrialization, transportation network, hydrological cycle, the amount and extent of pollution, etc. The impact of urbanization and responses of living things to the urbanized environment have the distributional pattern and health of plants and animals, human physical and mental health, behaviors, psychological responses, the self-domestication of man to higher forms of civilization, bio-indicators, biometers and laboratory bioassays of environmental quality, etc. In addition to food chains of which man is an integral part, the flow of energy, material, people and information, the metabolism of a city, and its carrying capacity as it relates to human well-being in various senses, etc. are important topics to be studied (Numata 1976, 1978a).

A city or cities and their immediate environment act together to form an urban system into which matter, energy, people and information flow from other urban systems and out of which organized and degraded

matter, degraded energy, people and information flow. Project 11 of MAB originally aimed only at the energy flow of urban and industrial systems. However, the title of the project has been changed to include more integrated studies. The objectives of MAB are connected to decision-making and planning, but at this stage of our study, we are only conducting problem-oriented basic research for those purposes.

In the Nature Study Park which we have been studying since 1950, various trees died over the last 35 years and the floristic compostion of the vegetation has changed. Usually the survival ratio of trees deteriorates with air pollution. However, it would be unwise to assume that the two phenomena are directly related. These are an earlier cause and a later effect situation. A complex sequence of cause and effect is involved here.

The survival ratio of the climax tree, *Castanopsis cuspidata* var. *sieboldii*, is rather high, but its health condition is not always good. Its vigor is gradually declining due to the defoliation done by the leaf miner and other noxious insects from May to June, every year. The same thing holds true in the case of the deciduous trees. This abnormal and unseasonal defoliation increasingly deteriorates the vigor of the trees. One of the causes of the outbreak of such insects may be the disappearance of insectivorous birds in the area. The disapearance of some birds, such as the great tits results from urbanization, in the form of noise, air pollution and decrease in the number of habitats. The combination of such complex causal relationships reduces the survival ratio of the trees. This means a deterioration in the environmental quality of a city, which in turn affects man's health and behavior patterns. On the basis of various accumulated data, a simulation model of the urban ecosystem will be established. It will include the flows of energy, materials and population as well as the network of components related to man's well-being. Our present study can be considered to be a part of the ecosystem studies based on these guidelines.

In our urban ecosystem studies, the impacts of urbanization on the components of urban environments were studied independently at first, and then the reaction of components to the environment was studied. Up

to this stage, action and reaction in Clementsian terms were pursued. This stage is multidisciplinary but not sufficiently interdisciplinary, and thus not integrated.

In the next stage, the biocentric and anthropocentric interdisciplinary approach was tried. Studies on the impact of the urban environment on vegetation are very easy and familiar for a plant ecologist. However, phytocentric, interdisciplinary studies on influences of vegetation on animals and man and their environment are not so easy nor familiar for plant ecologists.

In the third stage, the integration of the structure, function and dynamics of urban ecosystems was tried, particularly through the role of water, not only urban hydrology but also the role of water as throughput and indicator of increasing entropy. Water utilized in the production process (input and output) and water as a throughput are tools of integration.

Thus, multidisciplinary → interdisciplinary → integrated studies based on a biocentric or anthropocentric concept have been our ecological approaches to environmental problems.

9. Establishment of nature reserves and ralated problems

As mentioned in the introduction, the natural monument was the earliest concept used in Japan for designating plants and animals for conservation. The criteria for plant designation are: 1) big trees, old trees and deformed trees, 2) representative primeval forests and rare forest flora, 3) representative alpine plant zone, grasslands, plant communities on special rocks, sandy coasts, peat and caves, lakes and rivers, and 4) the boundary of plant distribution, etc. The criteria for animals designation are: 1) endemic animals and their habitat, 2) non-endemic but remarkable animals necessary for preservation, and 3) animals or animal communities in natural environments, among others. Besides these, representative areas including natural monuments to be preserved (nature reserves) are also designated. The wildlife reserves of the Japanese monkey, Japanese serow,

Japanese deer, Japanese crested ibis, Japanese crane and black wood pecker, etc. are also included in the natural monuments.

National and Quasi-national parks are zoned as Special Protection Areas, Special Areas (the First, Second and Third Classes) and Common Areas. The Special Protection Area is a strict reserve, but Special Areas are for coordination with forestry, and do not necessarily include buffer zones. The felling of trees is possible in 10% in the First Class Special Area, in 30% in the Second Class Special Area, freely without hindrance to the landscape in the Third Class Special Area, as well as unconditionally in the Common Area. The zoning of National and Quasi-national Parks should follow the idea of the Biosphere Reserve of MAB, such as core area, buffer zone and cultural zone.

