Natural History of Japanese Birds

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Preface [BOOK p.3]

Japan is a beautiful country. The hills and dales are covered with rich forest green, the river waters run clear and the mountain ranges in the distance look hazy purple, which perfectly fits a Japanese expression of "Sanshi-suimei (purple mountains and clear waters)", describing great natural beauty. There are also grassy plains, lakes and marshes, and mud flats. The scenery varies from season to season. In some regions, it changes from the fresh green of spring through the brilliant colors of autumn to the silver white of winter. Many forms of life including birds live in woodlands and shoreline areas.

Nothing can replace the pleasure of watching and listening to birds in the beauty of nature. It gives me the unequaled pleasure to listen to bird songs shrouded in the deep forest air, watch a large flock of shorebirds in the mud flats and realize the changes of the seasons in their melancholy calls. The number of people who enjoy watching birds has rapidly increased in Japan and is currently estimated to be more than one million.

People enjoy birds in many different ways. Some try to see as many species of birds as possible. Some enjoy the world of birds all year in their neighborhoods. Others carry out an in-depth study of their ecology, focusing on particular species. There is no telling which way is the best. Everyone can enjoy birds in their own ways according to their interests, the conditions of their dwelling area and how much free time they have.

Having said that, it would increase and deepen the enjoyment to know the composition of the world of Japanese birds. The nature and the world of birds of Japan are diverse and intriguing. It should double the pleasure of observing them, photographing them or exchanging information on them among friends to know their characteristics, noteworthy points and interesting observations about their natural history.

I will introduce the composition of the world of Japanese birds and the worlds of birds living in Japan. Many beautiful and intriguing photographs characterize this book. Since it is not a technical book, I have not placed a high priority on presenting the details of their distribution and ecology and the latest ornithological findings. I have aimed to write concisely and avoided using complex graphs. This book consists primarily of interesting topics so that you can enjoy looking at and reading it.

Here I will show you a general outline of the contents. This book begins with the characteristics of Japanese avifauna. The features of the natural environment of Japan, the species of birds living in its natural areas, the regional and habitat variations of the bird life and the representative birds of Japan are featured in Chapters 1-3. I have introduced a wide range of birds occurring throughout Japan from beech forests to grassland, mud flats and the ocean.

Secondly the seasonal worlds of birds are described in Chapter 4. The scene is a Japanese countryside called "satoyama". When horsetail shoots come out and violets and cherry blossoms bloom in spring, birds begin to sing and get ready for reproduction. Summer visitors also start arriving in Japan one after another from the tropical regions to brighten the scene considerably. When farmers are busy planting rice in early summer, birds are also busy raising their young. When summer visitors leave Japan in autumn, different species of birds come from the north. Ducks, geese and swans visit lakes, marshes and other bodies of water to winter. These wintering sites are greatly enlivened by their arrival. Naumann's Thrushes and Daurian Redstarts appear in desolate wintry fields and hills. Brown-eared Bulbuls and White-cheeked Starlings flock to few fruits left on persimmon trees.

In Chapter 5 the scene changes to urban areas and city-dwelling birds are taken up for a topic. Japan is a densely populated country. The gravitation of people toward cities is particularly remarkable. There are only a limited number of bird species in the city, but they live vigorously in the unnatural environment. This chapter refers to the birds which have expanded their range to urban areas, such as birds using rooftops of buildings as a breeding site, a family of Eastern Spot-billed Ducks walking across a road with some of the heaviest traffic in Japan to enter the moat of the Imperial Palace in Tokyo, the crows that make a loquat garden, Eurasian Tree Sparrows taking food from retired elderly people and Large-billed Crows causing various problems for city-dwellers.

Chapter 6 features birds with interesting behavior and ecology, such as Carrion Crows getting automobiles to run over and crush their walnuts. Striated Herons catching fish using a lure or live bait, cuckoos laying different colored eggs in a nest of different host species according to regions and an extremely tame Copper Pheasant showing interest even in classical music. Since many of these behaviors are closely related to the characteristics of the life of Japanese people and the nature of Japan, they are notable even on a global level.

Then the world of migratory birds is introduced in Chapter 7. The world of Japanese birds is not contained in Japan alone. It consists of various birds visiting Japan primarily as a migrant from the north and the south. Where and how do these birds come to Japan? And where do they return? Satellite-tracking studies answer these questions. Surprisingly, it is shown that there are birds like Honey Buzzards which come back to Japan traveling around all the countries of East Asia.

The last chapter describes the current status and future of Japanese birds. I will give an account of which birds are disappearing, what threats they face and which birds have become extinct in the dramatically changing environment. On the other hand, some birds have increased in number or expanded their range and caused friction with people. The actual situation will be brought to light. I will introduce some of the activities that have been carried out to realize a bright future in particular regions, some of which have produced remarkable

results.

This book is neither intended for professional ornithologists nor designed to introduce the latest ornithological findings. As we have seen, however, this book deals with a wide range of subjects involving birds of Japan. It shows what is known to what extent, and what remains unresolved. If you want to know more about these subjects, you can delve deeply into them using the references. Therefore, this book can also serve as a guide for people who want to begin the study of birds in Japan. It is filled with contents suitable for research topics.

In recent years, avian studies have advanced rapidly in Japan. The results of the studies have been published in many journals at home and abroad. Although this book is not aimed at introducing many of these results, the major ones have been taken up when they are related to the themes treated in the book are concerned. Recently, it is possible not only to obtain a wide variety of information but also to exchange information easily with many people at home and abroad on the internet. The types of available literature have increased. I will be happy if anyone who is attracted by the world of Japanese birds finds a topic for study using this book for reference and take a growing interest in birds.

I have focused on topics related to my own research because I can treat them more properly based on the findings of my own studies than I could if I focused only on information obtained from the literature or other research workers. I have already published many of these findings elsewhere. I have summarized them or added subsequent information to them in this book in order to avoid repeating them. Even then, the construction of this book forced me to reiterate some of the contents I had published elsewhere. I beg the pardon of the readers for that.

In August of this year (2014), the International Ornithological Congress will be held in Tokyo. Approximately 1,100 participants are expected from 65 countries around the world. This document is also intended as an introduction to the avifauna of Japan for the participants of the IOC from abroad. With that aim in mind, I have made the information concise and clear, using many photographs, and adding English captions to the figures and photos. At the same time that this book help researchers overseas to get an overview of the avifauna of Japan, it should help people of Japan to discuss birds of Japan with foreign researchers. I hope that information exchange and shared experiences proceeds with the help of this book.

This book carries wonderful photographs by courtesy of many people whose names are listed at the end. Without the cooperation of these people, I could not have produced a beautiful book like this. I was able to write up my description of nature of Japan with the help of so many remarkable photographs. This book is a dream-come-true for me in that sense. I am grateful for obtaining such an opportunity.

I owed the preparation of the figures to Naoya Hijikata, Yuriko Yamaguchi and Michiko Shigehara. I received valuable advice on collecting information from Nariko Oka, Masahiko Sakanashi, Nobuhiko Kishimoto, Masayuki Kurechi, Reiko Kurosawa, Tetsuo Shimada, Koichiro Sonobe, Ken'ichi Tokita and Yutaka Nakamura. Patricia Ormsby helped me prepare the English captions to the photographs. Reiko Kurosawa prepared the English text of the book, and Robert A. Askins reviewed the English. Hideo Doi, the former editor-in-chief of "Anima" magazine and Noriko Oishi of Heibonsha were a great help to me in editing this book. It was a lot of fun to gather, select and arrange various photographs with the two editors.

I would like to express my heartfelt gratitude to all the people that afforded cooperation and assistance in completing this book.

July 2014

Hiroyoshi Higuchi

Chapter 1:
The natural environment and birds of Japan

Natural environment of Japan [BOOK p.8]

Japan has a rich world of birds. If you go to the woods, you can meet various birds including passerines and woodpeckers. Large flocks of ducks and swans are found in lakes and marshes. A variety of different shorebirds gather in mud flats. And the world of birds varies greatly according to the region and season.

The rich avian world of Japan is closely related to its state of nature. The distribution and ecology of birds depend heavily on the characteristics of the environment where they live. It is necessary, therefore, to know the characteristics of the environment of Japan to better understand the world of birds of Japan, or the avifauna of Japan more precisely. What characterizes the natural environment of Japan and distinguishes it from that of other countries and regions? Or how is Japan represented in terms of a habitat for various forms of life including birds?

The characteristics of Japan represented by the environment are roughly classified into the following five types.

1) Japan is a forest country. It is true that grasslands and wetlands are also found in Japan, but forests predominate in the landscape due partly to the temperate humid climate. Although forests vary in type between regions, they amount to about 70% of this country. If farmland and even industrial sites are left abandoned, they will usually revert to woodland over time.

2) Japan is a mountainous country. Japan has a complicated landform with a great variety of surface features. Mountains account for approximately 70% of the country. Some of them are more than 3,000 m above sea level. The vegetation varies depending on elevations. Rivers of various sizes flow through rugged terrain with many lakes and marshes.

3) Japan is an elongated country extending north and south with little land area. Since Japan stretches out from 45 °N to 24 °N, it contains both the subarctic and subtropical zones. Therefore, it includes various vegetation types ranging from a boreal coniferous forest to a broad-leaved deciduous forest, an evergreen laurel forest and a subtropical mangrove forest (Fig 1.).

4) Japan is an island country, which implies three things: 1. it is surrounded by the sea, 2. it consists of as many as 6,800 islands of various sizes and 3. these islands are collectively close to the Asian continent. The northern end of Kyushu (the southernmost main island of Japan) lies only some 250 km from the southern tip of the Korean Peninsula. The major islands of Japan used to be connected to the Asian continent, but they were separated from the continent at different periods. Hokkaido (the northernmost main island), for instance, was separated from the continent only about 10,000 years ago. On the other hand, the Ogasawara Islands, which were formed 45-50 million years ago in the Pacific Ocean, have never been connected to the Asian continent.

5) Japan is a country with four seasons. Except for subtropical islands, such as the Nansei Islands and Ogasawara Islands, most regions of Japan are located in the temperate zone with four distinct seasons (i.e. spring, summer, autumn and winter). Forests and grasslands where birds live undergo a considerable change with the seasons. In spring, for instance, plants come into bud and put on fresh green colors and bloom. Leaves turn dark green as the season progresses into summer, when plants begin to bear fruit. When autumn is well advanced, leaves turn red or yellow and fall before winter.

As we have seen, the natural environment of Japan is highly diverse owing to its topography, geography, climate and seasons. In terms of habitats for birds, forests covering a large proportion of this country produce a complex structure in three dimensions. Mountains create diverse worlds according to elevations in a region. A myriad of islands strung from north to south have their respective worlds. Changes of the seasons produce landscapes of various types and structures in the same region and environment. Each of these factors provides many different habitats for birds. A diversity of Japanese avifauna is supported by its rich and diverse nature.

The features of Japanese avifauna [BOOK p.12]

Now let us look into the rich world of Japanese birds. The characteristics of Japanese avifauna can be deduced from the five aspects of the natural environment mentioned above.

Japan as a forest country provides habitats for many species of birds which live in woodlands. Of approximately 150 species of land birds breeding in Japan, about 100 species (67%) live in wooded habitats. Incidentally, land birds are a group of birds excluding the orders of ducks, grebes, tropic birds, loons, shearwaters, storks, gannets, pelicans, cranes and plovers. Different avian worlds are found in boreal coniferous forests in Hokkaido, beech forests in central to northern Honshu (the largest main island), laurel forests in western Japan and mangrove forests in subtropical islands. On the other hand, some 25 species (17%) occur in grasslands and wetlands, with only a few species such as Blue Rock Thrushes (*Monticola solitarius*) and Alpine Accentors (*Prunella collaris*) living in a rocky habitat.

Because Japan is a mountainous country, bird species vary greatly depending on elevation as well. There are the world of lowland birds in coastal areas, the world of montane birds in a low mountain zone and the world of subalpine birds in a subalpine zone. An alpine zone above the tree line which is more than 2,500 m above sea level is a habitat for Rock Ptarmigans (*Lagopus muta*), Spotted Nutcrackers (*Nucifraga caryocatactes*) and Alpine Accentors. Closely-related species tend to breed at different altitudes from each other as in

Eastern Crowned Leaf Warblers (*Phylloscopus coronatus*), Sakhalin Leaf Warblers (*P. borealoides*) and Japanese Leaf Warblers (*P. xanthodryas*). Valleys and mountain streams created by rugged terrain are home to birds, such as kingfishers, wagtails and Brown Dippers (*Cinclus pallasii*).

Japan as an elongated country extending from north to south contains both northern birds derived from the temperate, subarctic and arctic zones and southern birds distributed primarily in the southern temperate, subtropical and tropical zones. The northern birds are represented by Hazel Grouse (*Tetrastes bonasia*), Blakiston's Fish Owls (*Ketupa blakistoni*) and Pine Grosbeaks (*Pinicola enucleator*). In Japan they breed in Hokkaido alone. The southern birds include Crested Serpent Eagles (*Spilornis cheela*), Ruddy Kingfishers (*Halcyon coromanda*), Oriental Dollarbirds (*Eurystomus orientalis*), Fairy Pittas (*Pitta nympha*), Light-vented Bulbuls (*Pycnonotus sinensis*) and Japanese White-eyes (*Zosterops japonicus*). Many of these southern birds come to Japan from southern regions to breed in spring. However, "northern birds" or "southern birds" is not necessarily a clearly-defined division. Each type of vegetation found in the Japanese Archipelago extending north and south supports its own world of birds.

Because Japan as an island country located close to the Asian continent, it has many bird species in common with the continent. Most Japanese land birds have their origins in the Asian continent. On the other hand, Japan has endemic species or subspecies because it is isolated by the sea. Since many islands of Japan are different in geographical condition and the period of formation, the world of birds often varies greatly between islands. For instance, the avifauna of Hokkaido is considerably different from those of the other three main islands (Honshu, Shikoku and Kyushu). The world of birds differs in the Izu Islands, Ogasawara Islands and Nansei Islands as well. Subspecies vary from island to island in many bird species. The number of species tends to be greater on larger islands, but is smaller than expected from their size on oceanic islands, such as the Ogasawara Islands.

Japan as an island country inevitably has habitats associated with the sea, which allows many different species of seabirds to breed in Japan. The waters around Japan have one of the greatest biodiversity in the world (http://www.jamstec.go.jp/j/about/press_release/20100803/). The abundant marine resources allow a large number of seabirds to forage and breed in this area. Many sea bird species range widely over the ocean, but some species, such as Streaked Shearwaters (*Calonectris leucomelas*), Japanese Murrelets (*Synthliboramphus wumizusume*) and Short-tailed Albatrosses (*Phoebastria albatrus*) breed in the area around Japan.

In Japan as a country with four seasons, the world of birds changes greatly with the seasons. In spring and summer, a wide variety of colorful summer visitors come to Japan from tropical regions to breed — Barn Swallows (*Hirundo rustica*), Common Cuckoos (*Cuculus canorus*), Blue-and-white Flycatchers (*Cyanoptila cyanomelana*), Japanese Paradise Flycatchers (*Terpsiphone atrocaudata*), Ashy Minivets (*Pericrocotus divaricatus*), Jungle Nightjars (*Caprimulgus indicus*) and Brown Hawk-Owls (*Ninox scutulata*), for example. These species leave the breeding grounds in autumn, giving way to ducks, geese and swans that visit Japan from northern regions to winter. In spring and autumn, many different species of shorebirds rest their wings in various areas of Japan while on migration to and from their wintering grounds to the south of Japan.

Comparison of avifaunae between Japan and China [BOOK p.15]

The avifauna of Japan is quite diverse, reflecting the diversity and richness of its natural environment. Since Japan is an island country with limited land area, however, the avifauna is not as diverse as that of a continent. I will take China as a concrete example of a continent and compare the avifauna of Japan to that of China (Higuchi et al. 1995).

Before comparing the avifaunae of the two countries, I will summarize the characteristics of the natural environment of China. China is a vast country with an area of 9.6 million km^2, which covers a 1/15 of the land area of the Earth and is about 26 times as large as Japan. It extends 5,500 km north and south, which corresponds to 60 degrees in terms of a difference of latitude, and contains both the arctic and tropical zones. There are a range of mountains in the 8,000-meter class and plateaux around 5,000 m in elevation as well. About 70% of the country consists of mountains, hills and plateaux, while plains and basins account for the remaining 30%. In addition to plateaux and mountains, China contains forests, open forests, grasslands, rivers, wetlands, deserts, coasts and islands. Moreover, these habitats are each considerably large in size. Some of the rivers or wetlands are several or several dozen times as long or large as those of Japan. Some of the deserts are as large as Shikoku or Kyushu, which is the smaller one of the four main islands of Japan. Incidentally, there are no deserts in Japan.

In short, the natural environment of China is enormous in scale and highly diverse. The nature of Japan is diverse in its own way, but compares unfavorably in diversity and scale with that of China. Nothing but a coastal environment would be on a greater scale in Japan than in China. For perspective, the total length of coastlines is 29,800 km in Japan and 14,500 km in China (except for islands).

About 1,000 species in 77 families in 20 orders of birds breed in China. On the other hand, about 250 species in 54 families in 18 orders breed in Japan. You can see at a glance that there are many more species in China. Of the 20 orders of birds breeding in China, two orders, Trogoniformes and Psittaciformes, do not breed in Japan. Incidentally, parakeets currently found in Japan are non-native species. Of the 77 families of birds breeding in China, 23 families do not breed in Japan, which include Trogonidae, Bucerotidae, Capionidae, Eurylaimidae and Dicaeidae. They are distributed primarily in the tropics. On the other hand, all the bird families breeding in Japan breed in China as well.

The number of breeding bird species is larger in China than in Japan partly because the orders and families which are not found in Japan occur in China. In the same taxon (e.g. family), however, there is a great difference in the number of breeding species between the two countries. The families with more numerous species in China than in Japan include Muscicapidae, Phasianidae, Fringillidae, Accipitridae and Columbidae. For instance, 48 and four species of Phasianidae breed in China and Japan, respectively. In Accipitridae 41 and 13 species are found in China and Japan respectively. The differences are patently obvious.

On the other hand, the families with a greater number of breeding species in Japan include Diomedeidae, Procellariidae, Hydrobatidae and Alcidae. For instance, one and five species of Hydrobatidae breed in China and Japan, respectively. In Alcidae one and seven species breed in China and Japan respectively.

Birds with high species richness in China are land birds living in forests and grasslands. Again, this is related to the fact that China is a continental country and contains diverse and large-scale terrestrial environments. A greater number of bird species are generally found in a habitat with larger extent and more diverse environments. Many of the bird species of Japan as an island country have their origins in the Asian continent. However, only some species have come to Japan from the continent and settled, which is also related to the difference in the number of species between the two countries.

Bird families with a large number of species in Japan are those that live on the ocean and coast, which is related to the fact that Japan is an island country surrounded by a sea rich in resources.

Distribution of Japanese Birds [BOOK p.19]

As mentioned above, Japan extends long from north to south and consists of numerous islands that were formed in different periods. The Japanese avifauna is classified into several divisions due to these geographical and geological effects. I will provide an overview of major divisions.

Japan is biogeographicaly divided into the Palearctic region to the north and the Oriental region to the south by Watase line running between Akusekijima and Kodakarajima Islands of the Tokara Islands in the Nansei Islands (Fig. 2). From an ornithological point of view, however, Hachisuka line between Okinawa Island and the Yaeyama Islands or a boundary line between Yonaguni Island (the southernmost island of Japan) and Taiwan is more important than Watase line, which is located a little to the north of Hachisuka's line (Nishiumi 2006, 2009). Incidentally, the Nansei Islands consist of the Osumi Islands including Yakushima and Tanegashima Islands south of Kyushu, the Tokara Islands, and the Amami Islands, the Okinawa Islands, the Daito Islands, the Miyako Islands and the Yaeyama Islands located to the north of Taiwan.

To avoid complicating my explanations, I will mention only some relevant cases (see Nishiumu 2009 for details). Ryukyu Robins (*Luscinia komadori*) live in the Nansei Islands, but not in Kyushu and Taiwan. In the four main islands of Japan, on the other hand, live closely-related Japanese Robins (*L. akahige*). Japanese Pygmy Woodpeckers (*Dendrocopos kizuki*) are distributed from Kyushu to the Nansei Islands, but not in Taiwan, where closely-related Grey-headed Pygmy Woodpeckers (*Picoides canicapillus*) live. Grey-headed Woodpeckers (*Picus canus*) are found in the southern part of the Asian continent and Taiwan, but not in the Nansei Islands. From Kyushu to Honshu range closely-related Japanese Green Woodpeckers (*Picus awokera*). Oriental Scops Owls (*Otus sunia*) are distributed in the four main islands of Japan, but not in and south of the Nansei Islands where the closely-related Ryukyu Scops Owl (*O. elegans*) is found. White-bellied Green Pigeons (*Treron sieboldii*) breed from Hokkaido to Kyushu, but not in the Nansei Islands. From the Nansei Islands to Taiwan range closely-related Whistling Green Pigeons (*T. formosae*). There are 14 species that are distributed south to Kyushu but not in and south of the Nansei Islands. Of the year-round resident birds in Taiwan, 90 species do not occur in and north of the Nansei Islands. The latter bird group includes species in the Capitonidae, Timaliidae, Sylviidae, Dicaeidae and Oriolidae. The avifauna differs significantly between Taiwan and Kyushu.

In the main islands of Japan, on the other hand, Blakiston line between Hokkaido and Honshu and Tsushima line between the Korean Peninsula and Kyushu play a major role in the avifauna. In relation to Blakiston line, birds ranging from the eastern side of the Asian Continent to Hokkaido include Grey-headed Woodpecker, Lesser Spotted Woodpecker (*Dendrocopos minor*), Marsh Tit (*Poecile palustris*), Hazel Grouse and Blakiston's Fish Owl. On the other hand, the bird species which occur from Kyushu to Honshu but have not reached Hokkaido include Japanese Green Woodpecker, Alpine Accentor, Japaneses Marsh Warbler (*Locustella pryeri*), Japanese Reed Bunting (*Emberiza yessoensis*), Copper Pheasant (*Syrmaticus soemmerringii*) and Common Pheasant (*Phasianus colchicus*) (Common Pheasants found in Hokkaido are the introduced subspecies from the continent). There are many bird species which are separated into subspecies by Blakiston's line — Eurasian Jay (*Garrulus glandarius*), Long-tailed Tit (*Aegithalos caudatus*), Eurasian Nuthatch (*Sitta europaea*), Ural Owl (*Strix uralensis*), Great Spotted Woodpecker (*D. major*), White-backed Woodpecker (*D. leucotos*), Japanese Pygmy Woodpecker and Eurasian Treecreeper (*Certhia familiaris*), for example.

In terms of Tsushima line, on the other hand, there are about 10 bird species which are distributed to the southern tip of the Korean Peninsula but have not expanded their range to Kyushu or Honshu. They include Grey-headed Woodpecker, Hill Pigeon (*Columba rupestris*), Hazel Grouse, Eurasian Eagle Owl (*Bubo bubo*), Tawny Owl (*Strix aluco*), Crested Lark (*Galerida cristata*), Vinous-throated Parrotbill (*Paradoxornis webbianus*), and Marsh Tit. On the other hand, Mountain hawk-eagle (*Nisaetus nipalensis*), Copper Pheasant, White-bellied Green Pigeon, Crested Kingfisher (*Megaceryle lugubris*), Japanese Robin and Zitting Cisticola (*Cisticola juncidis*) occur in Kyushu but are not found in the Korean Peninsula. In Common Pheasant, Collared Scops Owl (*Otus lempiji*), White-backed Woodpecker, Japanese Pygmy Woodpecker, White Wagtail (*Motacilla alba*), Japanese Bush Warbler, Coal Tit (*Periparus ater*), Long-tailed Tit, Eurasian Skylark (*Alauda arvensis*), Meadow Bunting (*Emberiza cioides*), Oriental Greenfinch (*Chloris sinica*), Eurasian Jay and Large-billed Crow (*Corvus macrorhynchos*), different subspecies are separated by the Tsushima line.

