3

Justification for Inscription

Mountain stream of the Okuma River, the northern part of Okinawa Island (Photo: MOEJ)

3. Justification for Inscription

3.1.a. Brief synthesis

The nominated property comprises four regions, Amami-Oshima Island, Tokunoshima Island, the northern part of Okinawa Island in Central Ryukyus; and Iriomote Island in South Ryukyus. The four islands containing the nominated property are members of the Ryukyu Chain at the southern tip of the Japanese Archipelago aligned in an arc shape along the eastern rim of the Eurasian Continent. The nominated property is a terrestrial site covering 37,946 ha located between 24°20′ and 28°19′ north latitudes. Influenced by the Kuroshio Current and the Ogasawara High (subtropical high cell) that sits over the west part of north Pacific Ocean, it has a warm and humid subtropical climate and is covered mainly with evergreen broadleaved subtropical rainforests.

The Ryukyu Chain as it exists today is believed to have been formed through the formation and expansion of the Okinawa Trough and associated tectonic uplift and subsidence caused by subduction of the Philippine Sea plate beneath the Eurasian plate at the Ryukyu Trench that occurred since the middle Miocene (Neogene, approx. 15 Ma) of the Cenozoic, combined with changes in sea level due to climate change during the early Pleistocene (Quaternary, approx. 2 to 1.7 Ma) and deposition of Ryukyu limestone associated with the development of coral reefs (see 2.a.3.1. Geological history: Figure 2-16).

As the archipelago was separated from the Eurasian Continent by Okinawa Trough, the biota of the North Ryukyus, the Central Ryukyus and the South Ryukyus developed in isolation from each other by deep straits that run between the islands and by the Kuroshio Current. Some neighboring islands became connected and separated repeatedly according to fluctuations in the sea level. These changes in the distribution of land and water provided unique opportunities for speciation and endemism to the terrestrial creatures of the Central and South Ryukyus in which the nominated property is included. Moreover, the terrestrial biotas of the Central and South Ryukyus show different patterns of speciation and endemism stemming from the difference in the distance and timing of separation from the continent. As a result of diverse speciation across a wide variety of taxonomic groups, an exceptionally large number of endemic species and subspecies can be observed in the nominated property.

The nominated property is home to 1,808 vascular plant species (including subspecies, varieties, and hybrids), 22 terrestrial mammal species, 394 bird species, 36 reptile species, 21 amphibian species, 267 inland water fish species, 6,148 insect species and 47 freshwater decapod crustacean species, including 88 threatened species listed on the IUCN Red List (2016). It can be well said that the site provides an irreplaceable natural habitat for these creatures and for in-situ conservation of biological diversity.

Reflecting its geological history as a continental island group with a long history of isolation, the nominated property presents outstanding examples representing on-going processes of speciation of various endemic species/subspecies and valuable natural environment including habitats of many internationally recognized threatened species as well as endemic species.

3.1.b. Criteria under which inscription is proposed

Criterion (ix)

The Central and South Ryukyus which include the nominated property have given rise to numerous endemic species through speciation in various evolutionary lineages that occurred alongside the geological processes of separation from the continent and repeated joining and separation among the islands. In the Central Ryukyus, which were separated from the continent around the late Miocene (Neogene, approx. 11 to 5 Ma), relict endemic species, whose related species cannot be found in the neighboring regions, still survive on the islands. The South Ryukyus, which separated from Taiwan and the continent during the Pliocene (approx. 5 to 2.6 Ma), have many endemic species/subspecies with the most closely related species distributed in Taiwan and the continent. The nominated property is an outstanding example clearly representing unique processes of speciation and diversification of evolutionary lineages reflecting its geological history.

The Ryukyu Chain was part of the Eurasian Continent at its eastern rim until the middle Miocene (Neogene, approx. 15 Ma) and thus the terrestrial biota of this area was common with that of the neighboring parts of the continent. Later, as it became separated from the continent and formed an archipelago of small islands through the development of Okinawa Trough and two deep ocean gaps, the terrestrial creatures that then inhabited the islands became isolated from the other pieces of land, thereby segmenting their distribution and driving unique processes of evolution.