A wilderness area is more than 1,000 ha and the nature conservation area is more than 100 ha. These are designated by the Nature Conservation Law. These are conservation-oriented areas which are different from natural parks emphasizing the recreational use as well as conservation. However, these have no buffer zone outside the area. A buffer zone is necessary to maintain the wilderness area and to prevent direct human impact. However, in the case of South Sulpher Island, the whole island is a wilderness area as well as a keep-off area surrounded by the sea. In such a case, buffer zone is not absolutely necessary.

Protection Forests are designated under the Forest Law of 1950. They are divided into 17, such as for water resource conservation, erosion control and landslide prevention, etc. However, the designation of protection forests has sometimes been abandoned for convenience sake to make forest roads, golf courses in forests, and others.

Wildlife protection areas are designated by the Wildlife Protection and Hunting Law of 1918 (amended in 1963). Game-hunting is permitted for chosen species during the hunting season. When game decreases, hunting is temporarily prohibited and in some dangerous areas, gun-hunting is limited.

10. Protection of Endangered Species and Ecosystems

Development often results in the planting of oil palms at felling sites of tropical rain forests, making charcoal from the timber of mangrove forests, industrialization in temperate developed countries, and so on. The rapid loss of indigenous flora and fauna is a common impact.

In Japan, there are conservation-related problems following the large-scale felling of natural forests. On the Shiretoko Peninsula in northeastern Hokkaido, there is a natural mixed forest reflecting the cold-temperate climate which is an ecotone between the cool-temperate deciduous broad-leaved forest and the subarctic conifer forest "taiga" or the boreal forest. The area is designated as a National Park. However, in Japanese National Parks, there are 1st, 2nd and 3rd class Special Areas outside the Special Protection Area as mentioned earlier. The Special Areas are not buffer zones of strict reserve but rather areas for regulating forestry.

Fish-eating owls, black woodpeckers and white-tailed sea eagles are the endangered species in such mixed forests as conservationists have pointed out. Those species are really biologically important endangered species, however it is more important to preserve the mixed forest ecosystem including those species. Forestry Agency has said the following against the opinions of ecologists and conservationists

1) Old-age over-mature trees are felled in order for forest stands to be rejuvenated.
2) This is not a virgin forest, but a natural forest which was partly felled before.
3) This belongs to Special Areas which are areas for coordinating with forestry, and the felling following a contract between Forestry Agency and and Environment Agency when the National Park was designated is legal.
4) Felling a few trees (3～5／ha) causes almost no influence on the environment.
5) Key animal species, such as fish-eating owl have not been found by

a survey team for short period.

However, the Forestry Agency decided to fell the most vigorous trees based on the rusults of a survey team which said it could not find fish-eating owl during their short-time survey. This is very unreasonable. In one case, residents there opposed the action organizing and conducting the so called "Chipko Movement" in Northern India. However, the Forestry Agency felled the trees anyway. Those big trees were sold at an auction for a high price. All of this of course is contradictory to the objectives for rejuvenation.

The beech forest covering the cool-temperate region of Japan was widely felled by the postwar expansive forestry policy. A forest road was planned and is already partly completed in the largest area of beech forest in northern Honshu. Several years ago, the black woodpecker which had been believed to be living only in Hokkaido was found in that northern Honshu beech forest area. It is one of the endangered species of that beech forest which has a very rich fauna.

In the northern part of Okinawa Island, the so called Kunigami area, the primeval evergreen broad-leaved forest has been widely felled. The forest has endangered species, such as the Noguchi woodpecker, the long-legged gold beetle, and the Yanbaru clapper rail, etc. The forests mentioned above should be preserved as nature reserves without forest road construction. Unfortunately, this is virtually impossible to do in today's Japan where development is given priority over protection in almost every case where they conflict.

Recently, the Nature Conservation Society of Japan and the World Wildlife Fund-Japan prepared a draft endangered plant list. It should be enlarged to include sites, communities and ecosystems of those species as well.

The preservation of species by collecting them in botanical gardens and zoos in a long used method. However, there are various forms of botanical gardens from a sort of university institute to a recreation ground which are in general open to the public. Botanical gardens attached to a university are mainly used for research, even when open to the public,

and there one can find collected and grown a large variety of plants.