In terms of biogeography, the boundary line separating Kyushu and the Korean Peninsula through the Nansei Islands is more important than Blakiston line between Hokkaido and Honshu or Tsushima line between Kyushu and the Korean Peninsula. These differences in avifauna are closely related to the periods when the areas on both sides of each of the boundary lines were geographically separated or to the distances between them. Kyushu and the Korean Peninsula were connected by land and Hokkaido and Honshu were only separated by a narrow water way at the peak period of the Last Glacial Stage of the Quaternary (about 20,000 years ago) when the sea level dropped by 130-140 m (Koaze 2006). The

Nansei Islands have a more complicated and longer history of geographical barriers. Although the Nansei Islands are strung out in-between, the distance across the waters separating Kyushu and Taiwan is approximately 1,000 km, which is much greater than the Tsugaru Strait (ca. 20 km) between Hokkaido and Honshu or the Tsushima Strait (ca. 170 km) between Kyushu and the Korean Peninsula.

Species composition and richness of each island [BOOK p.24]

When we look at the species composition and richness of each island, larger islands have a tendency to accommodate a greater number of bird species as described earlier. This affords a good example of what is widely known in island biogeography (MacArthur & Wilson 1967). To take the four main islands of Japan as an instance, the number of land bird species is about 120 in Honshu, 110 in Hokkaido, 75 in Kyushu and 70 in Shikoku. The number of species increases with the area of an island. In the Izu Islands which are located off the Izu Peninsula, central Japan, Miyakejima Island with an area of about 55 km^2 contains 27 species of breeding land birds, while only 16 species breed in Aogashima Island which is a merely 5 km^2 in area. In Mikurajima Island which is intermediate in size between these two islands, the number of breeding land bird species also falls in-between. As an island becomes larger, it contains more diverse habitats and food resources, which in turn allows a greater number of bird species to live there.

In the Ogasawara Islands and Daito Islands far away from the mainland, on the other hand, the number of bird species is smaller than expected from the size of the islands. This phenomenon is also a good example of what is known from island biogeography. For instance, Chichijima and Hahajima of the Ogasawara Islands and Kozushima and Mikurajima of the Izu Islands are about 20 km^2 in area each. More than 20 species of land birds breed in Mikurajima and Kozushima islands which are only about 100 km away from Honshu, while Chichijima and Hahajima islands about 1,000 km away from Honshu contain only 10 species of breeding land birds. As the distance between an island and the mainland as a source of species supply becomes greater, it is more difficult for birds inferior in dispersal ability to reach the island.

If the species richness increases or decreases depending on the size or isolation degree of an island, groups and species of birds involved do not increase or decrease at random. What species comes to settle first or what species starts to fall out (become extinct) are determined with few exceptions. To take the case of woodpeckers, I will give a somewhat more detailed account of this situation (Higuchi 1980, with additional information).

Eleven species of woodpeckers are found in Japan. Of these woodpeckers, six species have a wide distribution. They are Black Woodpecker (*Dryocopus maritius*), White-backed Woodpecker, Great Spotted Woodpecker (*Dendrocopos major*), Japanese Green Woodpecker (*Picus awokera*), Grey-headed Woodpecker and Japanese Pygmy Woodpecker. Black Woodpeckers, the largest woodpecker of Japan, occur only in northern Honshu and Hokkaido including Rishiri Island off the northernmost coast of Hokkaido. The reason is that they are presumably unable to live in a small forest because they require a large home range (Kurosawa & Askins 2003). They can live in Rishiri Island probably due to the great altitude and the great forest area of this island (1,719 m).

Among the woodpeckers which occur in the Japanese Archipelago, the most numerous are Japanese Pygmy Woodpeckers. They are found in about one third of the about 100 islands studied. The islands where they live differed greatly in area and distance from the nearest main island of Japan or Taiwan. The area range from about 1 km^2 to more than 2,000 km^2 and the distance from less than 1 km to 500 km. However, the frequency of occurrence tends to be lower as the area decreases and the distance increases.

Japanese Green Woodpeckers that breed in the three main islands of Honshu, Shikoku and Kyushu breed in islands with an area of 1-500 km^2 and within 60 km of the main islands. All of these islands were connected to the four main islands by land at the peak of the fourth glacial epoch some 20,000 years ago. In Hokkaido where Japanese Green Woodpeckers do not occur, closely-related Grey-headed Woodpeckers live there instead, excluding any island off mainland Hokkaido.

White-backed Woodpeckers breed in islands with an area of more than 200 km^2 and at a distance of more than 30 km from the mainland. In other words, except for the four main islands, they live in a relatively large island at a considerable distance from the mainland. Examples include Sado, Oki and Amami-ohshima Islands. Great Spotted Woodpeckers breed only in Honshu and Hokkaido including its several offshore islands. As a whole, the islands where this species breed are located at a higher latitude than those where White-backed Woodpeckers occur. As we have seen, the size and degree of isolation of the islands where woodpeckers occur vary considerably between the species.

The combination of bird species found in an island is also interesting. Here I will deal with birds breeding as a year-round resident in a small island away from the mainland. Few woodpeckers are found in islands with an area of less than 1 km^2. It is islands with an area of 10 km^2 or more that contain more than one species. In Japan, more than two woodpecker species have been confirmed to breed in no other islands than Rishiri Island, northern Hokkaido with the exception of the four main islands. This island is home to Black Woodpeckers, Great Spotted Woodpeckers and Japanese Pygmy Woodpeckers.
In 13 islands two woodpecker species are known to breed. The combination of the breeding species is as follows: Japanese Pygmy Woodpeckers and Japanese Green Woodpeckers (on five islands), Japanese Pygmy Woodpeckers and Great Spotted Woodpeckers (on three), Japanese Pygmy Woodpeckers and White-backed Woodpeckers (on four), and Japanese Pygmy Woodpeckers and Okinawa Woodpeckers (*Sapheopipo noguchii*) (on one), which is a rare combination. The number of islands where each woodpecker species breeds decreases in the following order: Japanese Pygmy Woodpeckers (28 islands), Japanese Green Woodpeckers (seven), White-backed Woodpeckers (five) and Great Spotted Woodpeckers (four). Therefore, the number of species combinations bears some relation to the number of islands where each woodpecker species occurs. It is interesting, however, that there are no combinations of Great-Spotted and White-backed Woodpeckers, White-backed and Japanese Green Woodpeckers, Grey-headed and Japanese Green Woodpeckers, and Great-Spotted and Japanese Green Woodpeckers.

The species of each of these non-existent combinations

belong to the same genus and are similar in size, or they belong to different genera but do not differ greatly in body size. The former example is combinations of Grey-headed and Japanese Green Woodpeckers and of Great-Spotted and White-backed Woodpeckers. The latter is represented by a combination of Japanese Green and Great-Spotted Woodpeckers or Japanese Green and White-backed Woodpeckers. Interestingly, Grey-headed Woodpeckers are distributed from the eastern part of the Asian continent to Taiwan and Hokkaido, but they are not found in Honshu, Shikoku and Kyushu where Japanese Green Woodpeckers occur.

Similarity in body size and closeness in relationship between species generally reflect similarity in lifestyle in terms of feeding sites, foraging methods and food. In other words, similarity in lifestyle tends to increase between the species which are more closely related and less different in body size. Thus, the species of each of the above-mentioned non-existent combinations are similar in lifestyle. Incidentally, Grey-headed Woodpeckers and Eurasian Green Woodpeckers (*Picus viridis*) coexist in the vast European Continent. But the two species are quite different in body size. Eurasian Green Woodpeckers are distinctly larger than Grey-headed Woodpeckers.

In autumn or winter that corresponds to the period of dispersal and migration, on the other hand, a combination of more than two species or the above-mentioned non-existent combinations are temporarily observed in several islands. For instance, even in Oki Island where only Japanese Pygmy and White-backed Woodpeckers breed, Great-spotted and Japanese Green Woodpeckers have been observed in the non-breeding season. In winter Grey-headed Woodpeckers visit Rishiri Island, northern Hokkaido. In extreme cases, four species of Japanese Green, Great Spotted, White-backed and Japanese Pygmy Woodpeckers can be seen at the same time in Kinkazan, an island with an area of about 10 km^2 off Sendai, northern Honshu. Thus, non-existent combinations are not due to the absence of encounter of the species concerned.

It seems reasonable to assume, therefore, that two woodpecker species which are similar in lifestyle cannot coexist in a small island but those with markedly different lifestyles may live harmoniously there. It is assumed that a larger difference in the thickness of tree trunks and branches for foraging and in the kind and size of food between the species might facilitate their coexistence by reducing competition for resources.

However, this theory still does not explain the fact that the number of species combinations increases in autumn and winter when food resources tend to be scarce, but decreases in spring and summer when they are in plentiful supply. In addition to competition for resources, "reproductive interference" may be involved in the combination of species. Reproductive interference refers to the interaction between species over breeding which reduces the reproductive success of females (Homma et al. 2012). Although there are no observation or research reports about the reproductive interference of woodpeckers, it is interesting to study whether some reproductive interference operates in woodpeckers in the future. Studies on the effects of reproductive interference on the distribution and population changes of closely-related species have rapidly increased in plants and insects in recent years.

Chapter 2: Representative birds of Japan

Birds of Japan [BOOK p.28]

Because Japan is an island country, there are birds that do not occur in any other countries. To encounter these birds is one of the delights of watching birds in Japan. Not all of them are rare birds. Some of them are common and familiar birds for us. What are the birds that might be called a representative of Japanese birds? Here I will focus on land birds (based on Higuchi 1996 with correction and addition).

First, I will take up birds which live in Japan as year-round residents but are not found outside of Japan. They include (a) Copper Pheasant, Japanese Green Woodpecker, Japanese Wagtail (*Motacilla grandis*) and Japanese Accentor (*Prunella rubida*), which live in the four main islands and some of their surrounding islands, and (b) Izu Thrush (*Turdus celaenops*), Bonin White-eye (*Apalopteron familiare*), Lidth's Jay (*Garrulus lidthi*), Okinawa Woodpecker, Okinawa Rail (*Gallirallus okinawae*), Ryukyu Robin, Amami Woodcock (*Scolopax mira*) and about five additional species (extinct species included), which live or lived only in specific small islands.

Secondly there are summer visitors breeding in Japan alone. This group consists of (c) Japanese Robin, Yellow Bunting (*Emberiza sulphurata*), Japanese Leaf Warbler, Japanese Night Heron (*Gorsachius goisagi*), which breed in the four main islands and some of their surrounding islands, and (d) Ijima's Leaf Warbler (*Phylloscopus ijimae*) which breeds on specific islands. Until recently, Japanese Leaf Warblers were classified into several subspecies under the scientific name of *Phylloscopus borealis*, but molecular phylogenetic analyses and studies of songs have shown that it is appropriate for these subspecies to be treated as three separate species, namely Arctic Warbler *P. borealis*, Kamchatka Leaf Warber *P. examinandus* and Japanese Leaf Warbler *P. xanthodryas* (Alström et al. 2011, Saito et al. 2012, Ornithological Society of Japan 2012). I have also adopted this classification.

Of the bird species from (a) to (d), the endemic species of Japan are those included in (a) and (b). Although we would also like to refer to the birds of (c) and (d) as a Japanese endemic bird, we do not usually classify them into this group out of consideration for the wintering grounds.

I will take up the following birds as those close to (a)-(d) in status: (e) Varied Tits (*Poecile varius*), Japanese Thrush (*Turdus cardis*) and others, most of whose distributions lie in the Japanese Archipelago, but which are also found in some areas of the Asian continent and the neighboring islands, (f) Chestnut-cheeked Starling (*Agropsar philippensis*), Brown-headed Thrush (*Turdus chrysolaus*) and Grey Bunting (*Emberiza variabilis*), which breed from northern Honshu and Hokkaido to the Kuril Islands, Sakhalin and the southern part of the Kamchatka Peninsula, (g) Japaneses Marsh Warbler, Japanese Reed Bunting and others, which occur only in a limited area of the continent and a part of Japan, and (h) Japanese Wood Pigeon (*Columba janthina*), Styan's Grasshopper Warbler (*Locustella pleskei*) and others, which live only in islands around Japan and the eastern margin of the Asian continent.

Since national boundaries have been artificially demarcated through history, they may represent nothing biologically. Japan is relatively distinct in geographical and geological divisions because it consists of a group of islands, but its political borders have still not been established based on these natural factors alone. When you claim the endemism of species, therefore, you also need to take this into account.

Origin of endemic species [BOOK p.33]

How were the endemic species of Japan which can be called a representative of Japanese birds formed? To put it simply, they have been formed through their own process of evolution since the Japanese Archipelago was separated from the Asian continent, which is called geographic speciation. Since Common Pheasants (*Phasianus colchicus*) of Japan are sometimes treated as a separate species, they can be regarded as an example of the species formed through this process, if we accept this theory.

It cannot simply be assumed, however, that all of the Japanese endemic species have been formed through this process. For example, Japanese Wagtails (*Montacilla grandis*) are very similar to White Wagtails (*M. alba*), which are widely distributed in the continent, so it might be assumed that Japanese Wagtails diverged from White Wagtails to evolve into another species after the Japanese Archipelago was separated from the continent. In other words, since Japanese Wagtails had evolved their own habits and appearances while being isolated, they could coexist with White Wagtails without interbreeding when White Wagtails expanded their range to Japan afterwards. Herein, endemism through this process is referred to as "endemism through isolation or neoendemism".

In fact, however, Japanese Wagtails resemble White-browed Wagtails (*M. maderaspatensis*) found in India more closely than any of the many subspecies of White Wagtails that are widely distributed in the continent. It is certain that the two species have many features in common, such as black-and-white plumage markings, body size and the courtship behavior of mating males (Fig. 3). We may, therefore, think that the common ancestor of Japanese Wagtails and White-browed Wagtails once ranged widely over the continent, but this ancient bird gradually shrank their range and finally remained in Japan and India alone as the newly evolved White Wagtails expanded their distribution. Endemism through this process is called "relic endemism or paleoendemism".

But is it true that Japanese Wagtails are more closely related to White-browed Wagtails than to White Wagtails? Wagtails

vary greatly in plumage coloration depending on regions and individuals. In addition, their body size can easily change. Similar appearances might develop in areas far apart. And there is little evidence to show that (the ancestors of) Japanese and White-browed Wagtails were gradually replaced by White Wagtails. Japanese and White-browed Wagtails are somewhat or considerably larger than many of the subspecies of White Wagtails. Larger species are generally at an advantage in competition. In fact, Japanese Wagtails are dominant over White Wagtails at least in the river beds of Japan. Even if a larger species has an advantage in competition, it may shrink its range because it is inferior in the efficiency of resources use.

Then, which is correct, neoendemism or paleoendemism? Unfortunately, it is hard to say either way at the moment.

Molecular phylogenetic studies using the base sequence of mitochondria DNA (Alstrom & Mild 2003) show that the difference in the sequence between White Wagtails and Japanese Wagtails (2.4%) is clearly greater than that between the subspecies of White Wagtails (0-0.78%). This is also true of the difference between White Wagtails and White-browed Wagtails. Putting these pieces of information together, it is highly probable that Japanese Wagtails have become an endemic species through the process of paleoendemism. If molecular phylogenetic studies are extensively conducted in the future, there will be progress in clarifying the phylogenetic relationships of these "black-and-white wagtails".

It should be noted that a small number of Japanese Wagtails were recently reported to breed in the Korean Peninsula as well (Choi & Nam 2008). It is yet unknown, however, whether they are a new population that colonized the Korean Peninsula from Japan where they have evolved into an endemic species, or a relict population of Japanese Wagtails which were once widely distributed in the continent. This is another interesting topic I would like to consider, taking molecular phylogenetic analyses into account.

Are many of the endemic species old? [BOOK p.35]

What about other endemic species? Many of the endemic species in Japan have distinguishing features, such as plumage coloration as in Lidth's Jays and Copper Pheasants. It is unlikely that they developed these defining characteristics in a relatively short period in terms of an evolutionary time scale after they were geographically isolated.

In addition, the species that are considered to be most closely related to these endemic species inhabit remote regions in the continent instead of adjacent areas. For instance, Mrs. Hume's Pheasants (*Syrmaticus humiae*) and Elliot's Pheasants (*S. ellioti*) which are closely related to Copper Pheasants are found in Burma and southern China. Mikado Pheasants (*S. mikado)* of Taiwan are also closely related to these species. Lanceolated Jay (*Garrulus lanceolatus*) which are closely related to Lidth's Jays (*G. lidthi*) living in Amami-Oshima and Tokunoshima Islands occur in the Himalayas. Black-breasted Thrushes (*Turdus dissimilis*) that are remarkably similar to Izu Thrushes (*T. celaenops*) of the Izu Islands range from southern China to Burma.

These disjunct distributions suggest that the common ancestors of these species were once found in the vast areas where they have ceased to occur nowadays. In general, species with a disjunct distribution are considered to be older in origin than closely-related species with a wide and continuous distribution. It is assumed, therefore, that these endemic species are of ancient origin and have survived as relicts in the areas where they are found nowadays because they have become extinct in the other areas. We can see a stage before species become endemic through this process in the distributions of the birds in above-mentioned (e) to (h) categories that could be called a quasi-endemic species.

It is dangerous, however, to explore phylogenetic relationships based on distribution and morphological similarity alone. Molecular phylogenetic analyses using mitochondrial DNA suggest that Lidth's Jays are more closely related to Lanceolated Jays than to Eurasian Jays (*G. glandarius*) , while Izu Thrushes of the Izu Islands are closer to Brown-headed Thrushes (*T. chrysolaus*) than to Black-breasted Thrushes (Takagi 2007).

Ryukyu Robins (*Luscinia komadori*) that are endemic to the Nansei and Danjo Islands were classified into genus *Erithacus* in common with Japanese Robins (*L. akahige*) and European Robins (*Erithacus rubecula*). Ryukyu Robins appear to be close to European Robins in the habit of nesting in various sites, plumage coloration and egg color. Recent molecular phylogenetic analyses using mitochondrial DNA show that Ryukyu Robins are closest to Japanese Robins and it is assumed that they diverged in the Ryukyu Islands (Seki 2006). Currently, Ryukyu Robins and Japanese Robins are classified into the same genus *Luscinia* and European Robins remain in genus *Erithacus* (Ornithological Society of Japan 2012).

Bonin White-eyes (*Apalopteron familiare*) which are endemic to the Ogasawara or Bonin Islands were once classified into Pycnonotidae or Meliphagidae, but they have been reclassified into Zosteropidae based on the molecular phylogenetic analysis of the ribosomal RNA of mitochondria (Springer et al. 1995). This species is similar to white-eyes in behavior, such as the mutual feather preening (allopreening) between the mates of a pair and roosting with their bodies touching each other. The species which is closely related to Bonin White-eyes is assumed to be Golden White-eyes (*Cleptornis marchei*) found in Saipan of the Mariana Islands.

In order to determine the origins of endemic species, it is best to carry out more extensive molecular phylogenetic analyses and integrate them with the findings of morphology, ecology and behavioral sciences in the future.

It should also be noted that even the species which have become relicts only in Japan had not developed all of the characteristics that they have now before they were geographically isolated. In other words, they must have developed some new features after they were isolated. In fact, Copper Pheasants have variations enough to be divided into five subspecies in the Japanese Archipelago. Japanese Wagtails are no exception. They have developed the lifestyle that is considerably specialized to the river environments of Japan, even if they are Japanese relicts (Higuchi & Hirano 1989).

The term an old relict may give an image of a bird eking out a living without vitality, but this is not necessarily the case. It is an important topic for a future study to shed light on the origins and developments of the distinctive features of species endemic to Japan including those of their ecology.

Chapter 3:
Abundant varieties of forest birds and water birds

Japan contains various types of environments — forests, grasslands, lakes, marshes, rivers, mountains, tidal flats and the ocean, for example. Each of the environments has its own avian world and abounds with wildlife. Forests are lively with forest life and shorelines are alive with water-associated life, presenting distinct scenes with different types of birds. In this chapter, I will illustrate the worlds of birds living in these different environments with beautiful photographs.

World of forest birds [BOOK p.38]

In southwest Japan, it is dark even during the daytime inside a laurel forest consisting of broad-leaved evergreen trees, such as oaks, chinquapin and *Machilus thunbergii*. This is because the branches and leaves of the canopy forms clusters of various sizes in a patchwork, leaving narrow gaps in the foliage. Sunbeams filtering through the foliage of the canopy sometimes dance around on the forest floor as branches and leaves sway in the wind. This type of forest is the favorite habitat of Varied Tit, Japanese White-eye, Brown-eared Bulbul (*Hypsipetes amaurotis*), Japanese Green Woodpecker, Narcissus Flycatcher (*Ficedula narcissina*) and Japanese Paradise Flycatcher. Japanese Wood Pigeon, Fairy Pitta and Japanese Night Heron are also found primarily in this forest, though their populations are small and their distributions are limited.

Forests of broad-leaved deciduous trees, such as oaks and beeches in northern Honshu have a complicated hierarchical structure because they contain well-developed herbaceous and shrub layers due to sufficient light reaching the forest floor. Since these forests provide a variety of habitats and food for birds, they are especially alive with many different species of birds. In early summer, you can see and hear Brown-headed Thrush, Japanese Thrush, Siberian Blue Robin (*Luscinia cyane*), Japanese Bush Warbler, Eastern Crowned Leaf Warbler (*Phylloscopus coronatus*), Japanese White-eye, Brown-eared Bulbul, Blue-and-white Flycatcher (*Cyanoptila cyanomelana*), Narcissus Flycatcher, Japanese Paradise Flycatcher, Yellow Bunting, Japanese Grosbeak (*Eophona personata*), Asian Stubtail (*Urosphena squameiceps*), Varied Tit, Japanese Tit (*Parus minor*), Coal Tit, Willow Tit (*Poecile montanus*), Winter Wren (*Troglodytes troglodytes*), Japanese Green Woodpecker, Great-spotted Woodpecker, White-backed Woodpecker, Japanese Pygmy Woodpecker, Copper Pheasant, Mountain Hawk-Eagle, Honey Buzzard (*Pernis ptilorhynchus*), Lesser Cuckoo (*Cuculus poliocephalus*) and Oriental Cuckoo (*C. optatus*). Forests are already replete with their songs before sunrise.

In the subalpine coniferous forests at an elevation of 1,500-2,500 m that consist of Veitch's silver fir, Maries' fir, spruce and Tsuga, the most visible species are Coal Tit, Eurasian Bullfinch (*Pyrrhula pyrrhula*), Goldcrest (*Regulus regulus*), Japanese Robin, Red-flanked Bluetail (*Tarsiger cyanurus*) and Japanese Leaf Warbler. Refreshing songs of Siberian Thrushes (*Zoothera sibirica*) and high-pitched voices of Rufous Hawk-Cuckoos (*Hierococcyx hyperythrus*) resound through the forests as well.

Hokkaido located to the north of Honshu, on the other hand, is widely covered with coniferous forests composed of firs, spruces or mixed forests of conifers and broad-leaved deciduous trees such as birches. These northern forests abound with Willow Tit, Marsh Tit, Eurasian Nuthatch, Long-tailed Tit, Eastern Crowned Leaf Warbler, Black Woodpecker, Grey-headed Woodpecker, Japanese Pygmy Woodpecker, Hazel Grouse, Ural Owl and White-bellied Green Pigeon. With any luck, you could also meet rare species like Three-toed Woodpeckers (*Picoides tridactylus*). Deep bass voices of Blakiston's Fish Owls may boom through the stillness of night from riparian forests.

Bird species vary between forest types, but of course it does not mean that all of the component species differ from one type of forest to another. Many bird species are found in several different types of forests. Japanese White-eyes and Brown-eared Bulbuls, for instance, occur not only in laurel forests but also in broad-leaved deciduous forests. Long-tailed Tit, Japanese Pygmy Woodpecker, Winter Wren and Narcissus Flycatcher range widely from broadleaved-evergreen forests to coniferous forests. When taking the density of each species into account, which may vary between forest types, the bird community can basically be said to differ between forest types.

Golden Eagles adapted to forest life in Japan [BOOK p.40]

Considering ecological characteristics instead of species richness and composition, on the other hand, there is the bird species that has changed its lifestyle, deepening its relationship with mountain forests in Japan because it is an island dominated by forests and mountains. Golden Eagles (*Aquila chrysaetos*) which are widely distributed in Eurasia and North America where they live in open habitat including rocky areas, grasslands and shrubs. In Japan, however, they are forest-dwellers of mountainous regions (Higuchi 2013).

It is assumed that Golden Eagles that have settled in Japan have gradually adapted to forest life in the environment dominated by mountain forests. Even if it can be said that Golden Eagles are forest-dwellers, however, they are less agile than Mountain Hawk-Eagles that can move inside a forest with shorter wings than Golden Eagles. Therefore, they have settled in a forest with or adjacent to suitable hunting grounds, such as grassland and open environments with scrubland like a limestone area.

