

Ecological Background and Conservation of Japanese Islands

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Islands of Japan

Japan is really an insular country which consists of four main islands—Hokkaido, Honshu, Shikoku, and Kyushu—and many other small islands. Among these, Honshu is the seventh largest in the world, but it is not usually called an island. The four main islands are called the mainlands of Japan because of their great difference in size from Shikoku and Sado Is. as shown in Table 1.

Table 1. Area of Japanese mainlands and islands

Mainlands	Honshu	228,000 km ²
	Hokkaido	77,900
	Kyushu	35,600
	Shikoku	17,760
Islands	Sado Is.	857
	Amami-Oshima Is.	718

An island is geographically defined as an area of relatively small land mass surrounded by water contrasting with mainlands (continents or main islands).

According to statistics in 1957, the number of Japanese islands is 3,639. Now, the Bonin Islands must be added to this number. Among the 3,639 islands, there were 159 inhabited islands, and 866 uninhabited islands (1,025 in all) excluding the islands in the Seto Inland Sea and other inland seas and bays. The number of islands in the Seto Inland Sea is 525 (inhabited 173, and uninhabited 352). Among the 1,025 islands, 265 are more than circumference. The Remote Island Promotion Law is applied to the 845 islands including the 351 inhabited islands.

The Remote Island Promotion Law aims at stabilized living and improved welfare of the people living in islands remote from the mainland and at contributing to the development of the national economy. Therefore, this is not a protection law. If not applied properly, it becomes a destructive law. The Remote Island Promotion Law is applied to many islands in the inland sea.

Most of the Japanese islands are not oceanic islands but continental islands.

Since this paper was prepared, the Technical Meeting decided that all conservation issues affecting Japan and its offshore islands (other than the Bonin and Volcano groups) should be held over for discussion in connection with a later comprehensive review.

Some researchers consider Rebun Is., Okushiri Is., Tobishima Is., Awashima Is., Sado Is., Oki Is., Mishima Is., Iki Is., Tsushima Is., Hirado Is., Goto Is., Izu Is., Koshiki Is., Tanegashima Is., Yaku Is., and Ryukyu Is. oceanic islands and Izu Is., Ryukyu Is., as the so-called festoon islands consisting of volcanic land blocks.

The climate of islands is typically oceanic, but the climate of Japanese small islands is only slightly different from that of the Japanese mainlands, because most of the Japanese islands are continental ones near the mainlands.

Range of Plants and Animals in Japanese Islands

1. Watase Line. The border line between the palaeartic fauna and the oriental fauna is the Watase Line named by Y. Okada (1924) on the strait of Tokara between Yaku Is. and Amami-Oshima Is. This line is also the border between the original Japanese flora and the flora of the Ryukyus and Formosa. This is ecologically the border between the warm-temperate region and the subtropical region.

2. Hosokawa Line. Hosokawa (1934) proposed a phytogeographical border line between the Bonin Is. and Mariana Is. The Bonin Is. consist of Ogasawara Is. (Chichijima Is., Hahajima Is., and Mukojima Is.) and Iojima Is. belonging to the Fuji volcanic chain. Though the latter is in the south of Ogasawara Is., its flora is akin to that of Izu Is., Ryukyu Is. and Formosa, and a small part of the flora is similar to the flora of Micronesia, especially the Marianas. The flora of Ogasawara Is. is, of course, similar to that of Izu Is. and Ryukyu Is., but some interesting components are closely related to the flora of the Chinese continent or distant places in the Pacific, or quite endemic. According to Tsuyama (1968), such an interesting flora is palaeo-endemic or epibiotically endemic. The Hosokawa Line is related with the Watase Line geographically.

3. Schmidt Line and Miyabe Line. Kudo (1927) divided Saghalien into two parts, northern and southern. The former has a tundra-like vegetation with *Larix gmelini*, *Pinus pumila*, and so forth and the latter has a *Picea yezoensis* *Abies sachalinensis* forest with the characteristic flora of oriental Asia as dwarf bamboos. This is the Schmidt Line. The Miyabe Line was established on the Itrup strait of Kurile Is. dividing the northern and southern Kurile Is. by Miyabe (1890), Kudo (1922), and Tatewaki (1932).