What kind of botanical garden is good to play a role as a gene pool? Simply collecting and growing as many plants as possible is good. However, there are limitations of climate and soil. For instance, there is the Chibodas Botanical Garden on a mountain as well as the Bogor Botanical Garden on the lowland of Java Island (Indonesia). The Botanical Gardens of the University of Tokyo, Koishikawa (Tokyo) is on lowlands, and the one in Nikko in the highlands is a similar example. Botanical gardens as exhibitions have many exotic plants as well as indigenous plants. Those plants are mixed with the others in Bogox and in Rio de Janeiro. Foreign visitors want to see indigenous plants separated from exotics.

From the ecological point of view, it is undesirable for various species to be planted as individuals, but they should be planted so as to be included with vegetation to which they belong. They should be situated in a floristic composition with some characteristic species having high fidelity. Stratification of forests and grasslands and the combination of growth forms, such as erect, prostrate, climbing, etc., should also be considered. If a botanical garden is composed of such vegetation types, indigenous plants grow well in the framework of vegetations which play a role of the gene pool.

It is best to preserve the indigenous ecosystems of different sites in places such as wilderness areas, strict reserves in national parks, national natural monuments and others.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (the Washington Convention) is an international agreement concluded by 95 countries, including Japan, to regulate the international trade in endangered species. A private organization called Trade Records Analysis of Flora and Fauna in Commerce (Traffic Japan) is active in the protection of wildlife. A domestic law on the transfer of wild fauna and flora passed the Diet in 1987. We now hope for decrease in the endangered wildlife being imported into Japan via illegal trade routes.

11. Environmental Education

Environmental education covers such a wide range of subjects as nature study, natural history, nature conservation, environmental conservation (including anti-pollution) and environmental science (Numata 1978b). Promotion of environmental education after the war was strengthened by the Nature Conservation Society of Japan which requested Ministry of Education, Science and Culture to promote environmental education. The recommendation said that the school curriculum must have a unit of nature conservation with clear-cut aims and methods not only in science, but also in social studies, literature and moral education.

At the 11th Pacific Science Congress held in Tokyo in 1961, the idea of establishing research natural reserves was recommended to the Japanese Government (JIBP-CT 1966). The 64th Parliament in 1970 was called Kogai-Kokkai (Anti-pollution Assembly). It certified that protection of the people's health and the conservation of environment are more important than economic development. The expression "the harmony between environmental conservation and economic development" was not preferred there. After that, anti-pollution education was adopted as a part of social studies in schools as a kind of environmental education.

After a Symposium of the International Society for Vegetation Science was held in Tokyo in 1974, an International Symposium on Environmental Education was also held there. Man's activities make a great impact on his environment and change it. On the other hand, man adapts himself to this damaged environment. How and what to teach on such relationships between man and environment are very important questions for environmental education, and these matters were discussed at the 1974 Symposium (Numata, Benninghoff and Whitford 1977).

Since 1974, I organized a project team on environmental education, and the approach to it in primary, middle, high schools and universities (including postgraduate levels) was discussed in the team for 10 years. Our project team recommended concrete contents and methods of environmental

education to Ministry of Education, Science and Culture several times.

In 1977, the Guidance Manual for Teachers in Middle Schools was revised by the Ministry. A new unit "Man and Nature" was adopted in the Biology and Earth Science Course where the matter and energy supporting human life, and the balance of nature and environmental conservation were the main themes. As the basis for that, there was another unit on the web of life.

In the revised Guidance Manual for Teachers in High Schools, the balance of nature (heat balance of the earth, ecosystem and cycling of materials, etc.) and man and nature (resources, conservation of natural environment, etc.) are part of environmental education.

The Nature Conservation Society of Japan holds training courses for leaders in field education with prefectural authorities every year, and the trainees receive licences for it. The Society published a "Handbook for Leaders in Field Education". The Nature Study Park attached to the National Science Museum holds trainig courses on ecology and nature conservation, field exercises and so on for citizens.

In science education until now, there was a chapter "Organisms and Environment", however man is not included in organisms. Biology encompasses botany, zoology and microbiology, but usually does not include human biology. Anthropology is really a human science, but it usually treats prehistoric man or primitive society, and does not treat modern urbanized man nor industrialized society. There are sociology, psychology, economics, geography, medicine, etc. to treat modern man, however, human biology or ecology including various contents is not included in biology. Organisms dealt with in biology in schools also do not include man. Therefore, in Japan man in the textbook is not thought to have a great role in the food chain nor in ecosystems. The fact that science education overlooks man and organisms is a sad oversight of environmental education in Japan.