The Golden Eagle subspecies (*A. ch. japonica*) breeding in Japan and the Korean Peninsula has the smallest body size among the Golden eagle subspecies, which is probably related

to their adaptation to life in a forest. Birds are at an advantage when living in structurally complicated environments, such as a forest if they are superior in maneuverability. Japan is a rare area in the world where Mountain Hawk-Eagles and Golden Eagles coexist.

Birds of grassland [BOOK p.45]

Japan contains no extensive grasslands, but still there are relatively large ones in Hokkaido (the northernmost main island). The world of grassland birds is also more diverse in Hokkaido than in the other main islands. From spring to summer pubescent angelica, daylily and Japanese rose bloom in dry grasslands, which are alive with Common Stonechat, Siberian Rubythroat (*Luscinia calliope*), Black-browed Reed Warbler (*Acrocephalus bistrigiceps*), Common Reed Bunting (*Emberiza schoeniclus*), Chestnut-eared Bunting (*E. fucata*), Middendorff's Grasshopper Warbler (*Locustella ochotensis*), Lanceolated Warbler (*L. lanceolata*), Yellow-breasted Bunting (*E. aureola*) and Long-tailed Rosefinch (*Uragus sibiricus*).

Grasslands adjacent to a body of water are home to Red-crowned Cranes (*Grus japonensis*). Red-crowned Cranes in black-and-white plumage are graceful to watch when they stand in a green meadow or in the blue water. This can be called the typical summer scene of Hokkaido. You may see small brown chicks keeping up with their parents. These are also habitats for Oriental Reed Warbler (*Acrocephalus orientalis*), Latham's Snipe (*Gallinago hardwickii*) and Common Redshank (*Tringa totanus*). Latham's Snipes are common there, but the habitat available to Great Reed Warblers is much more limited in Hokkaido than in Honshu. Common Redshanks breed in small numbers in the grasslands of eastern Hokkaido.

Dry grasslands in Honshu and southward are home to Common Stonechat, Black-browed Reed Warbler, Japanese Reed Bunting, Chestnut-eared Bunting and Meadow Bunting. There are birds breeding in grasslands on the other main islands as well as Hokkaido, but Siberian Rubythroats, Yellow-breasted Buntings and Lanceolated Warblers breed in Hokkaido alone. Japanese Reed Buntings, on the other hand, do not breed in Hokkaido. As in Hokkaido, Eurasian Skylarks and Meadow Buntings frequently use farmland as a substitute for grassland in Honshu and southward as well. In wet grasslands, Oriental Reed Warblers sing vigorously here and there. Little Bitterns (*Ixobrychus sinensis*) move through reeds quietly. On summer evenings, a large number of swallows roost in shoreline reedbeds. Some roosts accommodate tens of thousands of birds and provide a spectacular sight when these birds come out of their roost in the morning. Common Cuckoos stay in grasslands with sparsely grown shrubs during the summer. The peaceful voice of cuckoos resounds and creates a unique soundscape coupled with the songs of other birds.

The grasslands of several small islands distant from the mainland are home to Styan's Grasshoppers Warblers (*L. pleskei*), which are different species from Middendorff's Grasshopper Warblers found in Hokkaido. They sing restlessly while sitting at the leaf top of bamboo or pampas grass or while soaring in the air. Islands including the Izu Islands support these habitats.

Birds of lakes and marshes [BOOK p.47]

Grasslands and forests are crowded with a large number of birds from spring to summer, whereas lakes and marshes attract many different birds from autumn to winter, such as Whooper Swan (*Cygnus cygnus*), Tundra Swan (*C. columbianus*), Greater White-fronted Goose (*Anser albifrons*), Bean Goose (*A. fabalis*), Mallard (*Anas platyrhynchos*), Northern Pintail (*Anas acuta*), Common Teal (*Anas crecca*), Eurasian Wigeon (*Anas penelope*), Mandarin Duck (*Aix galericulata*), Tufted Duck (*Aythya fuligula*), Common Pochard (*Anas ferina*), Common Merganser (*Mergus merganser*), Red-breasted Merganser (*M. serrator*) and Smew (*Mergellus albellus*). Some lakes and marshes are filled to capacity with birds jostling against one another.

There are many "swan lakes" in Japan. The major wintering sites of swans in Hokkaido are Lake Kutcharo, Wakkanai-Onuma Lake, Odaito Lagoon, Lake Kussharo, Lake Miyajima and Lake Utonai. In Honshu, Kominato Coast, Izunuma Marsh, the Abukuma River, Lake Hyoko and Nakaumi Lagoon are noted as swan lakes. Since people feed swans in many of these sites, swans tend to gather together. As Lake Akkeshi of eastern Hokkaido, however, there are places where several thousand Whooper Swans visit to winter without being fed by people. These sites are rich in aquatic plants for food and do not freeze even in the coldest period of winter because they are connected to the sea. Whooper and Tundra Swans generally tend to avoid sharing wintering grounds.

Geese prefer lakes or marshes adjacent to extensive rice fields as a wintering site — Lake Miyajima of Hokkaido, Hachirogata Lagoon, Izunuma Marsh and the Izumo Plain of Honshu, for example. Greater White-fronted Geese and Bean Geese forage in rice paddies, but *Anser fabalis middendorffii*, one of the subspecies of Bean Geese, tends to prefer a swamp abounding with aquatic plants including Manchurian wild rice and water chestnuts. In addition to Bean Geese and White-fronted Geese, Lesser White-fronted Geese (*Anser erythropus*) and Cackling Geese (*Branta hutchinsii*) have recently increased in number. Conservation efforts exerted jointly by the research workers of Japan and Russia seem to have produced desirable results.

Ducks visit lakes, marshes and rivers across Japan. Mallards, Common Teals and Eurasian Wigeons range over the country, while Mandarin Ducks are often found on the shores of a lake or marsh where branches and leaves hang down. A large number of Northern Pintails and Tufted Ducks are attracted to the places where people feed ducks. These ducks, Northern Pintails in particular, are skillful at taking food from people in dense condition. In Kyushu (the southernmost main island), there are not many Northern Pintails probably because feeding has not been performed, but Eurasian Wigeons are common, which is related to the fact that green grass suitable for their food is often found in grasslands close to lakes and marshes even in winter.

Herons, cormorants, coots and grebes also visit lakes and marshes — Grey Heron (*Ardea cinerea*), Great Egret (*A. alba*), Little Egret (*Egretta garzetta*), Great Cormorant (*Phalacrocorax carbo*), Common Moorhen (*Gallinula chloropus*), Eurasian Coot (*Fulica atra*), Little Grebe (*Tachybaptus ruficollis*), Black-necked Grebe (*Podiceps nigricollis*) and Red-necked

Grebe (*P. grisegena*), for example. Many species of herons, cormorants and coots remain in Japan throughout the year. Grey Herons, Great Cormorants and Eurasian Coots have recently expanded their ranges and increased in number.

Birds of coastal mudflats [BOOK p.50]

Many different shorebirds use tidal flats as stopover sites in Japan while on migration in spring and autumn. Well-known stopover sites are Lakes Komuke and Furen of Hokkaido, Sanbanze tidal flat (Chiba Pref.), Yatsu tidal flat (Chiba Pref.), Shiokawa tidal flat (Aichi Pref.), Fujimae tidal flat (Aichi Pref.), Nangan tidal flat (Osaka Pref.), Sone tidal flat (Fukuoka Pref.), Ariake Bay (Nagasaki Pref.) and Manko of Okinawa Island. In these sites, large and small shorebirds of various shapes rest their wings and feed in great numbers.

Different species of shorebirds forage in their own ways depending on the length and shape of their beaks. For instance, Eurasian Curlew (*Numenius arquata*), Far Eastern Curlew (*N. madagascariensis*) and Whimbrel (*N. phaeopus*) search for crabs and shellfish by inserting their long and decurved bills deep into the sand and mud. Black-tailed Godwit (*Limosa limosa*), Bar-tailed Godwit (*L. lapponica*), Common Greenshank (*Tringa nebularia*), Grey-tailed Tattler (*Heteroscelus brevipes*) and Terek Sandpiper (*Xenus cinereus*) pick up shrimps, shellfish and lugworms with their straight or slightly upward curved bills. Spoon-billed Sandpipers (*Eurynorhynchus pygmeus*) capture small animals by putting their spatula-shaped bills just under the surface of the water and moving them briefly from side to side. Ruddy Turnstones (*Arenaria interpres*) forage for small animals as they insert their shorter and slightly upward curved bills under shells and stones and flip them over.

Many species of shorebirds live in flocks. Some species may form a flock of several hundred or several thousand birds in mudflats. It is really worth seeing many different species feeding together or flying around in a large flock with wings glittering. In addition to shorebirds, terns, herons and gulls flock to coastal mudflats — Common Tern (*Sterna hirundo*), Little Tern (*S. albifrons*), Little Egret, Great Egret, Grey Heron and Black-tailed Gull (*Larus crassirostris*) and Herring Gull (*L. argentatus*), for example. Tidal flats become crowded with birds of various sizes.

Birds of rice fields [BOOK p.54]

Rice paddies are too important to ignore as inland waters in Japan. Since rice is widely cultivated in Japan, rice fields are found across the country, especially in lowlands. The major part of the lowlands which were dry during the winter turns into a large wet grassland from spring to early summer. Rice paddies have served as a habitat for the organisms of vanishing marshlands. In the world of birds, they are highly important as a stopover site, especially for shorebirds that migrate through inland areas.

In spring, rice fields filled with water are alive with shorebirds including Spotted Redshank (*Tringa erythropus*), Wood Sandpiper (*T. glareola*), Green Sandpiper (*T. ochropus*), Long-toed Stint (*Calidris subminuta*), Rufous-necked Stint (*C. ruficollis*), Ruff (*Philomachus pugnax*), Whimbrel, Black-tailed Godwit, Long-billed Dowitcher (*Limnodromus scolopaceus*), Common Snipe (*Gallinago gallinago*), Latham's Snipe, Ruddy Turnstone and Pacific Golden Plover (*Pluvialis fulva*). Incidentally, of these birds, Spotted Redshank, Wood Sandpiper, Green Sandpiper, Long-toed Stint, Common Snipe and Latham's Snipe are found in inland wetlands including rice paddies, but not in coastal mudflats. At this time of year, these shorebirds are at various molting stages, ranging from winter plumage to summer plumage for breeding. They rest their wings in rice fields or on the ridges between them and capture insects and small fish to build up their strength.

A large number of shorebirds also visit the summer flooded paddies that are rice paddies artificially filled with water from August to September (Furuya 2012). Summer flooded paddies are the rotational upland fields of rice and wheat that are filled with water after crops are harvested in summer. This attempt is aimed at providing habitats for various life forms including shorebirds as well as holding back insect pests and weeds. Bird droppings serve as fertilizer. In addition to shorebirds such as Spotted Redshank, Wood Sandpiper, Common Greenshank, Black-tailed Godwit, Grey-headed Lapwing (*Vanellus cinereus*) and Pacific Golden Plover, herons including Little Egret and Great Egret also visit these fields in large numbers.

An attempt to fill rice paddies with water after the harvest has more widely been carried out (http://kabukuri-tambo.jp/about-fuyumizu/). This type of rice paddy is called a "winter flooded paddy". These winter flooded paddies are also aimed at using bird feces as fertilizer as well as checking pest insects and weeds, and contribute to attracting waterfowl such as swans. Swans not only feed or rest but also roost in rice paddies filled with water.

From autumn to winter some rice fields are used as a wintering ground by cranes, such as Hooded Cranes (*Grus monacha*) and White-naped Cranes (*G. vipio*). In the Izumi Plain of Kagoshima Prefecture, southern Kyushu, for instance, wintering cranes amount to as many as 13,000 birds, out of which Hooded Cranes and White-naped Cranes are about 10,000 and 3,000 birds, respectively. Hooded Cranes wintering in Izumi account for more than 80% of the world population and White-naped Cranes about 50%. Depending on the feeding stations, they also forage for weeds, the second ears of rice, insects and frogs in the rice paddies where the harvest is over and fallow fields. They use rice fields filled with water as a roost.

It is Rooks (*Corvus frugilegus*) that have increased among the birds which use rice fields as a wintering site. In the past Rooks wintered primarily in western Japan, but in recent years they have expanded their wintering range to eastern and northern regions including Hokkaido. They have a habit of forming large flocks and often look like a black mass in a rice field, where they forage for the second ears of rice and small animals. In the period of spring migration in the Izumo Plain of Shimane Pref., for instance, Rooks are seen to head for the Korean Peninsula in large flocks like dark clouds after rising on updrafts.

Birds of the sea [BOOK p.58]

Because Japan is surrounded by the sea, it is home to a large variety of seabirds. Seabirds breeding in the Japanese Isles amount to as many as 38 species. The islands of Hokkaido,

such as Oshima-ohshima, Teuri, Rishiri, Rebun, Yururi and Moyururi Islands, are the breeding grounds of Rhinoceros Auklet (*Cerorhinca monocerata*), Common Murre (*Uria aalge*), Spectacled Guillemot (*Cepphus carbo*), Tufted Puffin (*Fratercula cirrhata*), Black-tailed Gull, Slaty-backed Gull (*Larus schistisagus*), Japanese Cormorant (*Phalacrocorax capillatus*), Pelagic Cormorant (*P. pelagicus*) and Red-faced Cormorant (*P. urile*). A huge mass of these birds present a magnificent spectacle, but also they utter deafening calls, which resound across the northern sea. The waters around these islands become their foraging sites, where they fly about in large flocks. A vast number of Rhinoceros Auklets are spectacular to watch in the evening when they return to the breeding grounds on the islands one after another.

In recent years, however, Common Murres, Spectacled Guillemots, Tufted Puffins and Red-faced Cormorants have been declining sharply due primarily to the by-catch of net-fishing in neighboring waters.

In isolated islands from southern Hokkaido to Okinawa, Streaked Shearwaters (*Calonectris leucomelas*) breed in large numbers. Some of these islands each contain from tens of thousands to hundreds of thousands of breeders. The Izu Islands and other small offshore islands from Honshu to Kyushu are used by Japanese Murrelets (*Synthliboramphus wumizusume*) as a breeding site. Some 2,000 to 3,000 birds breed in Biroujima Island of Miyazaki Pref., Kyushu, which is assumed to contain the largest breeding population. The two species breed only in Japan and its neighboring islands.

When Streaked Shearwaters fly out to the sea from the breeding sites, some take off directly from the ground, while others climb a thick slanted trunk of a tree and then take wing from there. They sometimes form a queue under such a tree in some islands including Mikurajima of the Izu Islands and Kanmurijima of Kyoto Pref..

On the islets in the waters from Kyushu to the Nansei Islands, terns breed — Roseate Terns (*Sterna dougallii*) and Black-naped Terns (*S. sumatrana*), for example. They are very beautiful to watch against the blue sky and sea when both on rocks and in flight. Many different sea birds including Bulwer's Petrel (*Bulweria bulwerii*) and Brown Booby (*Sula leucogaster*) breed on islands in these waters and around the Ogasawara Islands.

Oceanic islands are used by albatrosses as a breeding ground. Short-tailed Albatrosses (*Phoebastria albatrus*) and Black-footed Albatrosses (*P. nigripes*) breed in Torishima of the Izu Islands, while Black-footed Albatrosses and Laysan Albatrosses (*P. Immutabilis*) breed in Mukojima and its surrounding small islands of the Ogasawara Islands. Efforts to transfer Short-tailed Albatross chicks from Torishima to the Ogasawara Islands have been made, aiming to establish a new breeding population there and expand their breeding range (see the web site of the Yamashina Institute for Ornithology).

Short-tailed Albatrosses also breed in the Senkaku Islands, but recent molecular phylogenetic analyses show that the Short-tailed Albatrosses of the Senkaku Islands are genetically quite distant from those of Torishima Island. The genetic difference between the two populations can be greater than that between the closely-related species of other albatrosses (Eda & Higuchi 2012). The taxonomic status of these Short-tailed Albatrosses will be on the research agenda in the future.

The sea is alive with many different birds in winter as well. Ducks including Greater Scaup (*Aythya marila*), Tufted Duck, Common Pochard, Harlequin Duck (*Histrionicus histrionicus*), Black Scoter (*Melanitta americana*), Velvet Scoter (*M. fusca*) and Long-tailed Duck (*Clangula hyemalis*), gulls such as Black-tailed Gulls, Herring Gull, Slaty-backed Gull, Glaucous-winged Gull (*Larus glaucescens*) and Glaucous Gull (*L. hyperboreus*), and loons such as Red-throated Loon (*Gavia stellata*), Black-throated Loon (*G. arctica*) and Pacific Loon (*G. pacifica*) are found in the coastal waters of Japan. In northern Japan, Brant (*Branta bernicla*) are not uncommon. Greater Scaups may form a flock of tens of thousands to a hundred thousand birds in some areas. When they take off all at once, the sky is almost darkened.

Thousands to tens of thousands of Short-tailed Shearwaters (*Puffinus tenuirostris*) are found between May and July off the Pacific coasts from Shikoku and Honshu to eastern Hokkaido. Especially, in the Nemuro Strait of eastern Hokkaido, a huge flock of these birds are seen flying about close to the surface of the sea. After breeding in islands near Tasmania of southeastern Australia, they travel north across the equator to extensive areas from the Pacific coastal waters of Japan to the Bering Sea.

Short-tailed Shearwaters glean krill and small fish near the surface of the sea or filter-feed by diving. Many of the birds that are drifted to a warm current region poor in small animals as their staple food are the juveniles of the year and may die in massive numbers due to food shortage in the coastal waters from Shikoku to the Boso Peninsula of Chiba Pref.. On the other hand, the adult birds that reach directly a cold current region rich in food sources off the coast of eastern Hokkaido can build up their strength by consuming enough food (Oka 2008).

Chapter 4:
Four seasons of the satoyama

Seasons and the birds [BOOK p.62]

The world of birds changes from season to season in Japan, which does not simply mean that birds change their plumage coloration and shapes or they disappear and reappear with the season. The species composition itself varies between seasons. In this way the world of birds is different from that of plants or insects. Different migratory birds come to Japan from the south in spring and from the north in autumn, which causes significant changes in the avifauna.

Of course, all the bird species do not change with the season. Some birds are year-round residents. They show different aspects of life depending on the season. Roughly speaking, birds begin to breed from spring to early summer. They build a nest, lay eggs and incubate them to hatch young. From summer to autumn they molt to replace frayed or mite-infested feathers with new ones. In autumn, they move their home range a little or reorganize their territory. In winter when it may freeze and snow, they forage for limited food resources to survive.

It is very interesting that species composition varies and the same species changes its lifestyle according to the season. The four seasons are clearly distinguished in Japan. In this chapter, I will focus on "satoyama", or countryside and look at the world of birds season by season. "Satoyama" is a mosaic of rice paddies, fields, streams, coppices and hills, which is located between mountains and urban areas and where people have lived in harmony with nature. Since satoyama is an artificially-maintained environment, I did not refer to it in the features of the natural environment of Japan, but it is the environment that could be called an archetypal image in the mind of Japanese people. Many Japanese people have lived, played and learned in this satoyama environment. Satoyama is estimated to represent about 40% of Japan. It could be said, therefore, that it is an environment familiar to many Japanese.

Since satoyama includes habitats such as rice paddies, fields, streams, secondary forests and hills, it is home to many different birds, which facilitates observing the world of birds in each season. Focusing on satoyama in the Kanto region (areas around Tokyo), I will roughly draw the changes of the worlds of birds and nature surrounding them. Even in the Kanto region, the progress of seasons is somewhat different between the north and south. Therefore, please note that the descriptions of birds and flowers in terms of phenology are meant to be general.

Spring of Satoyama [BOOK p.63]

From February to March, when plum trees bloom beside rice fields, hills and dales resound with the songs of Japanese Bush Warblers. The song, which sounds like "Hoh, hokekyo", is familiar to any Japanese and it turns the bleak scenery to an idyllic rural landscape.

Japanese White-eyes frequently visit plum blossoms and suck the nectar. Although the saying goes, "Ume ni uguisu (a Japanese Bush Warbler in a blossoming plum tree)", the bush warbler-colored (olive green) little birds which usually come to plum blossoms are not Japanese Bush Warblers but Japanese White-eyes. Japanese Bush Warblers are grayish olive brown. Therefore, some people say that "Ume ni mejiro (a Japanese White-eye in a blossoming plum tree)" is correct. However, "Ume ni uguisu" is a metaphor for an excellent combination or beautiful harmony of two things. Japanese Bush Warblers and plum blossoms are the remarkable combination which represents the advent of spring. Incidentally, Japanese Bush Warblers also come to plum blossoms.

In early spring, spiketails (*Stachyurus praecox*) bear pale yellow flowers that look like ornamental hairpins and *Magnolia kobus* put out white flowers. Long-tailed Tits begin to build nests in the woods. They gather moss and look for feathers and downs to build a warm and comfortable nest. Surprisingly, it is not uncommon for them to collect down and hundreds of feathers. I somehow feel happy when I encounter them in the woods as they alight on the ground and fly off with feathers in the bill. Is it because they make me realize the arrival of spring all the more?

Meadow Buntings sing in grass and trees, while Japanese Tits and Varied Tits sing in trees. After plum blossoms, peach trees put out pink blossoms, followed by cherry trees. Hills and valleys are decorated with the white or pink blossoms of Japanese-cherry, Oshima-cherry and Yoshino-cherry trees. Brown-eared Bulbuls and Japanese White-eyes visit cherry blossoms to eat the nectar vigorously. In paddy fields where Japanese milk vetches and rape flowers are in bloom, Common Pheasants show up and flap their wings, crowing "Kehn, kehn" in a loud voice from time to time. Skylarks sing merrily in the air.

Sounds of drumming come out from the woods as woodpeckers drum their bills on tree trunks and branches. A loud drumming that sounds like "tarrrah" or "korkorkorh" is produced by Japanese Green Woodpeckers, whereas a soft trill is produced by Japanese Pygmy Woodpeckers. Japanese Green Woodpeckers sometimes emit a tremendous sound by drumming on large moso bamboos. In the bush some distance away, Chinese Bamboo Partridges (*Bambusicola thoracicus*) are singing "People play, people play" in a loud voice. Males and females occasionally sing in a remarkable duet.

When spring comes, Barn Swallows (*Hirundo rustica*) arrive from the tropical regions. They fly over meadows and coppices, calling "Bichitt, bichitt". They perch on power lines near houses and look around at their surroundings. They are probably checking for nest sites.

When hills and valleys are bright with fresh verdure after

cherry blossoms are gone, Gray-faced Buzzards (*Butastur indicus*) return to the breeding grounds of satoyama and call "Piqweee, piqweee". They perch on the treetops of the coppices that extend on either side of rice paddies and look around their surroundings. The arrival of this hawk is followed by the arrival of Blue-and-white Flycatcher, Narcissus Flycatcher, Japanese Paradise Flycatcher and Ashy Minivet (*Pericrocotus divaricatus*). Birds of beautiful colors and forms fly around in the woods, which resound with many different bird songs. It is the height of spring, when the landscape and soundscape of satoyama undergo a complete change. Some of the summer visitors, such as Narcissus Flycatchers and Blue-and-white Flycatchers, remain in the satoyama of central Japan, but still others head north.

From early summer to summer [BOOK p.64]

In the season of rice planting, frogs croak vigorously in rice paddies and damselflies become highly visible along streams. Blue-and-white Flycatchers sing high up in the trees of wooded slopes, while Narcissus Flycatchers and Japanese Paradise Flycatchers sing in the woods. The song of Blue-and-white Flycatchers has a pellucid tone, which sounds like "Pee-pee-pee-pee-pipp, gitgitgit" with a falling intonation. The song of Narcissus Flycatchers suggests the tones of a flute and the chirp of a small cicada (*Meimuna opalifera*). Eastern Crowned Leaf Warblers and Asian Stubtails may be heard to sing as well. The song of the former sounds like "Shochoo-ippai Gwee ("Drink a glass of Shochu at a gulp"). Asian Stubtails sing "Shi-sh-sh-sh-sh-shee" continuously as if they were crickets.

Gray-faced buzzards fly off from the treetops of the coppices adjacent to rice paddies to swoop on frogs in the paddies and the ridges between them. They prefer to capture Japanese brown frogs (*Rana japonica*), Japanese tree frogs (*Hyla japonica*) and Tokyo daruma pond frogs (*R. brevipoda*). In addition to frogs, they prey on reptiles including Japanese five-lined skinks (*Plestiodon japonicus*), Japanese grass lizards (*Takydromus tachydromoides*) and ringed grass snakes (*Rhabdophis tigrinus*). In reedbeds close by paddy fields, Oriental Reed Warblers sing "Goegoesh, Goegoesh, Goesh-goesh" in a loud voice. They are also a summer visitor.