Besides these, the Blakiston Line on the Tsugaru strait based on the distribution of mammals and birds, the Hatta Line on the Soya strait on the distribution of amphibia, the Hachisuka Line between Okinawa Is. and Yaeyama Is. on the distribution of birds, the Miyake Line on the Osumi strait on the distribution of insects and other animals were proposed, but they have not so great generality.

The climate of Japan is subarctic, cool-temperate, warm-temperate and subtropical from north to south, to which the potential natural (or climax) vegetation zones correspond. But the islands and the coastal part of the mainlands do not always comply with such a climatic zonation due to influences of the oceanic climate.

Patterns of Species Distribution—Inland and Seaside

Islands are in striking contrast to continents, particularly regarding the oceanic and continental. In Japan there are two types of species distribution in that respect; species distributed inland in the north and at the seaside in the south such as *Sonchus arvensis* var. *uliginosus*, *Zoysia japonica*, and so forth, and the reverse such as *Pittosporum tobira*, *Quercus dentata*, *Q. crispula*, *Pinus densiflora*, and *Cynodon dactylon* (Numata, 1967). The *Cynodon dactylon*-dominant pasture is an overspread inland grassland in the subtropical and warm-temperate regions of Nepal (Numata, 1965). In a word, species having such a distribution pattern may be widespread in islands in their peripheral area of distribution. For example, *Zoysia japonica* is a pasture grass of the *Fagus crenata* zone in Japan, but it spreads southward into the coastal region of the warm-temperate zone in Kyushu, Japan.

In the warm-temperate zone of Japan mainland, there is a spatial ordination of the distribution of the climax vegetation of *Machilus Thunbergii* forest—*Shiia Sieboldii* forest—*Cyclobalanopsis* spp. forest from coast to inland. The typical example is seen in Chiba Prefecture, central Japan (Numata and Asano, 1965). However, islets have only coastal climax of *Machilus Thunbergii* forest, such as Danjo Islands, Nagasaki Prefecture, Kyushu (Toyama, *et al.* 1968). This spatial ordination is also found in the distribution of grasses such as *Miscanthus condensatus*—*M. sinensis*. Such characteristics of oceanic islets will be shown in areas less than 2×2 km².

In Awashima Is. in the Japan Sea, the east half and west half are under the influence of the different climates of the Japan Sea type and the Pacific coast type. It is very similar to the east coast and west coast of Japan mainland. Even in small islands, such a climatic and vegetational discrimination will be found if there is a hilly or mountainous barrier as in Awashima Is., Rishiri Is., and others. In Awashima Is., the west half is covered by bamboo brakes and the east half never has a bamboo brake. This fact is also important from the viewpoint of conservation.

Geological History of Japan

In the Palaeozoic era, the backbone of Japanese islands was established as a continental terrace by the world-wide orogenic movement. Since the Permian period, Japan was a part of the continent and plants migrated into Japan from west or south in the Triassic period under the tropical rain climate. The climate of the Jurassic period was also tropical or subtropical. That of the Cretaceous period was a little dry.

In the Neogene period, violent faulting occurred which decided the geological structure of the east side of the Asiatic continent and made a prototype of the Japan Sea, the Okhotsk Sea, and the East China Sea. A great fault was made on the line from Izu Is. to the Mariana Is. and continued on the Fossa Magna dividing north-eastern Japan from south-western Japan. Such faultings in the Neogene period,