The basic concept of environmental education is the "ecosystem" proposed by Tansley (1935) and I use a "biocentric or anthropocentric environment system" (Numata 1953) as a more comprehensive concept, as

mentioned earlier. In the earth ecosystem, man is a newcomer producing undecomposable and toxic substances. Man is a producer, consumer and decomposer which is not included in usual ecosystem diagram in the Japanese biology textbook.

Man has posed great challenges to nature, such as that of atomic power, etc. as well as those implied by atomic and hydrogen bomb experiments. As Commoner (1971) pointed out, ash of an atomic bomb experiment in a South-Pacific island reached the stratosphere, migrated to the north by the jet stream, and reached the ground of the north pole as fallout. Lichens of the tundra absorbed it, caribous ate the lichens, and radioactive pollution of the Eskimoes was found within six months. Atomic dust had formerly not been thought to reach the ground so quickly. This example shows the characteristics of an ecosystem and why man and/or his presence influences cannot be ignored.

The integrated management of nature advocated at the UN Conference on Human Environment in 1972 was also based on the ecosystem standpoint. This is a main point of environmental education.

Environmental education has so far been promoted within the framework of school education, however environmental education in social and lifetime education is even more important. Environmental education is also effective as an out-of-school education connected with citizen's movements. Among the coastal pine forest plantation activities in Chiba City, citizens have purchased saplings of *Pinus thunbergii* and maintain coastal pine forest belt which they planted as a sand prevention forest. This kind of "greening" is a practical application of environmental education.

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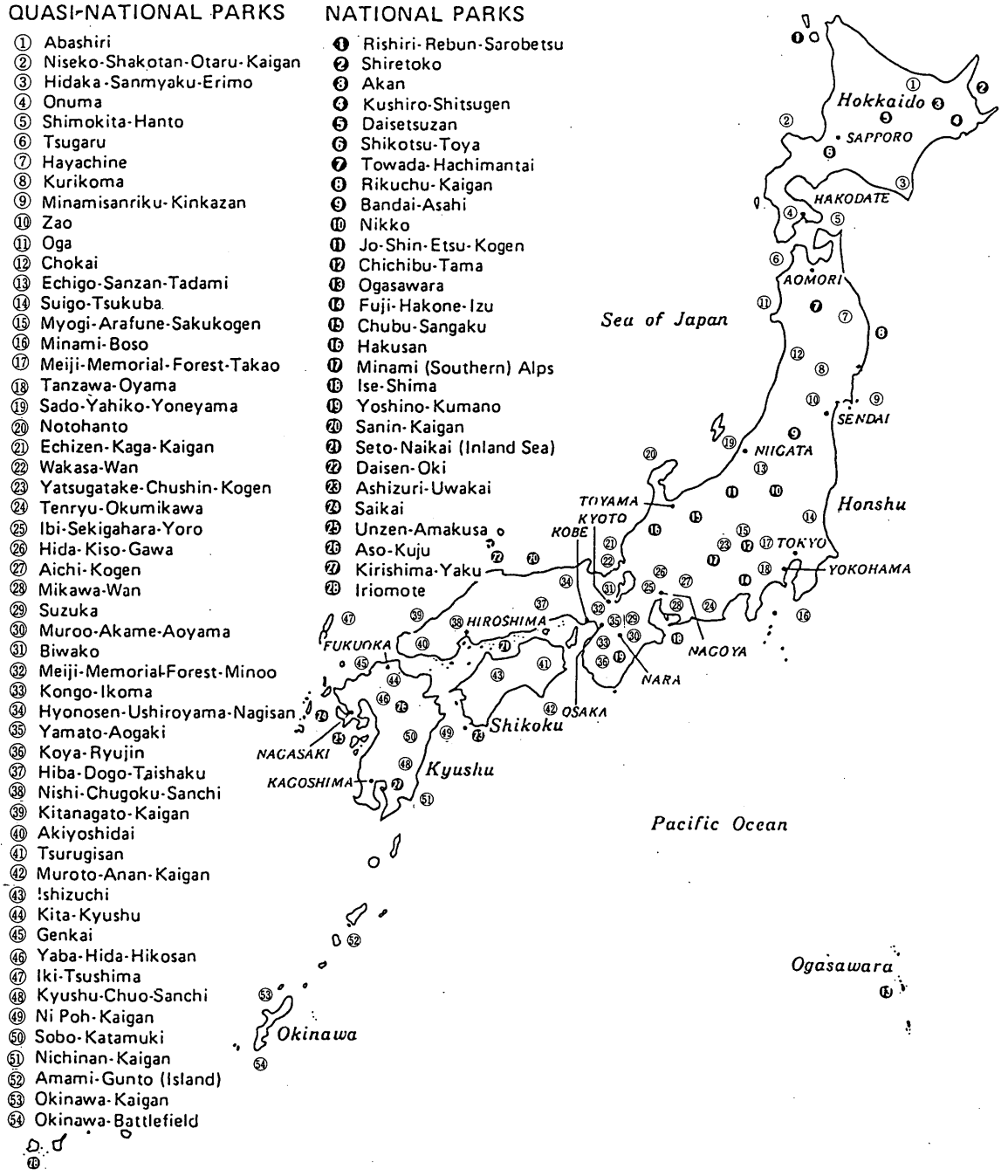