In May, Lesser Cuckoos arrive in Japan a little later than many other summer visitors. They shriek "Kyokkyott, Kyokyokyo" as they fly around over the woods. In the eaves of houses, the breeding of Barn Swallows is well advanced. In the woods, the nestlings of Japanese Bush warblers, Japanese Tits and Varied Tits have grown large. Long-tailed Tits have already been flying around busily in the woods with some ten fledglings. Blue-and-white Flycatchers, Narcissus Flycatchers and Japanese Paradise Flycatchers are in the middle of building a nest, laying eggs and incubating them. New life is born one after another and go out into nature. Hills and dales are the most vibrant with life about this time of year.

In the evening Brown Hawk-Owls hoot "Hohho, hohho" in large ginkgo and zelkova trees near farm houses. The male and the female of a pair may sing in a duet. They are probably nesting in the cavities of these trees. The shrill voices of Lesser Cuckoos resound through the darkness of night. Some of them are calling while flying around. Some Japanese Night Herons call "Boh, Boh" as they move along forest streams.

In June, the white flowers of Japanese dogwood are shining in a sunny spell during the rainy season. Lesser Cuckoos deposit their eggs in the nest of Japanese Bush Warblers. They lay chocolate-colored eggs similar to those of Japanese Bush Warblers, leaving it to their hosts to incubate the deposited eggs and raise the young. The eggs of Lesser Cuckoos hatch two or three days earlier than those of Japanese Bush Warblers. Lesser Cuckoo hatchlings place unhatched Japanese Bush Warbler eggs on their back and toss them out of the nest one by one. They monopolize the nest and the food from the foster parents.

Faintly-glowing points of light fly about over rice fields at night. They are Japanese fireflies. Many points of light flicker, waver and drift along. It is a fantastic sight.

Even after many of the song birds have finished breeding, Gray-faced Buzzards continue to raise their young. In this period, frogs, lizards and snakes are not easy to capture because rice has grown in paddy fields. Then Gray-faced Buzzards frequently swoop up or down on the branches and leaves of the forest canopy to capture insects, which are mostly grasshoppers and larvae of large moths, such as Japanese oak silkmoths (*Antheraea yamamai*).

In July, Barn Swallow juveniles sometimes flock to small reedbeds of marshes. There are many birds on reed leaves and stems swaying in the breeze. The birds that have finished breeding molt their feathers during the summer. They replace the old feathers damaged by mites with new ones. In the molting period, birds do not move about very often and do not call either. Instead of the calls and songs of birds, a continuous chorus of cicadas resounds through satoyama.

Autumn [BOOK p.70]

From September to October, when red spider lilies (*Lycoris radiata*) bear red flowers in the fields, Bull-headed Shrikes (*Lanius bucephalus*) often shriek "Keei-keei, Kich-kich-kich". Quiet hills and valleys resound with their shrills. During this period, the males and females stake out their own territories separately, and these shrieks represent a territorial declaration. This distinctive high-pitched call, which is called "Takanaki" in Japanese, is also used as a seasonal word indicating autumn in haiku (a type of Japanese poem). Bull-headed Shrikes occasionally chase each other calling. They often impale small animals such as insects, frogs and small fish on thorns and twigs. This impaled prey is called the "Hayanie" of shrikes. Some of the impaled prey may be eaten later.

The berries of Japanese snowbells are conspicuous and chinquapins (*Castanopsis sieboldii*) bears acorns. Varied Tits hold these berries and acorns between both their feet on the branch and make a hole in them with the bill to eat the inside. They also cache them in moss on the ground, cracks in the bark and at the root of a tree. They hold them in the bill with the pointed end forward and embed them into a caching site by tapping the blunt end. After that they cover them with moss and wood chips to hide them. These cached acorns are important food for winter survival.

When autumn is well advanced, winter visitors such as Naumann's Thrushes (*Turdus naumanni*) and Daurian Redstarts (*Phoenicurus auroreus*) arrive from the north. Naumann's Thrushes prefer open farmland, while Daurian Redstarts come to open woods and the backyards of houses. Naumann's Thrushes and Daurian Redstarts often call "Kekett" and "Hit-

hit kat-kat" respectively in this period. As in Bull-headed Shrikes, the males and females of Daurian Redstarts also set up their own territories separately. Their distinctive call serves as a territorial declaration. A flock of Rustic Buntings (*Emberiza rustica*) enter the shrubby areas, while Black-faced Buntings (*E. spodocephala*) show up at the edge of a forest. Grey Buntings, Red-flanked Bluetails and Pale Thrushes (*Turdus pallidus*) are sometimes found in the woods.

When trees have taken on autumnal colors, Japanese Waxwings (*Bombycilla japonica*), Bohemian Waxwings (*B. garrulus*) or Red Crossbills (*Loxia curvirostra*) show up during some years. Bohemian Waxwings and Red Crossbills vary greatly in number from one year to another. Waxwings gather in flocks to eat the berries of mistletoes, Japanese privets (*Ligustrum japonicum*) and privets (*L. obtusifolium*), while Red Crossbills perch on pine trees such as Japanese red pines (*Pinus densiflora*) and take the seeds out of the cones by twisting the crossed bills dexterously to eat them.

Against the sky aglow with the setting sun, a large flock of White-cheeked Starlings (*Spodiopsar cineraceus*) head for the roost. Hundreds or thousands of birds which have gathered from the neighborhood form a cluster like a dark cloud and fly around, changing its shape and size. Eventually, they descend to a coppice or a thicket of bamboo, calling loudly for awhile. Crows and Eurasian Tree Sparrows (*Passer montanus*) also form communal roosts.

Ducks including Mallard, Common Teal, Mandarin Duck and Eurasian Wigeon have already arrived in marshes and ponds. For a while after their arrival, the males have subdued plumage coloration similar to that of females. Year-round resident Eastern Spot-billed Ducks (*Anas zonorhyncha*) increase in number as well. Toward the end of autumn, the waterside become alive with flocks of wintering ducks, which presents a lively landscape and soundscape abounding with birds.

And winter [BOOK p.72]

In a coppice bare of leaves, a flock of some ten Azure-winged Magpies (*Cyanopica cyanus*) are pecking at something or bathing in a puddle on the ground covered with fallen leaves. They fly off in twos and threes and eventually disappear. They move around in the woods calling "Gyooi, Gyooi,". A Red-flanked Bluetail is perched on a shrub close to the place where the magpies were feeding. From time to time, it jumps down to the ground and returns to the tree with something small in the bill. When the blue back is lit up by sunshine filtering through the branches of trees, it grows still more vivid. The orange color of the flank also shines.

Long-tailed Tits and Japanese Tits move in a flock in the woods calling "Dee-dee-dee-dee". They are followed by Varied Tits and Japanese Pygmy Woodpeckers. There are some 30 birds in the flock. Long-tailed Tits move from twig to twig and Japanese Tits mostly feed on the ground. Varied Tits use the upper part of the woods, while Japanese Pygmy Woodpeckers forage on tree trunks. Although they form a mixed flock, the feeding places differ between the species.

Dozens of Bramblings (*Fringilla montifringilla*) are found in the rice field adjacent to the woods. There are also White-cheeked Starlings and Eurasian Tree Sparrows in flocks. The Bramblings take off all at once and perch on a nearby tree. The tree looks as if it put out flowers in the bleak winter landscape. White-cheeked Starlings are perched on a tree of Japanese persimmon (*Diospyros kaki*) at the edge of the field, pecking at the fruits. The ripe persimmons should be delicious. Brown-eared Bulbuls and Japanese White-eyes also come to the persimmon tree. Naumann's Thrushes and Eurasian Tree Sparrows follow suit as well. A flock of Eurasian Bullfinches are perched on a cherry tree, cutting off the buds one after another by the bill and eating them.

Mallards, Common Teals and Eastern Spot-billed Ducks are found in flocks in ponds and marshes. There are Mandarin Ducks on the shore that the branches and leaves of trees hang over. Every male duck has changed into beautiful breeding plumage. Common Teals show courtship behavior like scooping up the water. The Little Grebes that were out of sight between summer and autumn have returned. They frequently dive under the water to catch fish. A Common Kingfisher (*Alcedo atthis*) perches on the top of a snag. It is staring at the surface of the water but won't dive readily.

The evergreen bushes of camellias are found with many red flowers in places in a coppice. Japanese White-eyes occasionally visit the bushes to eat the nectar. Since they usually come by twos, they are probably a mated pair. They move from one camellia tree to the next with yellow camellia pollen at the base of the bill.

On a cold morning, the ground is covered with a thin layer of snow. A Carrion Crow (*Corvus corone*) digs up the ground covered with the fresh snow and takes out something. It looks like a nut. It was probably cached in the autumn. The crow pecks at it, holding it with the toes of both feet. After the crow has finished eating it, it starts to search for other cached food on the snow-covered ground again. The crow seems to remember the caching locations quite well because it retrieved the cached food under the conditions where it was difficult to find the locations.

The seasons rotate and plum trees put out blossoms again. Japanese White-eyes flock to them to eat the nectar. In the warm spring sunshine, Japanese Bush Warblers sing "Hoh, hokekyo". Naumann's Thrushes, Daurian Redstarts and various ducks which have survived the winter set out on a journey toward the north. After them many different summer visitors arrive from the tropical regions. Another new year of satoyama thus begins.

Chapter 5:
Active life of urban birds

Living in cities [BOOK p.76]

Despite its small size, Japan has a population of 130 million people. Large cities such as Tokyo and Osaka in particular are densely populated and only a limited species of birds live there. Typical urban birds, such as crows and Eurasian Tree Sparrows are, however, remarkably well adapted to city life. On the other hand, their adaptability and flexibility have caused friction with city dwellers. In this chapter I will introduce some of their flexible modes of life and frictions with city people.

Birds breeding on the rooftop of buildings [BOOK p.76]

In one of the downtown areas of Tokyo from Ueno to Okachimachi station, Black-tailed Gulls (*Larus ichthyaetus*) started to breed more than 10 years ago. Black-tailed Gulls usually breed on the ground and cliffs of islands and coasts in the Tohoku region (northern Honshu) and Hokkaido in Japan. They form a colony of several hundred or several thousand birds in the breeding grounds. There are no records, however, of their breeding in the center of any other city in the world.

It seems that some Black-tailed Gulls rescued and released in Ueno Zoo first began to breed in the zoo and its surroundings. It was five or six years ago that they started to increase markedly. At that time a large number of adult birds began to remain in April and May instead of returning to the breeding grounds of Tohoku and Hokkaido, and juveniles in dark brown plumage started to visit Shinobazunoike Pond adjacent to Ueno Zoo in July.

The rooftops of buildings in this area are used as a breeding site (Matsumaru & Higuchi 2013). They prefer the roofs which are off limits or left abandoned. Why have they begun to breed in the center of the city? One of the possible reasons is that Black-tailed Gulls have been increasing in number because their living conditions are improved by an increase in their prey animals due to the reduced use of pesticides. It is assumed that they have begun to breed in Tokyo instead of returning to the northern breeding grounds in spring because they are overcrowded. In addition, destruction of some of the breeding grounds by the Great East Japan Earthquake in March 2011 may have given them further impetus to gather in Tokyo.

The second reason is that the rooftop of a building is suitable to their breeding because it is relatively free of disturbance by people and it contains some shelf-like structures for nesting. Another reason is the possibility that a feeding site has become available in the neighborhood. What is important to communal breeders such as Black-tailed Gulls is a suitable feeding site as well as safe breeding grounds. It is still unknown where Black-tailed Gulls of Ueno feed, but there is a possibility that they scavenge in a garbage dump or take food from people. Black-tailed Gulls are seabirds, but they eat a wide variety of food from animal carcasses to food scraps.

Black-tailed Gulls use several buildings as nest sites in Ueno area. In one of the buildings, 20-30 pairs bred primarily in the shrubs planted for rooftop greening. In another building, five or six pairs attempted to nest in the flower bed on the rooftop. The number of Black-tailed Gulls breeding in Ueno area is estimated to be 30 to 40 pairs. The whole population is estimated at about 150 including the birds which do not attempt to breed due to a shortage of breeding sites.

But Black-tailed Gulls that breed on the rooftops and fly around their surroundings are a nuisance to the residents of the buildings and the neighbors. Cars and hung-out laundry are soiled with their feces. In addition, the rooftop where several dozen birds gather together resounds with their loud cries from early in the morning. As a result, the ward office of this area receives one complaint after another from the residents about Black-tailed Gulls, which results in them being persecuted in various ways. They are prevented from nesting or driven out in the middle of breeding. There are no breeding sites free from human interference on the rooftops of buildings in this area and they seemed to fail in their attempt to breed on the rooftops in 2013. Some pairs succeeded in breeding on artificial floating islands in Shinobazunoike Pond, however.

In Sapporo in Hokkaido, on the other hand, Slaty-backed Gulls (*L. schistisagus*) breed on the rooftops of buildings and parking towers (Nakamura 2012). It was also about ten years ago that they started to breed there. The sky of Sapporo, the largest city in northern Japan, rings with their cries in early summer. It seems that they have also caused problems such as water pipe clogging and soiling with their feces.

Little Terns (*Sterna albifrons*) breed on the rooftop of the Tokyo Metropolitan Morigasaki Wastewater Treatment Center located in Ota Ward. Little Terns come to Japan from Australia and New Zealand as a summer visitor. They prefer to breed communally in the gravel areas of rivers and coasts that are sparsely covered with grass. Since they are deprived of many of the breeding grounds by the large-scale development of these habitats, however, they tend to change their breeding grounds frequently these days. They sometimes use parking lots and vacant land. Under these circumstances, Little Terns started to breed in June 2001 on the rooftop of a huge concrete building in the Center.

The rooftop is off limits to the public and no one is allowed to enter without permission. The site is a safe haven for Little Terns. Initially, they failed in their attempt to breed because they laid eggs directly on the bare concrete surface where the eggs were exposed to wind and rain. Thereafter, the rooftop was covered with layers of sludgelite made of burnt sewage sludge, concrete splinters and shells, which has improved their

breeding performance. Various conservation efforts continue to be carried out (See Chapter 8), as a result of which Little Turns have continued to breed there, though the number of breeding pairs varies between years. In 2003, about 2,000 pairs attempted to breed and some 1,600 young were observed.

It is odd to see the white figures of Little Turns flying about over the rooftop of a concrete building, but it is a spectacular scene anyway. Since they are a rare species and do not cause feces- and loud call-related problems, no neighboring residents complain about them. The rooftop of the sewage treatment facility could be a valuable breeding ground for Little Turns which have been deprived of one breeding site after another.

According to the information on the internet, Grey-headed Lapwings (*Vanellus cinereus*) breed on some of the rooftops of schools and apartment complexes in Shizuoka, Aichi and Shiga Prefectures. As in Black-tailed Gulls in Tokyo, some of them use lawns planted for rooftop greening. Grey-headed Lapwings typically nest in rice paddies and on ridges bordering rice paddies in the Tokai region and westward. Their nests are often destroyed inadvertently by farm work. It seems that they are increasingly breeding on rooftops.

It could be said that the rooftops of buildings provide valuable breeding sites for rare birds as well as birds which have increased in number.

Duck family walking across a busy road into the moat of the Imperial Palace

[**BOOK p.80**]

Eastern Spot-billed Ducks are common year-round residents almost across Japan and do not usually attract public attention, but the Eastern Spot-billed Ducks breeding in Otemachi, central Tokyo are an exception. They bred close to the artificial pond of Mitsui & Co., Ltd. across a street from the inner moat of the Imperial Palace. In early summer the female parent walked with her some ten hatchlings across one of the busiest streets in Japan into the moat. Since the ducklings following their mother looked cute and awkward but at the same time brave, they were reported in the media as "the move of an Eastern Spot-billed Duck family to the Imperial Palace" almost every year in the late 1980s.

When the duck family walked across the road, police officers controlled the traffic as crowds of spectators watched. Stalls were set up on the side walk to sell "Spot-billed Duck rice crackers", and some people came to see the famous duck family all the way from Osaka by chartered bus. Mitsui & Co., Ltd. which owns the pond where the Eastern Spot-billed Ducks nested, appointed women called "Duck Ladies" to observe the ducks and record the observations.

Then, the duck family was not talked about any longer after around 2008 probably because Eastern Spot-billed Ducks disappeared from the area. In 2013, however, the duck family began to cross the road and move to the Imperial Palace again. It seems that one of the scenes representative of the early summer of central Tokyo has returned.

Frictions between humans and crows

[**BOOK p.81**]

Among birds living in urban areas, it is crows that especially draw the attention of city dwellers. While closely involved in the life of urban residents, crows live quite aggressively in a city, as a result of which they frequently cause frictions with them (See Higuchi 2010, 2013 for details).

Large-billed Crows in particular prefer to settle in a city and scavenge discarded food scraps in flocks. A large amount of garbage is discarded from shops and offices including restaurants, bars and coffee shops in downtown Tokyo. Dozens of Large-billed Crows gather around garbage bags and peck at them on the streets early in the morning.

Since these food scraps mostly come from restaurants, they are nutritious luxury food to crows. Crows not only eat them on the spot, but also often cache them behind bill boards, under flower pots and in gaps in show windows to take them out and eat a few hours or days later. Caching food is one of their habits.

The scavenging food scraps of crows causes another serious problem. An abundant supply of highly nutritious food allows for their population increase. The number of birds which die or weaken due to food shortage decreases, while the breeding performance improves, so a greater number of young are produced. In addition, the availability of a large amount of garbage attracts a lot of crows from the neighboring areas. The population increase enhances the chance of friction with urban residents. The frequent friction between crows and city dwellers result from an increase in the number of crows in urban areas.

Among crow problems, those which affect people's lives cannot be disregarded. One of these is that stones laid on the train tracks by crows (Higuchi & Morishita 2003). In the early summer of 1996, Carrion Crows placed stones on the tracks in Yokohama, Kanagawa Pref.. It was initially thought that people had done it, but police on a stakeout determined that the culprit was a crow. After that, I also carried out an investigation to cast light on how crows placed stones on the tracks.

The investigation showed that the feeding by people lay behind this incident. Some people fed bread crumbs to carp in a nearby river. Carrion Crows not only took and ate bread crumbs on the spot but also cached one crumb after another under the stones around the tracks. They took out these cached crumbs and ate them later. It is a habit of food caching as mentioned above.

When Carrion Crows cached bread crumbs and retrieved them to eat, they raised each stone with the bill at least once. They pushed a crumb between the stones and put a stone on it. They removed the stone from the cached crumb before taking it out to eat. When they picked up a stone, they sometimes placed the stone on top of the track on a level with their eyes to grasp it again in the bill or to peck at a crumb sticking to the stone. They used the tracks as a kind of table. In short, some of the stones placed on the tracks by Carrion Crows were left on the tracks.

This incident was solved by putting an end to feeding carp in the river. But stones are occasionally placed on the tracks by crows in some other areas, such as Kyushu and the Tohoku

region. In Kyushu, for instance, stones are more often placed on the tracks in areas with pig farms along the railroad. Crows flock in the farms to scavenge for a large quantity of tofu refuse pellets provided for pigs as feed and cache some of them around the tracks. When they cache or retrieve them, they happen to place stones on the tracks as in Yokomama.

This caching behavior results in delaying the trains, but so far has not led to major accidents, such as a derailment. Since stones are also placed on the bullet train tracks, however, it is an accident waiting to happen. It is highly probable that shock and the degree of damage are amplified when the train speed is great.

Crows have caused another serious problem for people in Kyoto. The behavior of Large-billed Crows taking candles have led to fires in the fields in Kyoto (Higuchi 2003). They took the candles that visitors placed as an offering in the precincts of a shrine, carried them away and hid them in the fallen leaves of a forest floor or in a thatched roof. Since the candles placed in the precincts are Japanese candles with a thick body and wick, they won't go out when crows carry them away. Therefore, they often start a fire when they are inserted into a thatched roof or a layer of fallen leaves. This is another case where the food caching habit of crows is involved.

Large-billed Crows eat the candles which they have taken away from shrines. Since Japanese candles are made from the berries of Japanese wax trees, they are rich in fat. Crows are very fond of fat. Although it is not clear how much nutrition the candles provide for Large-billed Crows, it goes without saying that they do not feed mainly on the candles. They may enjoy the candles as a luxury food item. They lick the melted wax of a lighted candle without fearing fire. Though the melted wax should be hot, they do not seem to mind it. The candles placed in great numbers in the precincts of a shrine are suitable food resources for Large-billed Crows, and it seems that they have developed the food culture of enjoying candle wax in this region.

Crows growing loquats [BOOK p.84]

This time I will tell you something cheerful about crows. Large-billed Crows are very fond of loquat fruit. In June loquats ripen in Tokyo and its surrounding areas. Large-billed Crows wait until loquats ripen, then literally devour them. They hold several large fruits in the bill and get them into the throat patch. It is not uncommon that some ten birds flock to one loquat tree.

But Large-billed Crows do not swallow a loquat whole. They spit out the seeds inside. The seeds will sprout later and become saplings. Since loquat seeds germinate relatively easily, there are many saplings around the parent tree. Not all of these saplings grow to bear fruit, but there is no doubt that Large-billed Crows have been increasing the number of loquat trees.

In June, loquat trees are heavy with yellow fruit in places along the Yamanote Line in central Tokyo and the Yokosuka Line for Kanagawa Pref.. Some of these trees are planted in the gardens of houses, but many of them are found in odd sites, such as vacant lots and areas outside the gardens and the grounds of a factory. Probably they have grown from the seeds Large-billed Crows spat out. Conditions permitting, loquat trees bear fruit seven or eight years after they sprout. This means that Large-billed Crows can eat the fruit of the trees grown from the seeds that they themselves sowed if they live for more than seven or eight years. Of course, they would not sow the seeds here and there with the intention of harvesting the fruit in the future, but their seed dispersal ends up increasing loquat trees in various places for their own benefit. It could be said that the Large-billed Crows which own a stable territory grow loquats for themselves.

In western Japan, particularly in the islands of the Seto Inland Sea, many loquat trees have grown outside the orchards because of seed dispersal of Large-billed Crows. In Awaji Island, which is famous for its loquat production, there are loquat trees that seem to have their origins in the seeds sown by Large-billed Crows in various areas. They have really planted loquat orchards in the island. But people do not harvest the loquats Large-billed Crows grow because they are smaller than those people cultivate. Not only people but also Large-billed Crows prefer to eat larger cultivated loquats, which obviously leads to friction with farmers.

Eurasian Tree Sparrows taking food from people's hands [BOOK p.86]

Eurasian Tree Sparrows are found in almost all residential areas and urban parks across Japan. They are the birds most closely associated with Japanese people apart from crows. Despite living close to people in Japan, Eurasian Tree Sparrows are very wary of them. They always keep a safe distance from people. It is probably because they have a long history of being persecuted due to their damage to rice, which is the staple food of the Japanese.

Unlike crows, Eurasian Tree Sparrows ("Tree Sparrows" afterwards) are not an anathema to people in urban areas. It is because that they are not too much of a nuisance to city dwellers. Moreover, in recent years, Tree Sparrows have more often come closer to people and take food directly from people's hands as in House Sparrows (*Passer domesticus*) of Europe. When did they begin to take food from people? What induced them to do it? What is the situation now? Here I will call the Tree Sparrows that come close to people's feet and hands without fearing people a "tame sparrow" and the birds that perch on people's hands and peck at food there a "hand-perching sparrow" (based on Higuchi 2013 with additional information).

Tame and hand-perching sparrows were first recorded in Yokohama Park of Yokohama City, Kanagawa Pref. in 1987 (Takai 1994). The record shows that not a few hand-perching sparrows were already found in the park at that time. This record is exceptionally early for Japan. It was not until around 2005 that tame or hand-perching sparrows appeared in other areas.

Around 2005, tame sparrows appeared in the Meiji Shrine and Shinobazu Pond, Tokyo. But hand-perching sparrows were not observed there at that time. In 2007, hand-perching sparrows were found in Nanki Shirahama resort of Wakayama Pref., Tsurumi Park in Osaka, and Daiba and Kitanomaru Park in Tokyo. In 2008, tame sparrows were observed on the rooftop of a department store in Nihonbashi, Tokyo.