on the other hand, established the Kurile Arc, Honshu Arc, Ryukyu Arc, Izu-Mariana Arc, quite similar to present day Japan. The outer side (Pacific side) of these arcs were always sinking and the inner side (Continental side) rising from the Cretaceous period to the Palaeogene period. On the contrary, the outer side became rising and the inner side sinking in the Neogene period. Relating to this conversion of rising-sinking movement and following faulting, was a violent volcanism in Japan. The magma reached the surface of the earth, filling the depressions of the sinking inner zone as lava, tuff and agglomerate. Due to this phenomenon, the inner zone is called the green tuff region. The green tuff is, too, characteristic to the peri-Pacific area, such as Indonesia, the west coast of North America, and so forth. Almost all of the volcanoes in the Quarternary period erupted in the green tuff region. The green tuff region became land mostly embracing the palaeo-Japan Sea at the end of the Neogene period and the skeleton of the present-day Japan was almost established. In the Neogene period a warm current reached Hokkaido and the subtropical or warm-temperate biota covered Japan several times, and on the contrary, a cold current moved southward during those warmer times.

Glaciation itself is seen only twice at Riss and Würm in Japanese high mountains, but the world-wide eustatic movement, of course, influenced the Japanese biota. Regression in the ice ages and transgression in the interglacial ages were also seen in Japan, but its influences were relatively small, and the land bridge from the Continent might have been open in the Pleistocene. In the Japanese Pleistocene, volcanism was more important than glaciation for the Japanese biota. The accumulation of volcanic ash all over the country influences very much the ecesis, spreading, and predominating of plants and animals.

In the Quarternary period, the peninsula-like Japan arc was eroded gradually in the four time ice epochs and sea water entered into valleys, inlets, water-courses, and others in the interglacial and post-glacial epochs.

Floristic Change by Introduced Exotic Plants

Invasion and ecesis of exotic plants into islands isolated by the sea is one of interesting problems of island ecology. There are more than 500 islets in the Seto Inland Sea of Japan. Among them, uninhabited islets have no exotic plants, whereas inhabited islets have widespread exotic weeds as *Erigeron canadensis*, *E. linifolius*, *Euphorbia supina*, and infrequent exotic plants such as *Trifolium repens*, *Oxalis Martiana*, *Aster subulatus*, *Bidens frondosa*, *Physalis angulata*, and so forth (Mori, 1951). Such a distribution of exotic plants is a good indicator of human influence on the wilderness of islands. Even on the Japan mainland, the problem of naturalization of exotic plants is similarly important as is endemism (Numata and Ono, 1952).

A Remarkable Example of Destruction of Island Ecosystems—Particularly on Bonin and Ryukyus Islands

Last year, the Bonin Islands were returned to Japan and several parties for preliminary survey of biota and ecology of the islands visited there. Before the Second World War, Japanese people lived in Chichijima Is., Hahajima Is., and Iojima Is. Other small islands were uninhabited because of the scarcity of drinking water in those islands.

According to the knowledge before the war, the flora of Bonin Islands contained higher plants of 90 families, 250 genera, and 400 species, 20% of which were endemic (Tsuyama, 1968). Bonin Islands are classified into Volcano Islands (Kita-Iojima Is., Iojima Is., and Minami-Iojima Is. belonging to the Fujia Volcanic Chain) and Ogasawara Islands (Mukojima Is., Chichijima Is., and Hahajima Is.). The flora of the former is akin to the flora of Izu Is., Ryukyu Is., and Taiwan (partly of Micronesia, especially Mariana Is.) In spite of their more southern location than the latter. A part of the flora of the latter is akin to that of Chinese continent and distant places in the Pacific, such as *Santalum boninense* (Santalaceae), *Clinostigma Savoryana* (Palmae), *Meterosidero boninensis* (Myrtaceae), *Osteomeles boninensis* (Rosaceae), and *Orobanche boninsimae* (Orobanchaceae). Especially, *Dendrocalia crepidifolia* (Compositae) is endemic.

The site of the villages of Chichijima Is. before the war are covered by jungles of *Ficus retusa*, *Chrysolidocarpus lutescens* (*Areca lutescens*), *Agave americana*, *Ficus elastica*, *Leucaena leucocephala*, *Pinus luchuensis*, *Casuarina equisetifolia*, and the like. The vegetation of Mukojima Is. runs greatly waste by the overgrazing of naturalized goats.