Fig. 1 The National and Quasi-National Parks in Japan

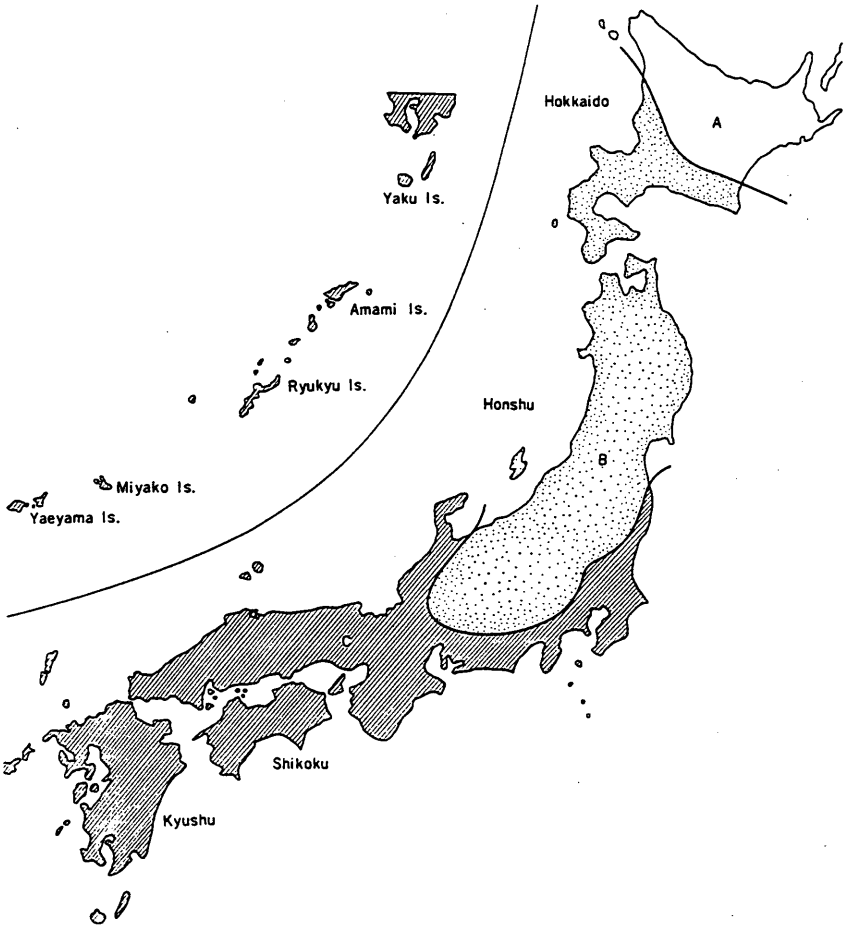

Fig. 2 The horizontal zones of climax forests of Japan
A : Cold-temperate evergreen needle-leaved formation,
B : Cold-temperate deciduous broad-leaved formation,
C : Warm-temperate and subtropical evergreen broad-leaved formation (Numata, 1969)