After 2009, hand-perching sparrows began to be reported from one place after another – Gaienmae in Tokyo, Kobe Port Island in Hyogo Pref., Yatsu Mudflat area in Chiba Pref., Oji

Ekimae Park in Tokyo, Osaka Castle Park in Osaka, Yamashita Park in Kanagawa Pref., Shinobazu Pond area in Tokyo, Obori Park in Fukuoka in Kyushu, Tokyo Disney Land in Chiba Pref., Hibiya Park in Tokyo and Nagai Park in Osaka in order of reported date, for example, as well as the original Yokohama Park. Tame sparrows and hand-perching sparrows have been seen ever since in these places except in the places where people have stopped feeding them.

It is primarily in parks or places similar to a park that tame or hand-perching sparrows are found. The record shows that they tend to appear independently in various urban areas rather than gradually expand from one area to neighboring ones.

Many of the people who feed Tree Sparrows in parks and other places are elderly people who often spend some time in these places. Because these people are retired, they usually have time on their hands and feel relaxed. With the retirement of baby boomers, people with plenty of free time have been increasing in recent years. In Ueno Park of Tokyo, for instance, some people sit on a bench doing nothing in particular, while others read books. Some others are playing Japanese chess or chatting with their friends.

Probably these people began to feed sparrows while spending leisure time in a park, which led to the appearance of tame sparrows and hand-perching sparrows. Is it because the number of people spending time in parks started to increase sharply around 2005 with the retirement of baby boomers that tame sparrows and hand-perching sparrows began to appear almost simultaneously in various urban areas about that time? It is assumed, in any case, that Tree Sparrows have gradually relaxed their wariness of people because they have been treated kindly now that they are not persecuted as a pest species as before.

It is by no means desirable to feed wild animals because they gather in large numbers, attracted by food as well as because they lose independence once they depend on humans. When they concentrate, they tend to face serious problems such as the transmission of infectious diseases. Frankly speaking, however, it is really heartwarming to see Tree Sparrows come hopping close to people and take food from their hands. People around the person who is feeding sparrows are also watching them affectionately. Overall, it is an unwelcome favor to Tree Sparrows that people sometimes feed them and sometimes do not at whim, but these tame sparrows and hand-perching sparrows are, as it were, the mirror of the conditions of human society.

Chapter 6:
Interesting ecological behavior of birds

Birds show a variety of interesting behaviors and habits. Some of them are really astonishing. Interesting behaviors and habits are found in birds around the world, but there are a number of notable examples in Japan as well. In this chapter, from among these examples I will introduce particularly remarkable ones, which are as follows: Carrion Crows that use automobiles to crack their walnuts, Striated Herons that use bait to fish, cuckoos that change their egg colors and hosts with the region, and a Copper Pheasant that listen to classical music. They are rare examples in the world or that are closely related to the characteristics of the nature and geography of Japan.

Carrion Crows that use automobiles to crack their walnuts [BOOK p.88]

Corvids (crows and their relatives) show a variety of smart behaviors. In Sapporo, Hokkaido, a Carrion Crow drank some water by moving the lever of a faucet in a park. After the crow finished drinking, however, it did not bother to stop the water and left it running, as a result of which the faucet was replaced with a different type so that the crow could not manipulate it.

Large-billed Crows take bars of soap away as well. They cache them under a layer of fallen leaves and flower pots to eat them later, not to wash their feet with them, because soap also contains fat. This behavior is similar to that of carrying candles away, which I introduced in "Chapter 5: Active life of urban birds". It is doubtful, therefore, that this can be considered "smart behavior".

The wisdom of crows is best represented in the behavior of using automobiles to crack their walnuts. In Sapporo, Akita in Akita Pref. and Sendai in Miyagi Pref., Carrion Crows use automobiles to crack the shell of hard Manchurian walnuts (Nihei & Higuchi 2001). Carrion Crows alight on a road with a walnut in the bill and place it in the position where the tires of cars are likely to pass, then they perch on a nearby tree or guardrail to wait for a car to run it over. When a car runs over the walnut, they dash to peck at its smashed contents.

It is not easy as it seems, however, to crack walnuts on a road by using automobiles. It is because the areas of a road where the tires of cars pass are considerably limited and crows need to place a walnut right in these narrow zones. When a walnut is not run over by a car for a long time, crows come down to the road and shift it slightly. They may change its position several times until it is run over. Some crows use traffic signals to crack their walnuts. When the light turns red, cars stop. Then crows walk toward one of the stopped cars with a walnut in the bill and place it just in front of one of the front tires, in which case it is run over and cracked without exception.

It could be said that these Carrion Crows live by using the advanced technology that has been developed by human society. There are few if any living creatures in the world that are so skillfully involved in human society as these crows.

It is in the relatively limited areas of the city that Carrion Crows use automobiles to crack walnuts in Sendai. These areas have several features in common. Firstly, there are walnut trees in the vicinity of the location where they use cars to crack walnuts. Since they not only eat walnuts but also cache them, they use cars as a nut cracker in winter as well as in autumn. Secondly, there is an intersection, a curve, a steep slope or a rotary in the sites where crows crack walnuts. It is assumed that it is easy for crows to place walnuts in these places because cars slow down or stop there. Thirdly the roads where walnuts are placed have moderate traffic. Moderate traffic means the amount of traffic that does not force crows to wait for a long time to place walnuts or put crows at risk of being run over when they place walnuts and when they eat cracked walnuts.

The place that best meets these three conditions is a driving school. In fact, it is in Kadan Driving School that crows began to use cars to crack walnuts in Sendai. This driving school is located on the Hirose River with a large number of Manchurian walnut trees on the banks. Crows bring one walnut after another from the riverside to the driving school and place them on the road. There are various things like curves and intersections in the school. The traffic is also "moderate". The trainee drivers occasionally take the trouble to steer their car toward a walnut ahead on the road to run it over probably because they are not in a hurry.

Although crows started to crack walnuts using cars in other areas around the 1990s, they began to do it at this driving school as early as in the 1970s probably because this school has satisfied these favorable conditions. It could be said that crows went out to ordinary roads after they had done a lot of practice in the driving school. In any case, there is no doubt that crows assess the local situation properly and behave accordingly.

It is interesting that Large-billed Crows do not attempt to crack walnuts by using cars. Even when they see Carrion Crows use cars to crack walnuts nearby, they never follow suit. But they sometimes drive Carrion Crows out of a road to rob the walnuts cracked open. Placing walnuts on a road involves risks in its own way. In some cases crows are hit by a car and die. Large-billed Crows may let Carrion Crows do the dangerous work and skim off the cream. It is really amazing to see how crows live.

Striated Herons that bait fish [BOOK p.90]

In terms of smart behavior, there is another highly remarkable bird in Japan. It is the Striated Heron (*Butorides striata*). Striated Herons attract fish using some suitable food for them and captures them with the bill, i.e. bait fishing (Higuchi 1986, 1987, 1988, 1993). In addition, the Striated Herons of Japan are more skillful at capturing fish than those of any other part

of the world. The fishing method of Striated Herons is kinds of "ground-bait fishing" or "bait casting", but here I will call it "bait casting".

It is in Suizenji Park and Lake Ezu adjacent to the park in Kumamoto City, Kyushu that Striated Herons are often seen to fish with this method. In these areas fishing by bait casting has been observed since 1983. I will describe their fishing in detail (Higuchi 1996 with additional information).

Striated Herons usually wait for fish to come close to them while walking slowly in the shallows or standing still on the shores. When fish come into range, Striated Herons pounce on them and capture them with their bills. But fish do not come close to them so easily. The bait casting of Striated Herons is a method for skillfully luring fish that won't come into range and capturing them.

Striated Herons take fish bait or substitutes for it (hereafter referred to as bait) in the bill, then stoop down to cast the bait on the water while watching fish closely. Fish are sensitive to the fall of bait and often approach it carelessly. When fish come into range, Striated Herons pounce on them and catch them.

Striated Herons usually look for bait after arriving at their favorite fishing spots, such as rocks and low tree branches on the shores. They are similar to human anglers in that they choose their fishing spots, then catch fish using bait. They use as bait many different things readily available to them including invertebrates such as flies, ants, damselflies, dragonfly nymphs, cicadas, spiders and earthworms, nuts, leaves, twigs, bark, moss, mushrooms, Styrofoam fragments, feathers, pebbles, bread crumbs and popcorn.

Striated Herons capture damselflies, flies and ants, when these insects are flying or resting on stones. They search in mud or under stones at the bottom of the water for dragonfly nymphs and earthworms. They tear nuts, leaves, twigs and bark off nearby trees and collect moss and mushrooms growing in the vicinity or pick them up with the bill when they find them floating on the water. They use Styrofoam fragments and feathers floating on the water, and the popcorn and bread crumbs that people feed to carp in the pond of the park.

Of the bait that Striated Herons use, earthworms and insects are, as an angler puts it, "live bait". On the other hand, nuts, leaves, twigs, bark, mushrooms and polystyrene fragments are lures because they are not food for fish. Striated Herons do live-bait fishing, lure fishing and even fly fishing as in human anglers. The success rate is usually higher in live-bait fishing than in lure fishing, but sometimes does not differ between them.

Striated Herons retrieve the bait which fish did not bite or leftover bait to use it again. In extreme cases, they reuse the same bait more than ten times. On other occasions they move somewhere else with the same bait and use it there again. The behavior look similar to human anglers when they move to another fishing spot carrying the bait.

Striated Herons bait fish in several different ways. They sometimes capture fish approaching the cast bait which is drifting closer to them with the current. They sometimes cast bait in quick succession and catch fish coming closer to it, which is more appropriately referred as to "ground-bait fishing". These two fishing methods are interesting, but do not require a high degree of technical skill. Striated Herons are reported to use these fishing methods occasionally in other areas at home and abroad (Kurosawa & Higuchi 1993).

The remarkable fishing method that Striated Herons use in Japan is to take careful aim at fish and throw bait at it after watching fish closely. It usually takes less than a second for herons to catch fish by this method. In short, instead of waiting for fish to come closer to the cast bait, they throw bait at the fish which has come into range and pounce on it at the moment when it was distracted by the bait. This is a truly spectacular feat, which is observed only in Suizenji Park and Lake Ezu adjacent to the park in the world.

The choice of fishing methods depends on birds and the conditions of fishing spots. In the sites with no rocks of suitable size or low branches which hide Striated Herons from view, they are forced to fish standing in the water within sight of fish. In these sites they cast bait in rapid succession to make up for this disadvantage. On the shores where there are no low shrubs or rocks and the water is deep, Striated Herons have no choice but to perch on a branch at a height of more than 2 m and fish. Since it consumes extra energy to jump and return from a height, they watch fish closely for a long time and throw bait at them. But the bait cast from such a height seldom falls exactly on the aimed position and the fishing success is not high. On shores with a large number of shrubs and rocks of suitable size, Striated Herons attempt bait casting carefully, while making full use of advanced fishing skill.

Striated Herons usually prey upon Japanese dace, pale chub and crucian carp, but never try to catch carp that are abundant and conspicuous, which means that they are highly selective about the fish they capture.

Striated Herons not only use lure but also modify it. For instance, the twigs Striated Herons use as bait are 2 cm long at most, but twigs of suitable size are not always available. When Striated Herons cannot get them, they hold a longer twig under both feet and snap one end of it off to a proper length to use as bait. When using leaves, they usually tear a bit off to use. This is because large leaves or twigs frighten fish instead of attracting them when they are thrown at them.

Juveniles of the year already play at bait casting. They pick up some objects with the bill and throw them on the water. But they almost always fail in their attempt. There are two reasons for the failure. One is that the bait is not appropriate as a lure. They may pick up an object that is too long, such as a branch or flight feather that is more than 20 cm long, and throw it on the water. Another problem is that they remain standing upright in full view of fish after they threw the bait (which does not deserve the name of bait). Adults crouch down on a rock or branch to make themselves less visible to fish when they cast their bait or after they throw it. Striated Herons need experience and learning to master fishing by bait casting.

The remarkable bait casting of Striated Herons in Kumamoto City is related to the fact that the water is crystal clear spring water. There are a number of clear springs in various areas – Suizennji Park and Lake Ezu in this city, for example. The water is clear in the marshes and ponds which Striated Herons use as a feeding site. It is possible to watch fish closely in the clear water, which allows for highly-developed bait casting. There are few if any marshes and ponds with such clear water in other areas both at home and abroad. It seems to be true for the world of wildlife as well that superb techniques are developed in a favorable environment.

Please see Higuchi (1993, 1996a) for the origin and development of bait fishing in Striated Herons.

Cuckoos that change their egg colors and hosts with the region [BOOK p.94]

Four species of cuckoos breed in Japan, namely Common Cuckoos (*Cuculus canorus*), Oriental Cuckoos (*C. optatus*), Lesser Cuckoos (*C. poliocephalus*) and Rufous Hawk-Cuckoos (*Hierococcyx sparverioides*). These birds are all brood parasites. In short they do not build a nest, but deposit their eggs in the nests of host birds and leave it to them to raise their young. In Honshu, Lesser Cuckoos lay their eggs primarily in the nests of Japanese Bush Warblers (*Cettia diphone*), while Oriental Cuckoos mostly parasitize Eastern Crowned Leaf Warblers (*Phylloscopus coronatus*). Rufous Hawk-Cuckoos parasitize Blue-and-white Flycatchers and Siberian Blue Robins (*Luscinia cyane*). The hosts of Common Cuckoos are Bull-headed Shrikes (*Lanius bucephalus*), Oriental Reed Warblers (*Acrocephalus orientalis*) and Meadow Buntings (Higuchi 1998).

They tend to lay eggs which are similar in coloration to those of their hosts. The eggs of Lesser Cuckoos are the same chocolate brown as those of Japanese Bush Warblers, while Rufous Hawk-Cuckoos lay blue eggs similar to those of Siberian Blue Robins. Common Cuckoos have many different host species. In some cases Common Cuckoos vary in gens depending on their host and they lay eggs which are similar in coloration and marking to those of each host species. Strangely, Oriental Cuckoos do not lay whitish eggs as in their host warblers. Having said that, they do not lay reddish brown or blue eggs either. Instead they lay eggs with brown spots which markedly contrast with a white background.

Even in the same species of cuckoos, the main host species and egg coloration vary from one region to another. In the Izu Islands where only Lesser Cuckoos breed, for instance, they occasionally parasitize Ijima's Leaf Warblers (*P. ijimae*) in addition to Japanese Bush Warblers. But Lesser Cuckoos lay chocolate brown eggs, which stand out among the white eggs of Ijima's Leaf Warblers. Still, Ijima's Leaf Warblers incubate the cuckoo eggs without responding to the difference in egg color.

In Hokkaido, Lesser Cuckoos do not breed except in the southern part. In the areas where Lesser Cuckoos do not breed, Oriental Cuckoos lay chocolate brown eggs in the nests of Japanese Bush Warblers (Higuchi & Sato 1984, Higuchi 1998, Higuchi 2011). These chocolate-colored eggs are indistinguishable from those of Lesser Cuckoos laid in the nests of Japanese Bush Warblers. In addition, Oriental Cuckoos in these regions also lay eggs in the nests of Eastern Crowned Leaf Warblers as in Honshu. But the egg color is chocolate brown. Eastern Crowned Leaf Warblers incubate and hatch them as if they were their own eggs.

It seems that Oriental Cuckoos which have started to parasitize Japanese Bush Warblers in the areas without Lesser Cuckoos have also begun to parasitize Eastern Crowned Leaf Warblers as in Honshu and lay chocolate-colored eggs, taking advantage of Eastern Crowned Leaf Warblers which do not reject eggs with a different color. As mentioned above, Oriental Cuckoos in Honshu mostly parasitize warblers and lay whitish eggs with conspicuous brown flecks that are different from those of warblers. It is probably because the warblers which Oriental Cuckoos parasitize are also tolerant of the difference in egg coloration.

On the other hand, Japanese Bush Warblers are discriminating when it comes to egg coloration. When fake eggs of various colors were experimentally placed in the nests of Japanese Bush Warblers, they were more frequently rejected when they differed more in color from the warbler egg (chocolate brown) (Higuchi 1989). For this reason, the Oriental Cuckoos of Hokkaido, like Lesser Cuckoos of Honshu, have probably started to lay the same chocolate-colored eggs similar to those of Japanese Bush Warblers.

It is interesting to note that the Oriental Cuckoos that have started to parasitize Japanese Bush Warblers lay eggs which are similar also in size to those of Lesser Cuckoos. Oriental Cuckoos lay smaller eggs to match those of leaf warblers in Honshu, but they lay larger eggs in Hokkaido because they parasitize Japanese Bush Warblers whose eggs are larger than those of leaf warblers. As a result, Oriental Cuckoos lay eggs as large as those of Lesser Cuckoos, which mostly parasitize Japanese Bush Warblers.

There is another interesting topic in this context. In the Oshima Peninsula, southern Hokkaido, both Lesser and Oriental Cuckoos parasitize Japanese Bush Warblers. Although it is unknown how they avoid competition for their host species, Lesser Cuckoos lay chocolate brown eggs in the peninsula as in other regions, but Oriental Cuckoos lay orange-colored eggs. They are much paler than chocolate brown with sparse brown flecks and about the size of a chocolate-colored egg. In other words, Oriental Cuckoos in the peninsula lay eggs between those with brown flecks on a white ground from Honshu and chocolate-colored ones from the other areas of Hokkaido.

The orange-colored eggs have been known for nearly 100 years. Those birds that lay orange eggs seemed to have been common in the region at that time because there are many egg specimens from that period. From the characteristic patterns of the eggshell surface, they are determined to be those of Oriental Cuckoos. The fact that Oriental Cuckoos in this region lay intermediate eggs suggests that they started to parasitize Japanese Bush Warblers in the not-so-distant past.

If that is the case, the egg color of Oriental Cuckoos in the peninsula may have changed in the last 100 years. It is possible that Oriental Cuckoos in this region have already laid more reddish eggs or chocolate-colored ones as in the other areas of Hokkaido. It is because Japanese Bush Warblers are very particular about the color of eggs in the nest. One hundred years may be too short on the evolutionary scale, but it is possible that Japanese Bush Warbler's ability to strictly discriminate egg colors changes the egg color of its brood parasites in a relatively short period of time.

Unfortunately, Japanese Bush Warblers have rapidly lost their habitat in this region in recent years due largely to residential development. The eggs of Oriental Cuckoos have not yet been found in the nests of Japanese Bush Warblers. I am looking forward to new evidence about these cuckoos from future research.

Copper Pheasant that listens to classical music [BOOK p.98]

Copper Pheasants (*Syrmaticus soemmerringii*) are an endemic species to Japan, and they competed with Common Pheasants (*Phasianus colchicus*) for the status of the national bird of Japan. They are unspectacular to look at from a distance, but the males are very beautiful to watch at close range with patterned plumage of various shades of brown. Some males have nearly one-meter tail feathers. In most cases, however, we catch a glimpse of them as they run quickly across our path when we are driving in a mountain road. They hide or run away quickly at the sight of humans. They are extremely vigilant about humans. I suspect that their vigilance is related to the long history as a game bird.

In rare cases, however, Copper Pheasants come close to people, follow them, peck at them and kick them. My search on the internet showed that these behaviors were observed in several different places of Honshu and Kyushu, and some of them were photographed. Although it is initially hard to believe, it is a fact.

In fact, I also observed these behaviors in the northern part of Kumamoto Pref., Kyushu in January 2013. The site was a planted woodlot facing cropland. As I headed for the woods with my colleagues according to the previous information, a Copper Pheasant came out of the edge of the wood. It was a male with remarkable plumage which was darker than that of the males found in Honshu. It was *S. s. soemmerringii*, a subspecies distributed in northern Kyushu. The bird had a tail about twice the body length and shone all over in the color of red copper when exposed to the sunlight. It approached us without pausing with its facial skin red and swollen. It came up to my feet, clucking. It walked slowly around me. It sometimes picked at the ground. It also pecked at grass. It inflated its body while raising the tail high up in front of us. It kept doing these things for more than half an hour. Meanwhile, one of our colleagues was even strongly kicked by the pheasant. It was an incredible sight.

Searching the internet for further information on Copper Pheasants, we found that the birds which approached, followed or kicked people without fearing them were all males. These behaviors are assumed to be a kind of territorial behavior. Male Copper Pheasants can be highly aggressive, especially in the breeding season. It could be assumed that they show aggression toward people who have intruded into their territory.

Or it is also possible that these are captive-raised birds that have not lost tameness after they were released into the wild. As a matter of fact, Copper Pheasants are bred in captivity and released into the wild in several regions of Japan. If that is the case, however, it is strange that there are no tame females. In addition, although Common Pheasants are raised in captivity and released into the wild in larger numbers than Copper Pheasants, no tame Common Pheasant has been reported. Hence, it is still unknown why these tame Copper Pheasants are found.

I would like to introduce the most baffling example of Copper Pheasant behavior. It is a story of a man and a male Copper Pheasant in a mountain village of Nara Pref., western Japan (Ohtsu 2008). His name is Masaaki Ohtsu. He is a retired teacher. The Copper Pheasant was named "Yama" after Yamadori, which is a Japanese name for a Copper Pheasant. When Mr. Ohtsu called out toward the hill at the back of his house, "Hey" or "Yama", the bird showed up. It came closer to him and walked around him. When he started walking, the bird followed him. It sometimes walked in a zigzag a meter or so ahead of him when he took a walk. It sometimes sat on his shoulder, head, arm or back. When it sat on him, it gently alighted on him instead of pouncing on him. But it also pulled his hair. On some occasions, he could grab its tail. It sometimes chased after his car. In addition, the bird listened to the classical music he played on the piano or flute. Eventually, the bird came into the house. This friendly relationship between them lasted for a year and a half.

Mr. Ohtsu did not feed the Copper Pheasant and did nothing in particular to attract the bird. One day, the bird suddenly came to him and made friends with him. It is extremely uncommon that wild birds, especially those which are highly vigilant as Copper Pheasants, form a close friendship with people in this way. Or rather this is probably an unprecedented case.

Unfortunately, the Copper Pheasant ceased to show up a year and a half later probably because it was attacked by some predators. A variety of mysteries remain, but I would like to explore the behaviors and origins of tame Copper Pheasants like the birds of Nara and other regions in the future.

Chapter 7:
Bird migration –from where to where

Bird worlds in different seasons [BOOK p.100]

Because Japan is a country with distinct seasonal changes, bird species vary greatly depending on the season. In spring, summer visitors come to Japan from the south – Barn Swallow, Blue-and-white Flycatcher, Narcissus Flycatcher, Japanese Paradise Flycatcher, Common Cuckoo, Jungle Nightjar, Brown Hawk Owl, Grey-faced Buzzard and Honey Buzzard, for example. These birds return to the south from late summer to autumn. As if to replace them, winter visitors such as Naumann's Thrush, Daurian Redstart and Japanese Waxwing arrive from the north with ducks, geese and swans in autumn.

Where do they come from and where do they go? Where are the north and the south? Do they take different routes when they come to Japan and when they return? These questions remained unresolved for a long time. But tracking studies using satellites (satellite tracking) that began in the 1990s have revealed various things (Higuchi 2005, Higuchi 2013). Satellite tracking provides real-time information about the locations and movements of birds no matter where they are on the earth. The results of satellite tracking are always interesting and sometimes can be surprising. Even common and familiar ducks, swans and hawks make a remarkable journey. There is a species that visits all the countries of East Asia while on migration.

I have been involved in research related to satellite tracking for more than 20 years. During this time, I performed a variety of joint researches with research workers at home and abroad, and achieved multiple results. In this chapter, I will introduce the salient findings after a brief explanation for the mechanisms of satellite tracking, showing that migration routes vary between bird species or groups and explaining why the same species takes different routes in the spring and autumn migrations.

Mechanisms of satellite tracking [BOOK p.101]

The mechanisms of satellite tracking I will explain below are those using the Argos system. Many of the tracking studies that have been conducted so far use this method. Some satellite tracking studies use GPS. Please see Higuchi (2013a) for the mechanisms, advantages and disadvantages of tracking using GPS

When you conduct a satellite tracking study, you need to mount a satellite transmitter on a target bird. Satellite transmitters for birds weigh 5 – 50 g and transmit radio waves of the 400 MHz band. They are attached to the back or collar. Signals from a transmitter are received by the Argos systems of several satellites such as NOAA (weather satellite) of the United States and METOP (earth observation satellite) of the European Union (Fig. 4). These satellites move around the earth on the polar orbit about 800 km above the ground in about 100 minutes. The Argos systems of these satellites measure the frequency of received signals and retransmit the signals along with the reception time and data to the receiving stations on the ground. The information sent to the receiving stations on the ground is transferred to the Argos processing centers in France and other countries, where it is converted into the location information of latitude and longitude. Research workers can obtain the location information on the internet only 20-30 minutes at the earliest after the satellites received the radio waves.