The number of birds of Bonin Is. reported till now is 97.5 of 12 resident birds are already extinct as follows: Hashibuto-garasu, Japanese jungle-crow (*Corvus leuallantii japonensis*); Ogasawara-mashiko, Bonin grosbeak (*Chaunoproctus ferreirostris*); Ogasawara-gabicho, Kittlitz's ground-thrush (*Turdus terrestris*); Ogasawara-karasu-bato, Bonin wood pigeon (*Columba versicolor*); and Hashibuto-goi, Bonin night heron (*Nycticorax caledonicus crassirostris*). An endemic species Meguro, Bonin white-eyed warbler (*Apalopteron familiare*) and an endemic subspecies Ogasawara-kawara-hiwa, Bonin greenfinch (*Chloris sinica kittlitzii*) are also extinct in Chichijima Is. Among the living terrestrial birds on Bonin Is., endemic species or subspecies Bonin white-eyed warbler; Bonin greenfinch; Ogasawara-hiyodori, Bonin brown-eared bulbul (*Microscelis amaurotis squameiceps*); Ogasawara-uguisu, Bonin bush-warbler (*Horeites diphone diphone*); and Akagashira-karasu-bato, red-headed wood pigeon (*Columba janthina nitens*) should be noted in danger.

Bonin Islands are also important as the northern limit of breeding of tropical sea birds. Steller's Albatross, *Diomedea albatrus*, is breeding in Kitanoshima Is. where it did not exist after the war. It may be alive somewhere on Mukojima Is.

There *Pteropus pselaphon* (Bonin great bat) and a variety of *Mus molossinus*

(Bonin mouse) as the noticeable mammals. Yamashina, *et al.* (1966) found Hashibuto-hiyodori, Large-billed brown-eared bubul (*Hypsipetes amaurotis magnirostris*); Iojima-mejiro, Sulphur Is. white-eye (*Zosteropus palpebrosa alani*); Iso-hiyodori, Large red-billed rock-thrush (*Monticola solitarius magnus*); and so forth, in Iojima Is. in spite of its being a battle-field during the war. *Phasianus colchicus tohkaidi* (green pheasant) and *Bambusicola thoracica tharacica* (bamboo partridge) introduced by American soldiers are breeding in the northern half of Iojima Is. Marcus Is. (Minami-torishima Is.) is important as the gathering place of sea birds (Kuroda, 1954; Fujisawa, 1963).

The insect fauna of Bonin Is. and Micronesian islands has been studied by Esaki (1930) and others. The bibliography of the insects of Micronesia by Esaki, Bryan, and Gressitt (1955) was published by the Bishop Museum. Yasumata (1968, personal communication) listed endemic species or subspecies of Bonin Islands (131 among the total 282 species) such as Odonata (5), Hemiptera (43), Lepidoptera (9), Coleoptera (27), Hymenoptera (9), and Diptera (38). Among them, Shijimicho, *Celastrina ogasawarensis* (Lycaenidae), one species of Tamamushi (Buprestidae, Coleoptera), and four species of Odonata are designated as the National Monuments. *Dacus dorsalis* (pest of orange, peach, plum, persimmon, mango, tomato, and so forth.) and *Cylas fomicarius* (pest of sweet potato) are very important pests which are not found in Japan mainland yet.

Achatina fulica (African snail) is overspreading in Chichijima Is. was introduced originally as an emergency food of soldiers during the war. For controlling this species, *Euglandina rosea* (a carnivorous snail of Florida) was tried as a natural enemy. On the other hand, *Bufo marianus* introduced as a natural enemy of *Scolopendra subspinipes* (great centipede) is now overspreading in Chichijima Is. (Shimizu, 1968).