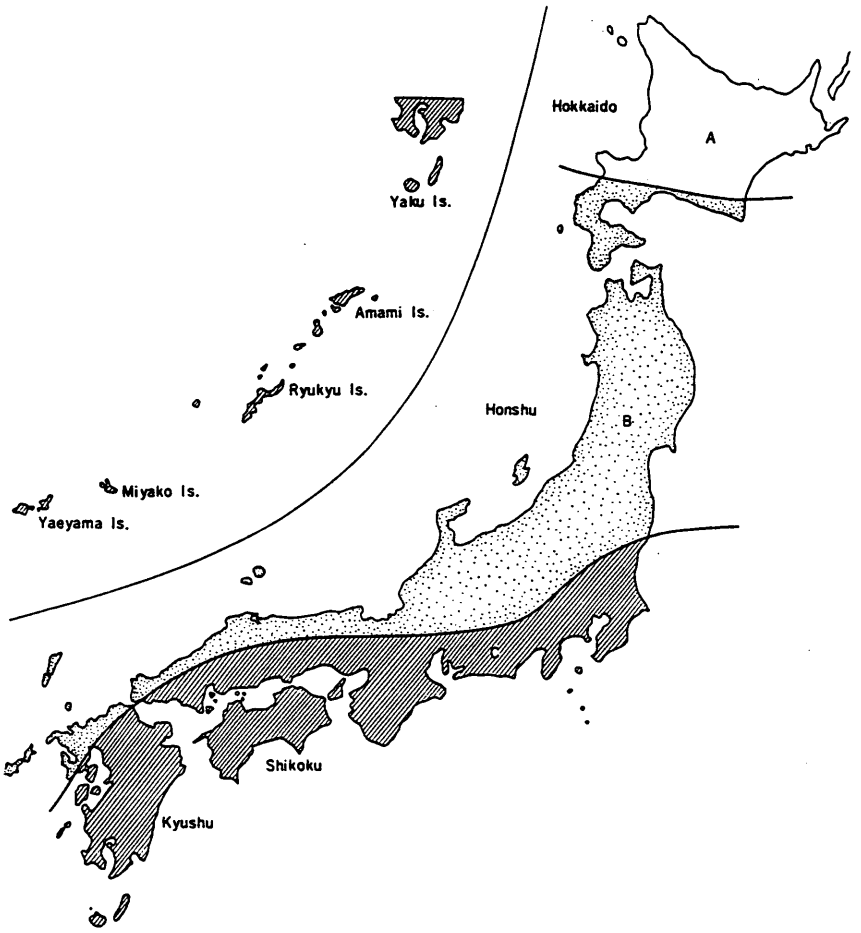

Fig. 3 The horizontal zones of semi-natural vegetation in Japan. When m and p show grasslands under mowing (meadows) and grazing (pastures) respectively, there are zones of Am: *Sasa* type, Ap: *Poa pratensis* type, Bm: *Miscanthus sinensis* type, Bp: *Zoysia japonica* type, Cm: *Miscanthus-Pleioblastus* type, and Cp: *Pleioblastus variegatus* var. *viridis* type. The border between A and B coincides with the northern limit of the *Fagus crenata* climax zone. The climates of A, B, and C are subarctic or cold temperate, cool temperate and Japan-Sea side type, and warm temperate respectively. The Ryukyu Islands within C belong to the subtropical region according to an ordinary classification of climate in Japan. (Numata, 1969)

Table 1. The flow of promulgation for nature conservatin for the past 100 years

1897	Forest Law
1911	A proposal for the preservation of historic sites and natural monuments to the House of Peers
1915	A circular notice on protected forests
1918	Wildlife Protection Law
1919	The Historic Sites, Scenic Beauty and Natural Monuments Preservation Law
1931	National Parks Law
1950	The Law for the Protection of Cultural Properties
1951	Forest Law for Protection Forests
1957	Natural Parks Law
1972	Nature Conservation Law

Table 2. Non-governmental organization for nature conservation

1934	Wild Bird Society of Japan
1947	Japanese Association for Preservation of Birds
1951	Nature Conservation Society of Japan
1961	World Wildlife Fund-Japan
1977	Japan Environment Association
1978	Japan Wildlife Research Center

Table 3. The area of nature reserves *

Kind	Area(ha)
Wilderness Areas	5,631
Nature Conservation Areas (National)	7,550
Nature Conservation Areas (Prefectural Special Areas)	21,916
National Wildlife Protection Areas	411,042
Natural Monuments	150,085
Special Protection Areas of National Parks	250,050
The First Class Special Areas of National Parks	157,042
Special Protection Areas of Quasi-national Parks	64,457
The First Class Special Areas of Quasi-national Parks	162,654
The First Special Areas of Prefectural National Parks	76,402
Protection Forests	148,967

* The total area of Japan is 377,851㎢