The location information from the Argos system lacks accuracy. The accuracy of the information differs each time depending on how stable the transmission frequency of a transmitter is and how often a satellite receives radio signals during the ten minutes when the satellite is passing over the transmitter. Therefore, the accuracy is shown in classes of 1, 2, 3, 0, A, and B. When a transmitter is at rest, the accuracies (measurement errors) of classes 1, 2 and 3 are 500 -1,500 m, 250 – 500 m and less than 250 m, respectively (Argos Online Manual). The accuracy of class 0 is more than 1,500 m without any specified upper limit. The accuracy is still worse in classes A and B.

Since the location information from the Argos system lacks accuracy as mentioned above, this system does not lend itself to tracking studies aimed at determining local movements in a range of several kilometers. It is effective enough, however, in determining the routes of long-distance migrants traveling several thousand kilometers or more than ten thousand kilometers. The battery life of a transmitter varies depending on the setting, but it ranges from several months to a year. There are also solar-powered transmitters, which work for 2-3 years or 4-5 years at most.

From where to where? [BOOK p.102]

Our research team has satellite-tracked many different birds including cranes such as White-naped Crane, Hooded Crane, Red-crowned Crane, Common Crane (*Grus grus*), Demoiselle Crane (*Anthropoides virgo*) and Siberian Crane (*G. leucogeranus*), swans such as Tundra Swan and Whooper Swan, ducks such as Mallard, Northern Pintail and Eurasian Wigeon and raptors such as Grey-faced Buzzard, Honey Buzzard, Common Buzzard (*Buteo buteo*), Rough-legged Buzzard (*B. lagopus*), Eastern Marsh Harrier (*Circus spilonotus*) and Hen Harrier (*C. cyaneus*). Many of the findings have been published in books as well as in scientific papers (e.g. Higuchi 2005, 2012ab, 2013, 2014). In addition, other groups have also satellite-tracked a few birds such as geese. Unfortunately, no bird species weighing less than 200 g have been satellite-tracked because even the lightest transmitter is too heavy for them.

Here I will introduce the salient tracking results of migrants such as White-naped Crane, Mallard, Northern Pintail, White-fronted Goose, Tundra Swan, Whooper Swan, White-tailed Eagle, Grey-faced Buzzard and Honey Buzzard. These birds come to Japan as summer or winter visitors. These results show what countries or regions are visited by migrants breeding or wintering in Japan. Many of the descriptions below are based on Higuchi (2005, 2012 abc, 2013, 2014). I have summarized the results published in several journals and added further information if necessary.

Migration of White-naped Cranes

[**BOOK p.102**]

The Izumi Plain of Kagoshima Pref. is one of the major wintering sites for cranes in the world. Hooded and White-naped Cranes wintering there amount to more than 10,000 birds. It was from 1991 to 1993 shortly after my team began satellite tracking studies that White-naped Cranes were first satellite-tracked from Izumi. The transmitters were developed by NTT for our satellite tracking studies. They were battery-powered.

We tracked nine White-naped Cranes as far as their breeding grounds. They left Izumi from the end of February to early March and reached the Korean Peninsula after moving along the western coast of Kyushu (Fig. 5). Some of them stayed overnight in Tsushima or the Goto Islands. Passing near Pusan located at the southeast end of the Korean Peninsula, they headed for Cheorwon and Panmunjom along the demilitarized zone (DMZ) between the DPRK (North Korea hereafter) and the ROK (South Korea). After staying there for a week or a month, they resumed traveling north, with seven birds along the eastern coast of North Korea and the other two along the western coast.

In mid-March the seven cranes moving along the eastern coast headed for the estuary of the Tumen River that North Korea, China and Russia border via Kumya of North Korea. Kumya is a natural delta wetland. The Tumen River rises in Mt. Baekdu (Paektu) between China and North Korea and flows into the Sea of Japan. Then, the cranes left for Lake Khanka on the border between China and Russia via the suburbs of Vladivostok and stayed in the lake for one or two weeks. From late March to late May they arrived at their destination, which was the Three Rivers Plain located in the northeastern part of Heilongjiang Province of China. The Three Rivers Plain is an alluvial wetland created by the Amur, Songhua and Ussuri Rivers. The plain is larger than Hokkaido.

On the other hand, the two cranes heading north along the western coast of North Korea entered China via the vicinity of the border between China and North Korea. Continuing the northward journey, they arrived in Zahlong near Qiqihar in the western part of Heilongjiang Province of China. This area is a large wetland known for the breeding grounds of Red-crowned Cranes, White-naped Cranes and Oriental Storks (*Ciconia boyciana*).

The cranes went back to Izumi taking almost the same routes in autumn (Higuchi et al. 2004). But there were fewer birds than in spring migration, and they left Khingansky and Muraviovka along the Amur river of southern Russia.

The important stop-over sites for the cranes in both spring and autumn migration are Cheorwon and Panmunjom in the DMZ (between South and North Korea), Kumya on the eastern seaboard of North Korea, the estuary of the Tumen River (that China, Russia and North Korea border) and Lake Khanka (between China and Russia). Many birds stay for a long period of time in the DMZ of the Korean Peninsula. One of them go back and forth between Cheorwon and Panmunjom while staying in the DMZ.

The demilitarized zone which is 4 km wide from the north to the south is strictly off limits to the public. Further, the several-kilometer-wide civilian control zone established to the south of the DMZ is also off limits except for the area where farming is partly allowed, as a result of which it could be said that these areas have ironically become a paradise or a sanctuary for birds (Higuchi & Minton 2000, Higuchi 2001).

Migration of ducks [**BOOK p.105**]

Many ducks have been satellite-tracked in the migration, but the route, period and pattern of migration vary greatly between individuals and are much more complicated than those of cranes and hawks. Therefore, I will provide only an overview focusing on their migration routes. Our study team used the transmitters of Microwave Telmetry Corp. and North Star Science and Technology Co., Ltd. of the U.S. They run on batteries or solar cells.

Mallards that fly across the Sea of Japan [**BOOK p.105**]

In the winters from 2005 to 2007, we captured a total of 65 Mallards (*Anas platyrhynchos*) and attached satellite transmitters to them in Obihiro in Hokkaido, Koshigaya in Saitama Pref., Sasebo in Nagasaki Pref. and Sadowara in Miyazaki Pref. We identified the routes of the spring migration for 27 birds, and tracked ten birds to the breeding grounds (Yamaguchi et al 2008; Fig. 6). The low efficiency of the tracking can be attributed to the fact that many ducks are hunted at home and abroad.

Although the migration routes varied greatly between individuals, birds wintering in the same site tended to take similar routes. The six Mallards that left Koshigaya in Saitama Pref. flew across the Sea of Japan to the southeastern part of Russia. Many of the Mallards that departed from Sasebo and Sadowara in Kyushu headed north along the eastern coast of the Korean Peninsula and reached the vicinity of the border between China and North Korea. Some of them moved to the area from northern China to south-central Russia. One Mallard from Obihiro, Hokkaido traveled to Kamchatka via the southern part of the Kuril Islands.

Some ducks changed course abruptly while on migration. One of the Mallards that left Sasebo, for instance, turned to the west suddenly and reached the vicinity of the border shared by Russia, China and Mongolia after they crossed the Sea of Japan to the continent. One of the Mallards that departed from Koshigaya, Saitama Pref. turned to the east and reached the northern tip of Sakhalin after moving to the north of Khabarovsk via Hokkaido.

The estimated breeding grounds range from northern to eastern China and from the Amur region to northern Sakhalin in Russia. They left the wintering grounds from March to April and arrived in the breeding grounds from mid-April to early June.

Northern Pintails that head for Kamchatka [BOOK p.106]
We attached transmitters to a total of 198 wintering Northern Pintails (*Anas acuta*) from 2007 to 2009 in Tokachi in Hokkaido, Shizukuishi in Iwate Pref., Izu-numa Marsh in Miyagi Pref., Koshigaya in Saitama Pref. and Itami in Hyogo Pref. to study their spring migration routes(Hupp et al. 2011). As in Mallards, however, many of the tracked birds were lost probably because they were shot while on migration.

They started the spring migration around March with some regional variation. Out of the 102 birds that left Japan, 61 birds moved to Sakhalin, while 35 birds traveled to Kamchatka (Fig. 7). Two birds went to the Kuril Islands and the other four moved directly to the Kolyma River basin or the Chukchi Peninsula in northern Russia. Of the birds that moved to Sakhalin, 17 and 14 birds headed for Kamchatka and the Magadan region, respectively. It is estimated that those birds that entered the Kamchatka Peninsula directly from Japan or through Sakhalin flew non-stop at least 1,200 km over the Sea of Okhotsk.

From the Kamchatka Peninsula, 30 birds headed for the Chukchi Peninsula, but many others remained to breed in the Kamchatka Peninsula. Many of the birds that reached the Magadan region moved to the Kolyma basin, but some spent the summer in Magadan.

Most of the birds that were assumed to breed in the Kamchatka Peninsula or the Chukchi Peninsula were those that went to Kamchatka directly from Japan or via Sakhalin. On the other hand, many of the birds that bred in the Kolyma River basin or the Magadan region flew to the breeding grounds through Sakhalin taking a more northern route over the Sea of Okhotsk. They arrived at their destination from late May to late June.

Northern Pintails use lakes, marshes, tidal flats, river basins and farmland as stopover sites. Many of the breeding areas and stopover sites in Russia are in an ideal environment where various-sized lakes and marshes are scattered along gently-meandering rivers.

Migration of Greater White-fronted Geese [BOOK p.107]
The Japanese Association for Wild Geese Protection satellite-tracked Greater White-fronted Geese (*Anser albifrons*) in the spring migration in collaboration with research workers of the United States Department of the Interior Biological Research Service (Fig. 8). They attached transmitters to ten birds in February 1994 in Izunuma Marsh in Miyagi Pref., northern Japan. They obtained location data on the spring migration from eight birds. They used battery-powered transmitters developed by NTT (Nippon Telegraph and Telephone Corporation).

Greater White-fronted Geese equipped with transmitters mostly left Izunuma and Kabukurinuma Marshes for the north around February 20, 1994. They stopped over in Hachirogata and Otomo Swamp, Akita Pref. from the end of February to the end of March, and moved to Miyajima Lake via Lake Utonai, Hokkaido from April to early May.

Of the eight birds that departed from Miyajima Lake in May, seven birds headed directly for the western coast of Kamchatka, but one bird traveled north along the eastern coast of Sakhalin. The birds which took off Miyajima Lake in the early morning of May 3 reached the central area of the Sea of Okhotsk about 1,000 km away ten hours later. Some of the birds which arrived in the western seaboard of the Kamchatka Peninsula crossed obliquely the southern part of the peninsula along the Kamchatka River to stop over in Lake Kharchinskoe, while others moved from the central part of the western seaboard of the peninsula to the northern part of the eastern coast. It suggests that the Kamchatka Peninsula, especially Lake Kharchinskoe, is an important stopover site for Greater White-fronted Geese. The three birds that could be tracked continuously resumed their journey toward the northeast about two weeks later, reaching the vicinity of Lake Pekurunii located in the coastal tundra of the Koryak Highlands facing the Bering Sea. Subsequently Greater White-fronted Geese were visually confirmed to breed in the areas around Lake Pekururnii, which shows that these areas are the breeding grounds of Greater White-fronted Geese wintering in Izunuma and Kabukurinuma Marshes, northern Japan.

With the cooperation of researchers of the United States Geological Survey Alaska Science Center, our research team tracked four Greater White-fronted Geese from Izumo, Shimane Pref., western Japan, in the spring of 2007. They flew non-stop across the Sea of Japan to reach the eastern coast of North Korea (Fig. 9), which is near Kumya where White-naped Cranes pass through in the spring migration. Unfortunately, we lost them thereafter probably due to the malfunction of the transmitters. In any case, it turns out that there is a migration route different from that taken by the Greater White-fronted Geese which leave the Tohoku region, northern Japan for the north. In the autumn of the same year, however, one of the tracked birds was identified by its leg band in Hokkaido. This suggests that the same individual takes different migration routes in spring and autumn and that the difference of migration route does not depend on the wintering population.

Migration of swans [BOOK p.108]

We have tracked Tundra Swans and Whooper Swans primarily in the spring migration from the wintering sites of Japan to the breeding grounds since the 1990s. Since 2009, we have determined the autumn migration routes of many birds equipped with solar-powered transmitters. Here, I will introduce Tundra Swans tracked from Lake Kutcharo, northern Hokkaido in the spring of 2009 and Whooper Swans tracked from northern Honshu and Hokkaido in the springs of the mid-1990s and around 2010.

Tundra Swans heading for the Arctic Circle [BOOK p.108]
In the spring of 2009, Tundra Swans (*Cygnus columbianus*) that left Lake Kutcharo headed for northern Sakhalin or the estuary of the Amur River between China and Russia traveling along the eastern coast or western coast of Sakhalin. After staying there for a while, they crossed the Sea of Okhotsk northward to the vicinity of Magadan and Okhotsk located on the northern coast of Okhotsk Sea. Then they flew north along the Kolyma River, one of the largest rivers of northeastern Russia to the breeding grounds in the tundra of the estuary of the Kolyma River (Fig. 10).

Since the migration routes vary slightly among individuals, I will provide a little more detailed information about the routes focusing on two particular birds (birds A and B). Bird

A stayed in Lake Kutcharo until April 20, and moved to the west-central seaboard of Sakhalin about 400 km to the north on April 24. After staying there until May 1, the bird resumed its journey and reached the southeastern coast of Khabarovsk Province on May 3, where it stayed at least until May 14. On May 21, it passed over the area of the Sea of Okhotsk about 700 km to the north-northeast, and reached the southwestern part of Magadan Province on May 23. Then it headed north-northeast and arrived in the eastern part of Sakha Republic on May 25, but it traveled about another 250 km on the same day to the lower reaches of the Kolyma River located in the north-eastern part of Sakha Republic. On May 27, it finally arrived at its destination in the tundra of the lower reaches of the Kolyma River about 50 km west of Chersky, a city above the Arctic Circle.

Bird B stayed around Lake Kutcharo until April 24. The bird traveled to the eastern coast of southern Sakhalin on May 29 and stayed in the waters around this area until May 1. After moving to the area of the sea about 13 km south-southwest of Poronaisk on May 5, it returned to Sakhalin to stay in coastal lakes and marshes close to Katangri from May 7 to 10. On May 18 it moved about 110 km north and stayed there until May 23. On May 25 it started to fly north over the Sea of Okhotsk and reached a place 75 km east of Okhotsk on the same day. Then it turned to the north-northeast, arriving at the middle reaches of the Kolyma River in the eastern part of Sakha Republic about 880 km away. It stayed there from June 1 to 3. On June 5, it arrived at its destination in the tundra near Usti-Chauso on the eastern coast of Chukchi Autonomous Okrug about 830 km to the east-northeast.

The important stopover sites for these Tundra Swans are the estuary of the Amur River, northern Sakhalin and Okhotsk and Magadan areas on the northern seaboard of the Sea of Okhotsk.

Migration of Whooper Swans [BOOK p.111]
In the springs of 1994 and 1995, eight adult Whooper Swans (*Cygnus cygnus*) were tracked from Kominato, Aomori Pref., northern Japan to the breeding grounds of Russia (Fig. 11).

In both years the Whooper Swans which left Kominato stopped over in the southeastern areas of Hokkaido such as the middle reaches of the Tokachi River and Lake Furen. Then they entered Aniva Bay, southern Sakhalin via the lakes of northeastern Hokkaido such as Lakes Abashiri and Saroma, and headed north along Sakhalin. They spent the summer in the lower reaches of the Amur River, the northern coast of the Sea of Okhotsk, the middle reaches of the Indigirka River and the lower reaches of the Kolyma River.

Then, in 2009 and the following few years, 25 birds were tracked from Lake Kussharo, eastern Hokkaido and Izunuma Marsh, Miyagi Pref. to the breeding grounds of Russia (Shimada et al. in press). The Whooper Swans that wintered in Izunuma Marsh left there from late February to mid-March and headed north along Honshu. Most of them went toward eastern Hokkaido, while some birds moved from the western part to northern part of Hokkaido. After that, except for a few birds that headed for the western coast of Kamchatka, all the birds traveled to the estuary of the Amur River across the sea from northern Sakhalin via Sakhalin. After leaving the estuary, they arrived in the middle reaches of the Kolyma and Indigirka Rivers through Magadan and Okhotsk. The birds that wintered in Lake Kusharo left there from mid-April to early May and went to the northeastern part of Russia, taking a route similar to that of the birds that moved through eastern Hokkaido from Izunuma Marsh.

The major stopover sites that many Whooper Swans use for a long period of time in the migration are the estuary of the Amur River and Magadan and Okhotsk areas on the northern seaboard of the Sea of Okhotsk. The breeding grounds of Whooper Swans were located a little to the south of those of Tundra Swans.

Migration of hawks and eagles [BOOK p.112]

White-tailed Eagles that travel around the Sea of Okhotsk [BOOK p.112]
In December 1995, two adult White-tailed Eagles (*Haliaeetus albicilla*) were captured and equipped with transmitters in Yakumo on the Oshima Peninsula, southern Hokkaido (Ueta et al. 1998). The transmitters were developed by NTT and set to operate only six hours per two days in order to track the eagles for a longer period of time.

The two birds left the wintering site in mid-February and early March 1996, respectively. Both of them took a circular route along the coast of the Sea of Okhotsk (Fig. 12). They left southern Hokkaido for Sakhalin. After heading north along Sakhalin, they still continued their northward journey along the eastern coast of the continent to enter the base of the Kamchatka Peninsula. Then one of the birds turned to the south and reached the central part of the peninsula on May 1. This bird stayed there until mid-October. The other bird arrived in the northeastern part of Kamchatka on May 19 and spent the summer there. The central part of Kamchatka where the former spent the summer is the major breeding ground of White-tailed Eagles on the peninsula.

They began their autumn migration by moving southward through the Kamchatka Peninsula. The bird that spent the summer in the northeastern part of the peninsula started to migrate on October 12, arriving in the central part of the peninsula on November 5. Then, it entered the Kuril Islands and reached Iturup Island before December 29, but it stopped sending out signals on January 4, 1997. The other bird set out on its migration on October 14 and reached Kunashir Island on December 1 through the Kuril Islands. Then it moved westward in Hokkaido and arrived in Yakumo, the wintering ground of the previous year on December 9.

Migration of Grey-faced Buzzards, a north-south linear movement [BOOK p.113]
We satellite-tracked a total of 15 adult Grey-faced Buzzards (*Butastur indicus*) in the spring and autumn migrations. We used solar-powered transmitters made by Microwave Telmetry USA Inc. and North Star Science and Technology Co., Ltd.

The migration routes varied depending on the wintering or breeding ground (Higuchi 2012a). Grey-faced Buzzards breeding in central or northern Honshu, such as Iwate, Tochigi, Chiba and Niigata Prefs. began to leave the breeding grounds from late August to early October. The birds which departed from Tochigi and Chiba Prefs. entered the Kii Peninsula through the Tokai region and moved to Kyushu through

Shikoku. The birds which left Niigata Pref. flew along the southern coast of Lake Biwa through the mountainous area from Nagano Pref. to Gifu Pref. Then they entered Shikoku via Awaji Island and went on to Kyushu (Fig. 13).

All of these birds headed for the Nansei Islands through the Osumi Peninsula at the southern tip of Kyushu. Most of their destinations were southern islands of the Nansei Islands, such as Iriomote and Ishigaki Islands. They arrived at the wintering grounds in mid-October.

The Grey-faced Buzzards that wintered in the Nansei Islands left the wintering grounds from late March to early April. Retracing their autumn migration route, they reached Kyushu through Okinawa Island, Amami-oshima Island and the Tokara Islands. Then they went to Shikoku from the eastern coast of Kyushu and crossed Shikoku to Honshu directly or via Awaji Island. Heading for the breeding grounds, they arrived there in April.

Grey-faced Buzzards breeding in northern Kyushu, such as Fukuoka Pref., on the other hand, moved further south beyond Iriomote and Ishigaki Islands through the Nansei Islands. They traveled as far as the Philippines and wintered there. They did not stop over in Taiwan. Their migration route in the spring differs greatly from that of autumn. Although the findings were obtained from a small number of tracked birds, both the satellite tracks and field observations show that the Grey-faced Buzzards which left the Philippines headed for Taiwan instead of the Nansei Islands through which they moved in the autumn migration. When they reached Taiwan, they turned to the west in the northern or central part of Taiwan and crossed the sea to the continent. Unfortunately it is still unknown which route they take to return to Japan. They are, however, suspected to come to Japan through the Korean Peninsula as Honey Buzzards do, as described in the following account.

Honey Buzzards that visit every country of East Asia [**BOOK p.114**]

We satellite-tracked more than 50 Honey Buzzards (*Pernis ptilorhynchus*) and determined their migration routes after the autumn of 2003 (Fig. 14). We used solar powered transmitters made by Microwave Telmetry USA Inc. and North Star Science and Technology Co., Ltd. I will briefly introduce their migration below.

The Honey Buzzards that left the breeding grounds in the central or northern part of Honshu from late September to early October first headed for Kyushu and crossed the East China Sea which is about 700 km across to the estuary of the Yangtze River of China through the Goto Islands west of northern Kyushu. Then they traveled south through inland China, reaching Sumatra through the Indochina and Malay Peninsulas. In Sumatra they divided into two groups. One group moved northeast as far as the Philippines or Borneo, while the other headed east and reached Java in Indonesia or the Lesser Sunda Islands. They arrived in their wintering grounds on these islands from November to December.

In spring, however, Honey Buzzards took a route that differed greatly from that in autumn. They left their wintering grounds from mid-February to March. They retraced their autumn route as far as the northern part of the Malay Peninsula. When they reached the peninsula, however, some of them turned 90 degrees and traveled east to Cambodia, where they turned 90 degrees again to head north. The others moved north from the peninsula and entered southern China through Myanmar and other areas. When both groups of birds met together in southern China, they flew north as far as the northern part of the Korean Peninsula. They looked as if they were not coming directly back to Japan, but, believe it or not, they turned 90 degrees there and went down the peninsula to enter Kyushu. Then they changed 90 degrees again and headed east to return to their breeding grounds in Nagano, Yamagata and Aomori Prefs.

They arrived at the breeding grounds in Japan from mid-to late May. Interestingly, they all stopped over for a week or a month somewhere in Southeast Asia or southern China during the spring migration. It is unknown why they stopped over for such a long period of time, but they probably built up their strength in the areas rich in bee and wasp resources including apiaries.

It should be noted that each of Honey Buzzards visits most of the countries of East Asia during the spring and autumn migrations. As a population, therefore, they visit all the countries of East Asia.

Reasons for seasonal difference of migration routes [**BOOK p.116**]

As mentioned above, migration routes vary greatly depending on the bird species or group. These differences are related to the habitat types and distributions, food types and seasonal changes, morphological differences and origins of bird species or groups.

In some species such as the White-tailed Eagle and Honey Buzzard, migration routes differ greatly between spring and autumn migrations. Why do they not take the same route when migrating in spring and autumn? Our research team has been exploring the reasons in Honey Buzzards, paying attention to weather conditions (Yamaguchi et al. 2012, Higuchi 2012a). The East China Sea is a key area when Honey Buzzards decide their migration route. For the hawk species that move on the wind without flapping very often, it is quite dangerous to cross the sea which is 700 km wide and has no islands. Therefore, a key consideration is whether to cross it.

Examining the weather conditions of spring and autumn in the East China Sea and its surrounding waters, especially the wind direction and strength, we found that the wind is blowing from the east or east-northeast quite steadily from mid-September to early October when Honey Buzzards head for the continent. Honey Buzzards are assumed to fly west using this tailwind. In addition, it is suspected that updrafts occur at this time at an altitude of several hundred to a thousand meters where Honey Buzzards fly. When Honey Buzzards travel long distances over the land, they usually alternate soaring on updrafts with gliding to reduce energy-consuming flapping. There is a possibility that they fly in a similar manner when crossing the East China Sea. It is assumed that they cross the 700 km-wide sea with no islands in autumn, using regional weather conditions to their advantage.

In spring, on the other hand, weather is unstable in the East China Sea. The wind blows from various directions and the seasonal rain front has already been developed over the sea in the south in May. Moreover, there appears to be no updrafts in this area of the sea in spring. It is too dangerous, therefore, for Honey Buzzards to cross the 700 km-wide sea in spring.