Concerning the important birds of Ryukyu Is. from the standpoint of conservation, Dr. Yamashina and Dr. N. Kuroda (personal communication) point out the following: 1) Noguchi-gera, Bryer's woodpecker (*Sapheopipo noguchii*)—a very rare species in Ryukyu Is. which lives in a part of the forests in the northern region of Okinawa Is. should be noted in danger because of the felling of the forests. The conservation of the habitat of Bryer's woodpecker is a very urgent problem. 2) A great colony of sea birds of Senkaku Is. is well known to us, however it is recently in danger of extinction due to a reckless hunting of people from Taiwan. Seguro-ajisashi, sooty tern (*Sterna fuscata mebilosa*) is very common there, Kuro-ajisashi, brown noddy (*Anous stolidus pileatus*) is rather frequent, and Katsuo-dori, booby (*Sula leucogaster plotus*) and Oomizunagi-dori, streaked shearwater (*Puffinus leucomelas*) are also frequent. A survey team of Japan will be sent to the islands next year (1969).

Conservation of Japanese islands

Japanese islands have much beautiful scenery. The National Parks and Quasi-

Table 2. Japanese National and Quasi-National Parks related to islands

Island	Prefecture	Nature Park
Rishiri Is., Rebun Is.	Hokkaido	Rishiri-Rebun Q.N.P.
Izu Is.	Tokyo	Fuji-Hakone-Izu N.P.
Sado Is.	Niigata	Sado-Yahiko Q.N.P.
Three Is. of Aichi	Aichi	Mikawan Q.N.P.
Shima Is.	Mie	Ise-Shima N.P.
Oshima Is.	Wakayama	Yoshino-Kumano N.P.
Islands of Seto Inland Sea and Numajima Is.	Hyogo, Okayama, Hiroshima, Yamaguchi, Kagawa, Ehime, Oita	Seto Inland Sea N.P.
Oki Is.	Shimane	Daisen-Oki N.P.
Oshima Is., many small is.	Hyogo, Tottori	Sanin Coast N.P.
Six islands of Yamaguchi	Yamaguchi	Kitanagato Coast Q.N.P.
Ishima Is., Dewajima Is.	Tokushima	Muroto-Anan Coast Q.N.P.
Okinoshima Is., Kashiwa Is.	Kochi	Ashizuri Q.N.P.
Chikuzen Is., Genkai Is.	Fukuoka, Saga	Genkai Q.N.P.
Goto Is., Hirado Is.	Nagasaki	Saikai Q.N.P.
Amakusa Is., Nagashima Is.	Kumamoto, Kagoshima	Unzen-Amakusa N.P.
Yaku Is. and three islands	Kagoshima	Kirishima-Yaku N.P.

National Parks including the natural beauty of islands are shown in Table 2. Besides these, National Parks, including the marine parks of Bonin Is. and Ryukyu Is., are now under consideration. The Marine Park Law and the strengthening of reservation of primeval nature are being prepared by the Ministry of Public Welfare. The Science Council of Japan has the Committee of Nature Conservation and recently the Subcommittee of Considering Countermeasures for Bonin Is. The Tokyo Metropolitan Governor is going to establish a Metropolitan Nature Park, Marine Laboratory, and associated features in the Bonin Is. The Ecological Society of Japan has a Committee of Nature Conservation and recommended a reservation plan on primeval forests and is preparing to recommend the marine nature reserves to the Government. The Committee of Conservation of Cultural Assets in the Ministry of Education is surveying some of Japanese islands (e.g., Danjo-Gunto Is. in Kyushu in 1967). Ryukyu Is. have been studied by many university teams (e.g., Kyushu University, Osaka City University, Kagoshima University).

The JIBP-CT, of course, is studying some Japanese Is. (e.g., Yaku Is. of Kyushu in 1967-68), but we have already three CT projects (Studies on types of terrestrial communities and their conservation, Studies on survey methods and conservation of animal communities in terrestrial ecosystems, and Studies on production and conservation of grassland ecosystems), and it is very difficult to enlarge our budgets for new projects. We are mostly interested in studying the chains of Kurile Is., Izu-Mariana Is., Ryukyu Is., and Iki-Tsushima Is. from the palaeoecological viewpoint, especially of the relations to the continent and of volcanism in the Quarternary period. However it is very difficult to realize all these programs under the limitation of the Governmental budget. We must search for other money sources to

promote these new programmes. We want to study ecologically such island chains cooperating with neighboring countries within the frame of IBP.

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