Even if they must take a wide detour, it is obviously much safer to cross the Korean/Tsushima Strait, which is only about 170 km wide from the southern tip of the Korean Peninsula, and enter Kyushu.

Presumably these seasonal differences in weather conditions, especially the wind conditions of the East China Sea, have an important effect on the spring and autumn migration routes of Honey Buzzards (Higuchi 2014). I suspect that they take a more inland route in China in spring than in autumn because it is more convenient when they move as far as the northern part of the Korean Peninsula. They always stop over somewhere for a week or a month before they begin to move inland in China probably because the spring roundabout route is longer than the autumn route. They may need to build up their strength in the stopover site.

Migratory birds connecting people together [BOOK p.119]

Migratory birds connect nature of one country or region to that of another country or region through their migration. In that sense, the nature of Japan is connected to that of various countries of Southeast Asia as well as that of Russia, China and the Korean Peninsula.

At the same time, migratory birds link the people of regions far apart (Higuchi, 2011). Many people gather to watch birds migrating at good observation spots along migration routes. In Japan, for instance, several hundred or several thousand people visit at a time the Shirakaba Pass in Nagano Pref., Cape Irago in Aichi Pref. and Cape Sata in Kagoshima Pref. to watch the migration of hawks such as Honey and Grey-faced Buzzards. There are many non-birdwatchers among these visitors. Even though they cannot identify the species of hawks, they experience a wonder of nature and romantic dreams aroused by the phenomenon of bird migration while looking at hundreds or thousands of migrating hawks. A great many people of countries and regions along the migration routes also have similar experiences. The people of Thai, Malaysia and Indonesia enjoy watching possibly the same flock of birds that we saw in Japan.

Of all the living creatures, those which play a role like this are extremely limited. In that sense, one can tell that migratory birds are unique. It is not uncommon that the people of regions on the migration routes to use the internet to exchange and share information, such as the species and number of observed birds and how the birds migrated. Such information has played a major role in assessing the present state of birds to determine their conservation issues and consider possible measures. In the process, people share fun and enjoyment and also sense the importance of ties between people.

Against a background of the above-mentioned situation, my research group conducted an "Oriental Honey Buzzard Migration Satellite-Tracking Project Open-To-The-Public" from the autumn of 2012 to the early summer of 2013. It is a project to provide publicity for bird migration by showing the findings of the satellite tracking of migratory birds. The birds selected for this project were four Honey Buzzards. In addition of posting the migration route on a website, we described how they migrated on Facebook in five languages: Japanese, English, Korean, Chinese and Indonesian. While we were carrying out the project, a great many people at home and abroad visited our website to share information on the satellite tracking and exchange various sorts of information. People living in areas far apart were connected by their interest in the migration of Honey Buzzards (Higuchi 2013a).

Chapter 8:
The present state of Japanese birds and their future

Looking into the present state of Japanese birds [BOOK p.120]

Japan has a unique world of birds. A variety of birds sing and fly around in the beautiful forests. Many shorebirds flock together in the tidal flats and move around busily. A great number of seabirds gather in the islands off the coast, calling gaily as they raise their young. In the oceanic islands far away from land, the birds live which are not found in any other habitats. In Japan, you can see and hear birds wherever you go. Every region has a birdscape all of its own. And the birdscape changes with the season. Japan has a really remarkable world of birds.

In recent years, however, the avian world of Japan has been changing greatly. Many species have declined and diminished their range both on land and in the sea. On land, forest birds and long-distance migrants have markedly decreased in the abundance. (Yamaura et al. 2009). Some birds have already disappeared from the sky and forests of Japan. On the other hand, some birds have increased in number or expanded their range, which has led to various frictions with people. Moreover, the frictions are becoming increasingly serious.

Then which birds are declining? Which birds are causing frictions with people? What is responsible for the declines and frictions? What measures have been taken against these problems, and are they successful?

In this chapter, I will introduce the current state of birds in Japan and conservation efforts as well as measures against the problems between birds and people. But I would like to show the essentials of the problems visually using a variety of related photographs instead of explaining them in detail. Please see the relevant papers and books cited for details.

Birds on the decline [BOOK p.121]

The birds which have markedly declined in Japan are long-distance migrants, especially summer visitors from Southeast Asia (Higuchi 2005, Higuchi 2013). They are such birds as Japanese Paradise Flycatcher, Ashy Minivet, Brown-headed Thrush, Yellow-breasted Bunting, Brown Shrike (*Lanius cristatus*), Tiger Shrike (*L. tigrinus*), Jungle Nightjar (*Caprimulgus indicus*), Ruddy Kingfisher (*Halcyon coromanda*), Brown Hawk Owl (*Ninox scutulata*) and Ruddy-breasted Crake (*Porzana fusca*). Many of these birds were commonly found in the past. In recent years, however, they have disappeared or sharply decreased in most of their habitats. Even in the famous bird areas, such as Mt. Fuji, Oku-Nikko and the Togakushi Highland, there is not very much life in a morning chorus sung primarily by these birds in early summer.

It was in the 1980s and after 2000 that these summer visitors declined significantly, but the period of the decline varied depending on the species. Tiger Shrikes and Ruddy Kingfishers were already on the decline in the 1960s and 70s. The habitats vary greatly among summer visitors. Japanese Paradise Flycatchers, Ashy Minivets and Ruddy Kingfishers are found in forests, while Brown-headed Thrushes, Brown Shrikes and Tiger Shrikes live in open woodland. On the other hand, Yellow-breasted Buntings are grassland-dwellers and Ruddy-breasted Crakes are associated with wetlands. In many of the habitats which year-round residents and summer visitors share, the former have not decreased appreciably, but the latter has been steeply declining.

But not all the species of summer visitors have declined. It seems that Narcissus Flycatchers, Blue-and-white Flycatchers and Eastern Crowned Leaf Warblers have not declined so markedly. In addition, the situation differs considerably from one region to another. Some birds such as Japanese Paradise Flycatchers have sharply declined in eastern Japan but not in western Japan. A notable exception is the Nansei Islands, where Japanese Paradise Flycatchers, Ashy Minivets and Ruddy Kingfishers still occur commonly. The island populations of some species such as Ashy Minivets are year-round residents, though the population that comes to Honshu consists of summer visitors.

The decline of summer visitors is attributed primarily to environmental changes in the breeding and wintering grounds. In Japan, deforestation, grassland destruction and mudflat reclamation have deprived summer visitors of their breeding grounds. In the wintering grounds, on the other hand, the destruction of rainforests and the reclamation of swamps and tidal flats have been progressing rapidly. Rainforests in particular were destroyed on a large scale in the 1980s, during the period when summer visitors sharply declined (Higuchi & Morishita 1999, Higuchi 2005, 2013).

The decline of Yellow-breasted Buntings seems to be due largely to poaching in areas along the migration route (Chan 2004). In China, hundreds to tens of thousands of Yellow-breasted Buntings are confiscated every year in Sanshui, Tianjin, Nanhai and Enping each, which is only a disclosed cases. These poached Yellow-breasted Buntings are sold as food. Other bird species are also poached, but Yellow-breasted Buntings are easy to capture in large numbers because they roost in large flocks in reed beds.

Grey-faced Buzzard, which is a summer visitor hawk, has been decreasing as well (Kawakami & Higuchi 2003, Azuma 2013). Grey-faced Buzzards are regarded as a flagship species of satoyama countryside habitat and feed on frogs, lizards and snakes. The satoyama environment has been changed dramatically by the development of residential areas, golf courses and factories, reducing the habitat of Grey-faced Buzzards. In the remaining paddy fields, paddy field management is proceeding rapidly to improve farming efficiency with the winter drainage of paddy fields, the construction of the vertical walls of irrigation channels and water supply pipe systems between rivers

and irrigation channels, for example. This management has interfered with the lives and movements of frogs and snakes, and reduced the biodiversity of paddy fields including their surroundings, which in turn has degraded the habitat conditions of Grey-faced Buzzards (Sakai & Higuchi 2013). In addition, abandoned farmland has increased due to the aging of the rural population, as a result of which the satoyama environment has been degenerating as a whole (Azuma 2013). These factors are responsible for the decline of Grey-faced Buzzards.

Shorebirds that use tidal flats and inland wetlands have been decreasing as well (Amano 2006). In the last two decades, the number of shorebirds has decreased by 40 and 50% in the spring and autumn migrations, respectively. There is especially a sharp decline in the number of Kentish Plover (*Charadrius alexandrinus*), Great Knot (*Calidris tenuirostris*), Ruddy Turnstone, Eurasian Curlew and Dunlin (*C. alpina*) which use tidal flats and Spotted Redshank, Wood Sandpiper, Black-tailed Godwit, Sharp-tailed Sandpiper (*C. acuminata*) and Common Snipe which use inland wetlands. Lively flocks of shorebirds in coastal mudflats and inland wetlands are becoming memories of the past. It is assumed that the reduction or degradation of tidal flats and inland wetlands in Japan as a stopover site as well as environmental changes in the breeding and wintering grounds are involved in the decline of shorebirds.

It is not only migratory birds that are decreasing. Many of the year-round resident hawks, especially Mountain Hawk Eagles and Golden Eagles are also on the decline. In recent years, the breeding performance has been deteriorating rapidly in Mountain Hawk Eagles and Golden Eagles living in forests (Ozawa 2013, Sudo 2013, Yamazaki 2013). A rise in breeding failures seems to be related to a variety of human-related factors, particularly the reduction of the prey species of birds and mammals due to deforestation and the subsequent abandonment of afforestation management. There is a possibility that they will find it difficult to maintain their populations any longer in the near future. Golden Eagles, in particular, are still declining despite the fact that the population is already quite small, which has aroused grave concern for their future.

Not only hawks but also various year-round residents, ranging from Eurasian Tree Sparrows and Eurasian Skylarks to Rock Ptarmigans (*Lagopus muta*), are reported to be on the decline in Japan. Factors in the decline vary between species, but in general, changes in the quality and quantity of habitats have played a major role in the decline. The decline of Eurasian Tree Sparrows can be attributed to a decrease in feeding grounds and the structural changes of the buildings which they use as nest sites (Mikami 2012, Mikami et al. 2013), while that of Eurasian Skylarks is related to the fragmentation of farmland and a decrease in the wheat fields where they prefer to live (Ueta et al. 2005). Herons feeding in paddy fields have been affected by paddy field management (Higuchi & Narusue 1997, Lane & Fujioka 1998). The decline of Rock Ptarmigans living in the alpine zone is due largely to the invasion of mammals into their habitat such as foxes, martens, deer and monkeys (Nakamura 2013). Martens and foxes prey on the chicks of Rock Ptarmigans, while deer and monkeys consume the alpine plants which Rock Ptarmigans feed on. Foxes have climbed up to the alpine zone seeking leftovers from mountaineers and food scraps discarded from mountain huts, while deer and monkeys have increased in the satoyama hills that are no longer managed and have expanded their range. It is assumed that global warming is also accelerating their range expansion into high mountains.

Looking at the decline of year-round residents, you should note that it is possible that they are decreasing in Japan as a whole even if they are not decreasing at a local level. Of course, this does not apply only to resident birds, but in the case of the resident birds that are widely distributed, it is hard to evaluate the state of the entire population. In migratory birds, on the other hand, it is relatively easy to grasp changes in their populations because they can be seen passing in large flocks in areas along the migration routes. In Japan where forest and wetland environments have been diminishing overall, we do not have detailed population data of year-round residents including Varied Tit, Japanese Wagtail, Winter Wren, Scaly Thrush (*Zoothera dauma*), Japanese Pygmy Woodpecker and Ural Owl. I fear that some of them have declined without our noticing.

In seabirds, on the other hand, those breeding in coastal areas and remote islands are known to have markedly declined. Common Murre (*Uria aalge*), Spectacled Guillemot (*Cepphus carbo*), Tufted Puffin (*Fratercula cirrhata*) and Pelagic Cormorant (*Phalacrocorax pelagicus*), all of which breed in the coastal areas of Hokkaido, have declined. In Teurito Island off the northwestern coast, Common Murres were reduced from more than 40,000 birds in 1938 to only 13 birds in 2002, and are facing the danger of extinction. Bycatch by drift netting is a major factor of the decline. Drift netting is a method of fishing from a boat by spreading long fishing nets in a straight line or in a hook or wave shape and allowing an ocean current or waves to carry them. Since Common Murres chase after fish with wings flapping under the water in both vertical and horizontal directions, they are particularly vulnerable to being caught in the drift nets. As a result, a huge number of Common Murres fell victim to the drift nets. In addition, Large-billed Crows and Slaty-backed Gulls have increased and preyed on their eggs and chicks, which have accelerated the decrease of Common Murres.

Spectacled Guillemots and Tufted Puffins have also sharply declined for the same reason. Tufted Puffins now breed only in limited capes and islands in eastern Hokkaido. In the past, several hundred birds bred in Yururi, Moyururi, Daikokujima Islands and Cape Kiritappu, but currently only about ten pairs breed primarily in Yururi and Moyururi Islands.

Marine pollution by plastic litter is also responsible for the decline of seabirds (Sao et al. 1995, Ogi et al. 1999). Plastic pollution of the sea occurs when a variety of waste plastic pieces drift in the ocean. Resin pellets (fine pieces of plastic) produced during plastic production are a major factor in the pollution. These resin pellets, most of which seem to have leaked out of factories, are now drifting in all of the oceans of the world. Resin pellets and other plastic waste indefinitely remain in the environment and absorb a high concentration of petroleum-related chemical matter. Since plastic products contain a variety of additives that are also synthetic chemicals, seabirds and other marine animals will ruin their health if they take plastics mistaking these pellets for food.

Birds at risk [BOOK p.127]

Nowadays birds are exposed to a variety of threats. In addition to the destruction and degradation of habitats, poaching, bycatch and environmental pollution as mentioned above, birds face many additional threats including predation by introduced species, collisions with wind turbines, radioactive contamination and global warming. Of these threats, I will take up only the effects on birds of predation by introduced species, wind turbine collisions and global warming on account of limited space. Please see Higuchi (2010) for general issues and Møller et al. (2012, 2013) for radioactive contamination.

Predation by introduced species [BOOK p.127]

It causes various problems to introduce foreign organisms to places other than their original habitats. Introduced predators in particular can have a devastating effect on ecosystems. For instance, Javan mongooses (*Herpestes javanicus*) of South Asian origin were introduced to Okinawa and Amami-ohshima Islands for the purpose of controlling venomous habu snakes and the rats that cause damage to crops. Introduced mongooses have increased in number and expanded their range, preying on birds such as Amami Woodcocks, Lidth's Jays and Ryukyu Robins in Amami-ohshima Island (Yamada 2002, Ishida et al. 2003) and Okinawa Rails in Okinawa Island (Ozaki 2005). These rare endemic birds have sharply decreased as a result. But the decline of Okinawa Rails seems to be due in part also to road accidents and predation by feral cats.

In Miyake Island of the Izu Islands, Japanese weasels were released to control rats which cause damage to crops. These released weasels subsequently had a profound influence on the ecosystem of the island. I will provide details below.

Twenty male Japanese weasels were released in Miyake Island from 1976 to 1977. The weasels did not increase, and were not very much helpful in reducing damage to crops and forests. Subsequently (probably around 1982), about 20 male and female weasels were released again. The weasels rapidly increased their abundance and expanded their range (Hasegawa 1986). As a result, the mice decreased but other animals were affected at the same time. Okada's five-lined skinks in particular were significantly affected. They used to be commonly found in the Izu Islands and occurred in high density in Miyake Island before weasels were released. But they started to decrease in 1983 and almost disappeared in the early 1990s.

The disappearance of Okada's five-lined skinks affected Grey-faced Buzzards. Grey-faced Buzzards visit Miyake Island in April to breed. They fed on this skink, which represented more than 90% of the food delivered to their nestlings. The breeding performance of Gray-faced Buzzards deteriorated with the reduction of the skink that was their staple food and they ceased to visit the island in the 1990s. The introduction of weasels has produced a great change in the structure of the food chain of the island.

Izu Thrushes (*Turdus celaenops*), an endemic and national monument species, have also decreased rapidly in Miyake Island. The number of Izu Thrushes detected in the breeding period in a census route of 50 m by 1 km was about 30 birds until around 1980, but it was reduced to about 7 birds in 1990. At present, it is only 3-5 birds at most. In addition to Izu Thrushes, Chinese Bamboo Partridges, Eurasian Woodcocks and Streaked Shearwaters have markedly declined. In Chinese Bamboo Partridges, the population density is about one-tenth of what it was before weasels were released. Eurasian Woodcocks were commonly found in the island before the weasel release, but few if any birds are sighted nowadays. It is assumed that Streaked Shearwaters have ceased to breed on Miyake Island. The introduction of weasels has an adverse effect on the marine ecosystem as well.

Izu Thrushes, Chinese Bamboo Partridges and Eurasian Woodcocks were probably frequently preyed on during feeding or nesting because they tend to spend most time on the ground. Streaked Shearwaters were highly vulnerable to the predation of weasels in the breeding period because they nest in a burrow right under the ground surface in a forest, though they are seabirds.

Weasels preyed on eggs and nestlings as well as adult birds. In Izu Thrushes, for instance, we studied the breeding success (number of fledglings/total number of eggs) before and after the weasel release (Takagi & Higuchi 1992). The results showed that the breeding success was reduced from 85% in 1973 before the weasel release to 71-78% in 1978 - 80 after the initial release of weasels, but it dropped to about 7% on average in 1991 and 1992 after the second release. In fact, weasels were seen attacking the nests of Japanese Pygmy Woodpeckers and Izu Thrushes. Since nestlings are an immobile clump of meat, they would be fair game for weasels.

The introduction of weasels has also changed the behavior of birds, a typical example of which is afforded by Izu Thrushes. Izu Thrushes were not afraid of people and seen at close range in roads and fields. It was not uncommon for them to walk with quick short steps a little ahead of people. Nowadays, however, they put a greater distance between people and themselves. They have probably increased their alertness due to the predation of weasels. Also, Japanese Bush Warblers have started to build their nests in higher positions (Hamao & Higuchi 2013), which probably makes the nests less visible to weasels on the ground.

Collisions with wind turbines [BOOK p.130]

Against a background of growing dependence on clean energy, wind farms are rapidly increasing at home and abroad. In Japan the need for wind farms has been growing especially since the nuclear power plant accident due to the Great East Japan Earthquake in 2011. Since the conditions of location for wind farms tend to overlap with those of bird habitats, however, birds have collided with wind turbines in various areas.

Both year-round residents and migrants have collided with wind turbines. Among year-round residents, the victims range from hawks and crows to small birds (Shiraki 2013). Black Kites (*Milvus migrans*) living in coastal areas and Golden Eagles hunting in the open areas of mountains are particularly prone to collide with wind turbines. Since Golden Eagles generally have a poor breeding performance as mentioned before, injury or killing of adult birds in wind turbine collisions could have a significant impact on the maintenance of the population, even if the cases are not numerous. Migratory birds that move along mountain ridges or headlands also tend to fall victim to wind turbines – Honey and Grey-faced Buzzards,

ducks, geese and small birds are examples.

In Hokkaido, White-tailed Eagles and Steller's Sea Eagles wintering in coastal areas are vulnerable to turbine collisions. White-tailed Eagles are particularly prone to the collision because they fly at a relatively low altitudes (Ueta et al. 2010, Shiraki 2013). Incidentally, Steller's Sea Eagles are a winter visitor, while some of the White-tailed Eagle population are year-round residents and others are winter visitors.

But the actual situation of bird collisions with wind turbines is not known very well in Japan. It is necessary to conduct in-depth investigations into the conditions of bird - turbine collisions as to the time, place, species and the mode of collisions. There is a possibility that wind turbines will be constructed closer to the sea or offshore in the future. In that case, wind farms will have effects on many different seabirds. There is an urgent need to collect information on these effects.

Another problem of wind farms that should not be neglected is environmental destruction due to farm construction. A limited area of land may be sufficient for the construction of one wind turbine, but the construction of the entire wind farm usually involves a massive destruction of the environment because the construction includes access roads and related facilities. It is also necessary to carry out a thorough investigation into the impacts of such environmental destruction on birds.

Impacts of global warming on birds

[BOOK p.131]

According to the estimation of the Intergovernmental Panel on Climate Change (IPCC), the average global temperature has increased by 0.74˚C for the last 100 years. In Japan, on the other hand, the mean annual temperature increases at a rate of 1.07˚C during this 100-year period, and the years with higher temperatures than normal have increased since the 1990s in particular. It is expected that the average global temperature will be 1.1 or 6.4˚C higher in 2100 (the range is due to differences in climate models). A rise in temperature hastens phenology, such as flowering, fruit production and the start of breeding season and migratory movements of plants and animals. In the case of birds, the arrival date of summer visitors and the start of breeding undergo a change.

In Japan, for instance, Chestnut-cheeked Starlings (*Agropsar philippensis*) start to lay eggs about two weeks earlier than about 30 years ago (Koike & Higuchi 2002, 2009). In short, they started to lay eggs on May 25 on average in 1978, but on May 10 in 2004. Summer visitors tend to come to Japan earlier and song birds tend to start to sing earlier. According to the Japan Meteorological Agency, for instance, Japanese Bush Warblers start to sing about 32 days earlier than 50 years ago in Oita City, Kyushu. In addition, Barn Swallows come to Nagoya City, Aichi Pref. about 10 days earlier than 52 years ago (Higuchi 2008, 2013).

There are many exceptions, however. In some areas, Japanese Bush Warblers start to sing later than before and Barn Swallows come to some areas later than before. Japanese Bush Warblers tend to start singing later year by year in Yokohama and Hiroshima despite the fact that the spring air temperatures are increasing in the two cities.

Winter visitors tend to visit Japan later. For instance, Naumann's Thrushes, Pale Thrushes and Daurian Redstarts come to Yokohama nine days on average later and leave there 21 days earlier than 23 years ago. As a result, the wintering period is shortened by about a month (Kobori et al. 2012).

Global warming has brought about changes in bird distributions as well. The number of Tundra Swans and Greater White-fronted Geese wintering in Hokkaido was very limited until the 1980s, but it has been increasing rapidly in recent years. In the case of Grey-faced Buzzards, the northern limit of the wintering grounds has been coming further north to the southern part of Kyushu from Amami-ohshima Island since 2000.

Global warming has also produced changes in bird populations. Tundra Swans have sharply increased in abundance since the 1980s. According to the simultaneous national census of waterfowl conducted every January, the number of Tundra Swans wintering in Japan was 1,745 in 1975, but increased to 40,485 (about 23 fold) in 2008. In Niigata Pref. where the increase was particularly significant, the number increased from 69 in 1975 to 16,277 (about 236 fold) in 2008, which accounted for 40% of all the Tundra Swans wintering in Japan (Koike & Higuchi 2009, Higuchi 2012).

When we examined the relationship between the number of Tundra Swans wintering in Japan and the climate changes of the breeding grounds (the estuary of the Kolyma River in Russia), a major stopover site (Esashi of Hokkaido) and the wintering grounds (Niigata Pref.), it turned out that the number of adult and young birds wintering in Japan was affected by the downward trend of snowfall in the wintering grounds and the upward trend of temperatures in the breeding and stopover sites. Reduced snowfall in wintering grounds facilitates feeding in paddy fields and other foraging sites, and temperature rise in the breeding and stopover sites allows for obtaining sufficient food early. In addition, the number of juveniles wintering in Japan was heavily influenced by the upward trend of temperatures in the breeding grounds. It is assumed that as temperatures are higher in the breeding grounds, the breeding performance improves, as a result of which the number of juveniles wintering in Japan increases (Koike & Higuchi 2009, Higuchi 2012).

Similar effects seem to have occurred in Whooper Swans, which have increased in number as well (Koyama et al. 2013). The increase of these swans has the potential to degrade the ecosystem of their breeding grounds. The degradation of the ecosystem of the breeding grounds will result in the reduction or disappearance of various organisms including plants, which in turn will affect the breeding of swans. We cannot be simply pleased that swans wintering in Japan have increased.

The response to temperature changes varies between species or taxa in the same area. In general, plants are slower to respond to a change in temperature than animals. In Niigata Pref., for instance, Yoshino cherry and Chestnut-cheeked Starlings have hastened the start of blossoming and breeding respectively for the last 30 years, but the latter has changed twice as fast (Koike et al. 2006). In consequence, Chestnut-cheeked Starlings have not recently been able to make full use of cherries which they fed to their young in large numbers until the 1970s because cherries are not ripe yet when they raise their nestlings. Morrow's honeysuckles are a more eloquent example of the discrepancy between fruiting and nestling periods. Morrow's honeysuckles are found in abundance in the breeding grounds of Chestnut-cheeked Starlings and they fed

the berries to their nestlings in large numbers in the past. In recent years, however, Chestnut-cheeked Starlings have not fed the berries to their young because they are not ripe yet during the nestling period.

Although the changes in diet suggest a possible impact on the breeding performance of the starlings, the breeding performance of Chestnut-cheeked Starlings has not deteriorated so far in Niigata Pref.. There is a possibility, however, that the breeding performance will decline eventually with further global warming.

Combined effects [BOOK p.132]

As mentioned above, birds are facing a variety of threats, but it should be noted that the same bird species may be exposed to several different threats simultaneously in the same region. For example, it is not uncommon for raptors to face deforestation, the risk of collisions with wind turbines and chemical pollution at the same time. Habitat destruction and the introduction of alien species occur at the same time in islands, and rice paddies with advanced field management can be polluted with chemicals, such as pesticides. In the case of the introduction of non-native species, several species may be brought onto the same island. In the Ogasawara Islands, for instance, different alien species, such as rats, feral cats and goats have settled and exerted various negative effects on native species. In addition, the effects of global warming are felt all over the world. The effects of radioactive contamination due to a nuclear accident are also felt widely these days.

In addition, migratory birds are also exposed to several threats simultaneously or one after another while on migration. Even if threats are removed in one of the countries or regions concerned, migratory birds will never stop decreasing if these threats remain in the other countries or regions.

Extinct birds of Japan [BOOK p.133]

Five following endemic bird species became extinct in Japan: Bonin Grosbeak (*Chaunoproctus ferreorostris*), Bonin Thrush (*Cichlopasser terrestris*), Bonin Wood Pigeon (*Columba versicolor*), Ryukyu Wood Pigeon (*Columba jouyi*) and Miyako Island Kingfisher (*Todiramphus miyakoensis*). Bonin Grosbeak, Bonin Thrush and Bonin Wood Pigeon were endemic to the Bonin (Ogasawara) Islands and became extinct by the first half of the 20th century. Their extinction can be attributed to the development of the Ogasawara Islands which began in 1830. Ryukyu Wood Pigeons that lived in the Daito Islands and Okinawa Island were not only affected by the deforestation of their habitats but also were heavily hunted for meat, which was also true for Bonin Wood Pigeons and Japanese Wood Pigeons. Ryukyu Wood Pigeons were last sighted in Okinawa Island in 1904 and in the Daito Islands in 1936.

Miyako Island Kingfishers were endemic to Miyako Island located in the southern part of the Nansei Islands. They have not been observed since 1887 when a single bird was collected. Their ecology is completely unknown. It is assumed that the loss of mangroves was responsible for their extinction. But there is doubt about their status as a species (Morioka 1989), and they may not be recognized as a species. They are highly similar in morphology to the subspecies of Micronesian Kingfishers (*Todiramphus cinnamominus*) living on Guam Island.

Extinct bird subspecies in Japan include Daito Warbler (*Cettia diphone restricta*), Daito Wren (*Troglodytes troglodytes orii*) and Daito Varied Tit (*Poecile varius orii*) that lived in the Daito Islands, and Nankeen Night Heron (*Nycticorax caledonicus crassirostris*), White-browed Crake (*Porzana cinerea brevipes*) and Bonin White-eye of Mukojima Island (*Apalopteron familiare familiare*) that occurred in the Ogasawara Islands. These birds seem to have become extinct due to habitat destruction and predation by introduced predators such as cats. All of these extinct species or subspecies lived on small islands far away from the mainland of Japan. Their extinction is an eloquent example of the fragility of island ecosystems.

In the species without any subspecies that were widely distributed in the mainland of Japan, Crested Ibises (*Nipponia nippon*) and Oriental Storks (*Ciconia boyciana*) became extinct. To take Crested Ibises as an example, I will describe how they became extinct at greater length.

According to old records, Crested Ibises ranged widely in eastern Japan, such as the Tohoku, Kanto and Hokuriku regions and Hokkaido in the early Edo period, around the 17th century (The following is primarily based on the description of Yasuda 1983). In the mid-Edo period, around 18th century, the shogunate or various lords established game preserves or raised Crested Ibises in captivity and released them, as a result of which they expanded their range into western Japan.

In the Meiji era (around the late 19th century), however, Crested Ibises began to decline sharply. Since game reserves were abolished and hunting was left uncontrolled in the Meiji era, conspicuous and beautiful Crested Ibises became a perfect target. "Regulations on hunting" were established in 1892, but Crested Ibises were still not designated as a protected bird at that time. Therefore, Crested Ibises went on decreasing and when they were protected in 1908, they had already disappeared from most regions of Japan.

Crested Ibises were considered to be extinct at the beginning of the 1920s. But they were discovered in Ishikawa Pref. in 1929 and in Sado Island in 1931. It was estimated that 80 or 120 birds survived in total. Against this background, they were designated as a natural monument of the nation in 1934. In the 1940s, however, deforestation due to World War II diminished the habitats of Crested Ibises further. Thus, when the cry for their protection arose again after the war, a total of only about 30 Crested Ibises remained in limited areas of Sado Island and the Noto Peninsula, Ishikawa Pref..

Crested Ibises were designated as a special national treasure in 1952 and as an Internationally-protected Bird in 1960. In addition, loach started to be released in paddy fields to provide them with food around that time by local people and a governmental agency. In that period, however, Crested Ibises suffered the misfortune that frustrated the conservation efforts. Pesticides started to be widely used in farmland and aquatic animals such as fish which Crested Ibises fed on were contaminated, which probably resulted in the number of Crested Ibises decreasing to only one that was found in the Noto Peninsula in 1964. This bird was captured and sent to Sado, but died in the following year. Ultimately, only about ten birds survived that period in the mountainous region of Sado Island which was not very much affected by pesticides. In 1967 the Crested Ibis Conservation Center was founded in Sado Island and conservation efforts began to be made. Despite the efforts, however, Crested Ibises decreased to only

five birds in the mountains of Sado in 1979. These five birds were captured to raise in captivity in January 1981, when Crested Ibises disappeared from the wild in Japan. After that, captive breeding efforts were exerted including attempts to cross Japanese Crested Ibises with birds provided by China. But these efforts did not save Crested Ibises from extinction. The last bird named "Kin" died in October 2003. This history of Crested Ibises is an eloquent example of the difficulty of recovering wildlife driven to the brink of extinction. Crested Ibises found in Sado now are derived from captive-raised and released birds of Chinese origin.

Friction with people [BOOK p.136]

While many different birds have been decreasing and conservation efforts have been made for them, some birds have increased in number or expanded their range and caused friction with people. Birds have caused notable friction with people other than those between crows and city dwellers treated in Chapter 5 – damage to crops and freshwater fish stock, attacks on people and collisions with aircraft, for example. In addition, these problems tend to increase and exacerbate year by year. Let's take a look at the typical cases.

Agricultural damage [BOOK p.136]

The damage of birds to agriculture varies between species, but ranges from vegetables to fruit. Farm products have suffered serious damage from Brown-eared Bulbuls, White-cheeked Starlings, crows and ducks. The annual amount of the damage from these birds has reached 4.8 to 7.7 billion yen in the last decade (From the Ministry of Agriculture, Forestry and Fisheries production station statistics).

Although most of the agricultural damage has not begun in recent years, the damage of Greater White-fronted Geese to wheat has markedly increased since the mid-1990s. In Bibai City of Hokkaido, for instance, flocks of several hundred Greater White-fronted Geese visit wheat fields in early spring and eat wheat leaves as if they were mowing the lawn (Ushiyama et al. 2003, Amano et al. 2004). They begin to eat wheat leaves after they have consumed all the fallen rice grains left in paddy fields. It seems that the damage of Greater White-fronted Geese to wheat is related to the switch from rice to wheat production due to government policies that favor reductions of rice acreage.

Crops have also recently suffered damage from rare species that are fully protected – Red-crowned Cranes of eastern Hokkaido and Hooded Cranes and White-naped Cranes of Izumi in Kagoshima Pref., for example. These cranes enjoy artificial feeding and many of their habitats are thoroughly protected. An increase in the agricultural damage is closely related to a rise in the population due to artificial feeding. Since they have increased in abundance, they have expanded their foraging range into the surrounding agricultural land. In Izumi, sufficient roost and feeding sites are provided for the cranes, which is aimed at attracting the cranes and preventing them from causing damage to crops in the neighboring fields as well as conserving the cranes.

Damage to fisheries [BOOK p.137]

The major damage to fisheries is that of Great Cormorants (*Phalacrocorax carbo*) to freshwater fish, such as Ayu fish, Japanese dace, Yamame trout, Amago-trout and Crucian Carp. These fish have been released into rivers in large quantities in recent years, but many of them have been captured by Great Cormorants. Great Cormorants form flocks of dozens or sometimes hundreds of birds, and they chase and literally swallow fish whole.

The fishery damage is reported from all the regions of Japan, but there is a great deal of damage especially in the Kanto, Tokai and Kinki regions. The amount of the damage in Japan as a whole was 900 million yen in 1993, 1.6 billion yen in 1997, 2.5 billion yen in 2002, 4.6 billion yen in 2004 and 7.3 billion yen in 2006 (Cited from the website of the National Federation of Inland Fisheries Co-operative Associations etc.). The damage has been increasing year by year, but the accuracy of the damage estimation requires further investigation.

Great Cormorants were declining steadily until the 1970s. Their breeding colony in Daiganji Temple in Chiba City was designated as a national natural monument, but it also disappeared. Subsequently, especially since the 1990s, however, they have been increasing in abundance and expanding their range. It is estimated that a total of 50,000-60,000 or more birds are widely distributed from Hokkaido to Okinawa Pref. nowadays.

It seems that an increase in the population of Great Cormorants is related to the recovery of fish resources due to an improvement in water quality both in coastal and freshwater systems, the massive release of fish such as Yamame trout and Ayu fish in inland rivers and an increase in non-native fish such as Bluegill and Black Bass. The range expansion can be attributed to the dispersion of the local population due to the destruction of the breeding colonies as well as an increase in the population.

Attacks on people [BOOK p.137]

Crows and Black Kites (*Milvus migrans*) can be a threat to people when they attack them. Black Kites have caused trouble especially on the coastal areas of Kanagawa Pref.. It is not uncommon for Black Kites to swoop down to snatch food away when people are having a meal in a seaside outdoor restaurant or on the beach in Zushi, Kamakura, Fujisawa, Kurihama and other seaboard cities. They tend to make trouble for people more frequently in a place with few green spaces and crowds of people (Galbreath et al. 2014).

Since Black Kites grab things with their sharp talons, they occasionally cause minor injuries to hands or arms of people when they swoop down on food. But on rare occasions, there were accidents in which the talons of kites accidentally hit people on the head resulting in a wound that needs a few stitches in a hospital.

It is not unusual for Black Kites to fly around in a flock. Therefore, the main problem with Black Kites seems that they frighten people and that they snatch food away or disturb them during a meal rather than that they hurt them with the talons. It is quite natural that you should be frightened if large hawks such as Black Kites swoop down on you one after

another, while flying overhead in a flock. Black Kites have caused similar problems in western Japan as well.

It is because people threw or held out food to Black Kites that they began to snatch food from people. Black Kites which have learned to take the food offered by people have started to snatch food from people without fearing them. These kite problems not only tend to increase in a region but also to expand into neighboring regions. Tourist associations or local governments are racking their brains over complaints from citizens and tourists about Black Kites.

In contrast to Black Kites, crows intentionally attack people. That said, they seldom inflict serious injuries. It is the attacks of Large-billed Crows living in cities that often become an issue of public concern. They usually attack people during the breeding period from May to June. During this period, crows are extremely nervous because they have eggs or chicks in a nest. When people pass by the nest, crows attack them to defend the nest. They come flying from behind and use both feet to kick the passing people in the head. The head wounds are seldom serious, even if they may bleed (Higuchi & Morishita 2000).

But the attack of crows on people is now a social problem. After crow attacks became a social problem (Higuchi 2010), at the beginning of the 2000s, the Tokyo Metropolitan Government suddenly started to receive a large number of complaints about crow attacks. This occurred not because the crows increased sharply or that they became suddenly more aggressive. The number of complains increased primarily because of reporting in the media, especially on television. Television reports showed the scenes of people bleeding from the head attacked by a crow or people who were carried to a hospital and needed several stitches. In addition, some of the reporters held a crow perched on their heads while the crow pecked at them with its thick bill. Then TV viewers received the impression that crows were frightening birds. Therefore, people readily made phone calls to the government when crows only came close to people or flew overhead threateningly. It is true that crows occasionally inflict an injury that may bleed, but few people attacked by crows suffer an injury which needs several stitches. One of the few people who sustained a serious injury fell over and hit his head against a nearby concrete block wall when he hastily tried to dodge a crow flying toward him. It is extremely unlikely that a crow would perch on a person's head and peck at it repeatedly. Inaccurate or exaggerated media coverage have aroused unreasonable fear in citizens.

In response to rapidly-increasing complaints from the residents about crows, the Tokyo Metropolitan Government conducted crow control on a massive scale. More than 100 trap cages were placed throughout the city and hundreds of crow nests were destroyed every year as well. From around 2002, 9,000 to 18,000 crows were captured every year (from Tokyo Metropolitan Bureau of Environment website), probably as a result of which crows were on the decline and complaint calls about crows decreased as well. Although it is necessary to reduce the number of crows for several reasons, it should be regarded as a problem that a large number of crows were destroyed due to inaccurate media coverage.

Bird strikes [BOOK p.140]

The collision of birds with aircraft is widely known as a "bird strike" in English. Plane crashes due to bird strikes have occurred all over the world, taking a heavy toll of lives. Bird strikes may cause an airplane to crash in residential areas, which inflicts enormous damage. In Japan as many as 1,000 to 1,300 bird strikes are reported every year, none of which fortunately has led to a plane crash (Higuchi 2010, from the website of the Ministry of Land, Infrastructure and Transport). Since this number is for cases reported by major domestic airlines alone, it would be much larger if the reports from overseas airlines flying to Japan are included.

Relatively large birds such as Black Kites, herons and crows and small birds such as White-cheeked Starlings and Barn Swallows frequently collide with airplanes. Black Kites, herons and other larger birds tend to crash into an airplane because they cannot take off promptly and dodge around it when it approaches them on a runway. When they take off clumsily, they collide with an airplane. White-cheeked Starlings and Barn Swallows, on the other hand, can take off quickly and avoid an approaching plane deftly, but they tend to form a large flock, which increases the chance of collision.

In Japan bird strikes occur frequently in airports with a large number of takeoffs and landings, such as Tokyo International Airport, which is stochastically understandable. But bird strikes also occur frequently in some local airports with a small number of takeoffs and landings. Most of these airports are located in the vicinity of a fishing port or an estuary. Various organisms including fish carcasses are carried to an estuary from the sea and the upper reaches of the river. The birds which are prone to crash into planes such as Black Kites, crows and gulls scavenge for these carcasses. Therefore, they tend to gather together in estuaries and collide with planes. A large amount of unwanted fish and the like are discarded in fishing ports. They also attract Black Kites, crows and gulls, which also increases the chance of a bird strike.

Governmental bodies and airlines have taken measures to prevent bird strikes – a bird-patrol car to drive away birds by firing blanks while moving in a car, the use of hawks and dogs, and environmental management to prevent birds from settling in an airport, for example.

A bird strike is a serious nuisance to people, but fatal to birds. This is true of collisions with wind turbines as well. Collisions with wind turbines are often considered from the point of view of wildlife because they usually involve large birds such as eagles, geese and swans. Since bird strikes affect people's lives, however, they are looked at from the perspective of people. Birds are innocent victims in either case. In any case, it is necessary to take effective measures to conserve birds as well as minimize friction between people and birds.

Conservation efforts [BOOK p.141]

Since nature is deteriorating and the world of birds is vanishing in Japan, a bright future does not seem to be waiting for them. But various efforts have still been exerted to make their future brighter even if slightly.

Efforts to conserve habitats, such as beech forests, evergreen broadleaved forests, satoyama countryside, wetlands and tidal

flats have been made by local people, conservation groups, research workers and governmental bodies independently or in cooperation with each other. Many of these activities are regarded as an effort to conserve ecosystems in which many species interact one another. There are tens of thousands of private organizations involved in these activities across Japan, the number of which is increasing year by year.

On the other hand, governmental agencies have also attempted to conserve habitats by registering relevant habitats as a World Natural Heritage Site or a Ramsar Convention site as well as designating them as a wildlife reserve or a national park. There are 81 nationally designated wildlife reserves, 31 national parks, 46 Ramsar Convention sites and 4 World Natural Heritage sites in Japan as of March 2014. Many of these areas are important habitats for birds. There is a possibility that the number of designated and registered sites will increase in the future.

Efforts to prevent the degradation of habitats have also been exerted extensively. For instance, rice paddies are in the limelight as an important substitute for inland marshes and ponds, which have been disappearing, but they have been losing biodiversity due to their structural changes brought about by field management. Research workers and concerned local people have been attempting to maintain biodiversity in paddy fields without reducing rice harvests. The conservation of Grey-faced Buzzards and the reintroduction project of Crested Ibises and Oriental Storks have also been carried out in conjunction with these attempts to conserve the biodiversity of rice fields.

Efforts have been exerted to conserve particular species, especially rare species and some of them have achieved remarkable results. In Torishima Island, for instance, Short-tailed Albatrosses declined sharply from the 19th to the early 20th century because more than five million birds were hunted for their feathers. They were considered to be extinct at the end of the 1940s, but it was confirmed that about 10 birds survived to breed in the island in 1951. Long-term efforts resulted in the breeding population increase, exceeding 600 pairs at the end of 2013. The recovery of the population was due to vegetation management and preventive measures against debris flow at the nest site. (Hasegawa 2003 and see "Trajectory to the Short-tailed Albatross revival" on the home page of Toho University Media Center).

In addition, considering the possibility of the volcanic eruption of Torishima, Short-tailed Albatross chicks born in Torishima have been transported to Mukojima of the Ogasawara Islands in order to establish a new breeding population there (Deguchi et al. 2014, the website of Yamashina Institute for Ornithology). Researchers and relevant governmental agencies have made these conservation efforts in close cooperation with one another.

Columba janthina nitens, a subspecies of Japanese Wood Pigeon in the Ogasawara Islands, also shows signs of population recovery. There were only 30-40 birds in the Ogasawara Islands as a whole until around 2000. Research workers, conservation groups and concerned governmental agencies reviewed from various angles why the population did not increase and concluded that the predation of feral cats was a major factor in the poor breeding performance of this subspecies. As preventive measures against the predation of feral cats, they have been controlled or sterilized since 2005, as a result of which the population of this subspecies has increased and expanded its range considerably. They are now found not only in the woods but also in the parks and residential areas (Arikawa 2013).

The horizontal and vertical structures of a forest suitable for hunting and breeding by Mountain Hawk Eagles and Golden Eagles were studied and forest management has been attempted based on the findings (Sudo 2013, Yamazaki 2013). Important problems for the future include the creation of hunting space, the conversion of conifer plantations to broad-leaved or mixed forests and the connection of forests. Researchers, conservation organizations and governmental agencies have cooperated in these activities.

Conservation efforts have also borne fruit in Cackling Geese (*Branta hutchinsii*) (Kurechi 2006, website of "Foster A Goose Program"). Several hundred Cackling Geese visited Japan until the first half of the 1930s. But the then government of Japan undertook blue fox farming and released many foxes in the Kuril Islands which were the breeding grounds of Cackling Geese. As a result, almost all Cackling Geese disappeared from the wintering and breeding grounds. Subsequently Cackling Goose population wintering in Japan recovered due to the tireless efforts of the researchers and relevant parties of Japan, Russia and US. The key to success in this goose conservation project was to release captive-raised young birds under two years of age in as large a flock as possible. In the winter of 2013-2014, more than 600 Cackling Geese came to Niigata Pref. and the Tohoku region.

The creation of substitutes for disappearing natural habitats has also been attempted – winter- or summer-flooded-rice paddies, for example. As explained in Chapter 3, if rice fields are flooded during the autumn and winter, soil is improved at the same time as pest insects and weeds are reduced. In addition to these advantages, these fields attract waterfowl such as swans. Swans use winter-flooded-paddies as a site for feeding, resting and roosting. Summer- flooded-paddies are the fields which are flooded after wheat was harvested in the fields where rice and wheat are cultivated alternately. This attempt is aimed at forming species-rich biota including shorebirds in farmland. Again, pest insects and weeds are suppressed in summer-flooded-fields. In addition to shorebirds such as Spotted Redshank, Wood Sandpiper, Common Greenshank, Black-tailed Godwit, Grey-headed Lapwing and Pacific Golden Plover, herons, such as Great and Little Egrets, visit summer-flooded-fields in large numbers. These birds fertilize the fields with their droppings.

A breeding site created on the rooftop of a building affords another example of attempts to provide alternative habitats for birds (see Chapter 5). This is a full-fledged conservation effort in Little Terns (Fujita et al. 2009, Little Tern Project website). Little Terns have been deprived of many of their breeding grounds by the development of the gravelly areas of coastal shorelines and the shores of large rivers. Consequently, they started to breed on the rooftop of the Tokyo Metropolitan Morigasaki Wastewater Treatment Center located in Ota Ward, Tokyo in June 2001. Initially, they laid eggs directly on top of the concrete roof and failed to hatch eggs due to wind and rain. But subsequently, research workers, citizens and governmental bodies worked together on improving the conditions of the nesting site, expanding the target area, removing predators and establishing shelters for protection

from predators and strong sunshine. In 2003, about 2,000 pairs attempted to nest and about 1,600 young were observed. Unfortunately, the number of breeding pairs has decreased in recent years, but the project members have continued various conservation efforts.

As mentioned in the case of Cackling Goose conservation, international cooperation and collaboration are extremely important to the conservation of migratory birds. In satellite tracking-related projects, we have carried out various studies in cooperation with the research workers and people involved in conservation of Russia, China, South Korea, North Korea, India, Indonesia and the United States. Many of the results have actually been used for the conservation of birds (Higuchi 2005, 2013)

To take examples from the conservation efforts of cranes, a protected area of several thousand hectares has been established in each of the two important stopover sites in North Korea based on the results of the satellite tracking of cranes. The natural park of more than 5,000 ha has been established in the breeding ground of Muraviovka in the central-southern part of Russia. The results of satellite tracking did not particularly play a major role in the establishment of this park, but promoted the exchange of relevant people between Japan and Russia. The natural park at Muraviovka has been established with the aim of reconciling the conservation of biodiversity with farming. Today, it is widely known as a place for the practice of environmental education and conservation.

The Three Rivers plain of Heilongjiang Province in China has been found to be important as a breeding ground for White-naped Cranes wintering in Izumi, southern Japan. We proposed major changes to the initial plan for developing the plain, considering the results of satellite tracking and aerial surveys and satellite images in combination. The contents of the proposal ranged from the reduction and change of development area to the establishment of new protected areas and a post-development monitoring system. Part of the proposal – for example, the establishment of protected areas – was subsequently carried out. It is believed that these results have made a considerable contribution to conserving cranes migrating between Japan and Russia or China.

For the future [BOOK p.144]

In the 1960s and 1970s when the environmental movement was growing in Japan, conservationists and governmental agencies often were in conflict over development. Since both parties stuck fast to their own opinions, they often remained as far apart as ever. In addition, some conservation activities were not based on scientific data or ideas, and most researchers were not interested in the conservation of nature.

Subsequently, the situation changed greatly. Since the conservation of the environment and biodiversity has occupied a proper position in more recent government administrations, cooperative and constructive relations have come to be maintained between governmental agencies and conservationists. There are also still various difficult problems, of course, but there is a general tendency toward attaching great importance to mutual understanding and cooperation aimed at the common goal of conservation. Conservation-related studies have advanced rapidly, particularly among young people. Increasingly, people of different positions are attempting to form a consensus on an issue involving their own interests through discussion. The general public not only has taken a growing interest in the environment and wildlife but also has a deeper understanding of them.

Economic development is still advancing at a terrific pace, and circumstances surrounding nature including birds are far from favorable. As mentioned above, however, there are many auspicious signs as well. It is certain that various conservation efforts will continue to be made in the future.

Japan is one of the most heavily populated countries in the world, which carries considerable potential for destroying or degrading the environment due to the inevitable expansion of living and industrial areas. The wise use of land and nature as well as their conservation and management are badly needed. The survival of the rich biodiversity and uniquely interesting avian world of Japan depends on our wise judgment and our ability of putting it into practice.

AUTHOR

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