Those processes are particularly evident in non-flying terrestrial vertebrates that have low dispersal capacity and cannot easily cross the ocean gaps. Among them, many relict endemic species can be seen in the Central Ryukyus. Relict endemic species are the descendants of ancient species that have survived on the islands isolated by ocean gaps, while their conspecifics and related species and lineages that used to inhabit the neighboring areas have been driven extinct by predators or fierce competition on the continent. Relict endemic species generally have large genetic differences with their related species and lineages that inhabit other areas and are characteristically distributed in discontinuous areas. Representative examples of relict endemic species in the nominated property include monospecific Amami rabbit (*Pentalagus furnessi*) that occurs only on Amami-Oshima and Tokunoshima Islands (see 2.a.3.2.: Column 2); Amami jay (*Garrulus lidthi*) on Amami-Oshima Island; Ryukyu black-breasted leaf turtle (*Geoemyda japonica*) and Namie's frog (*Limnonectes namiyei*) in the northen part of Okinawa Island; and Ryukyu long-haired rat (*Diplothrix legata*) and Anderson's crocodile newt (*Echinotriton andersoni*) distributed on nominated three islands. There are also plant relict endemic species such as *Arisaema heterocephalum* (Araceae)*, Viola amamiana* (Violaceae), *Polystichum obae* (Dryopteridaceae) and *Platanthera sonoharae* (Orchidaceae).

The Central Ryukyus also offers examples of relict species that have speciated into different species or subspecies now endemic to individual islands. One example is the spiny rats which separated into a different endemic species on each of Amami-Oshima Island, Tokunoshima Island and Okinawa Island (see 2.a.3.2.: Column 3). Another example is the species group of Ryukyu ground gecko which separated into different endemic species and subspecies in each of Tokunoshima Island, Okinawa Island (which are both included in the nominated property) and the surrounding islands. On the other hand, there are no relict endemic species in the South

Ryukyus, but instead, many endemic species and subspecies closely related to those in Taiwan and the continent can be found, showing evidence of speciation between neighboring islands. Many species of this kind are seen in Iriomote Island. Speciation between populations that inhabit different islands is still ongoing to this date. As a result of genetic differentiation caused by isolation into different geographic populations through the geological formation of the islands, various examples of speciation and endemic species/subspecies specific to each individual island can be seen across the Central and South Ryukyus. A typical example is the group of tip-nosed frogs, that have speciated into five different species in the area from the Amami Island Group to Taiwan (see 2.a.3.2; Column 4). Among them, four species are seen in the nominated property. Other examples of diverse speciation involving various animals from invertebrates to mammals as well as plants are abundant in the nominated property.

Reflecting these biological processes, the rate of endemic species is remarkably high in the terrestrial mammals, terrestrial reptiles, amphibians and Japanese freshwater crabs (Potamidae) (a type of inland decapod crustacean) of the nominated property. Among terrestrial mammals, 13 (18, hereinafter figures in parentheses include subspecies) out of 22 (23) native species are endemic to Central and/or South Ryukyus, meaning that the endemic rate is 59% (78%). Likewise, 23 (33) out of 36 (38) native terrestrial reptile species are endemic, meaning an endemic rate of 64% (87%); 18 (19) out of 21 (22) native amphibian species are endemic, meaning an endemic rate of 86% (86%); and all the 14 Japanese freshwater crab species are endemic meaning that the endemic rate is 100%. As for the flora, 950–1,300 vascular plant species (including subspecies, varieties and hybrids) grow in each of the four regions containing the nominated property, and of these, a total of 180 species are endemic.

Based on these facts, the nominated property is recognized as an important and significant area for in-situ conservation of biological diversity from a global perspective as follows;

1) Birdlife International has identified “Nansei Shoto” (islands lying between Kyushu and Taiwan including the nominated property) as one of the “Endemic Bird Areas of the World” in consideration of the fact that the area is home to various endemic bird species like Okinawa rail (*Gallirallus okinawae*) and Amami woodcock (*Scolopax mira*).

2) WWF has identified the forest ecosystems of the Nansei-Shoto Islands including the nominated property as “Nansei Shoto Archipelago Forests” ecoregion, one of the Global 200: Priority Ecoregions for Global Conservation.

3) Conservation International has identified the Japanese archipelago as a Biodiversity Hotspot with a particular mention for the numerous endemic species that inhabit the nominated property.

The Central and South Ryukyus respectively show different processes of speciation, and by considering the different processes together from a larger perspective, we will be able to understand the whole picture of the ongoing speciation and phylogenetic differentiation reflecting the geological history of the entire Ryukyu Chain. This will in turn lead to deepened understanding of the diverse speciation processes that take place on the continental islands not only in East Asia but in the world. The nominated property can thus be deemed as one of

the best natural laboratories in the world for studying the formation history of continental islands and biological evolution processes therein. The details of the formation history and the precise age of each island have yet to be elucidated, but research areas such as phylogeography, geology and palaeontology are being actively pursued at the moment. It is expected that the whole picture will be revealed in the future by accumulating and comprehensively integrating findings from the latest studies.

Criterion (x)

The nominated property provides important and significant natural habitats for many globally threatened species listed on the IUCN Red List. It also provides irreplaceable habitats for relict and new endemic species, such as the diverse examples seen among non-flying lineages dependent on the inland water environment. Typical examples are the amphibians which have very limited chances of dispersing across the sea due to physiological reasons, thereby reflecting the property's geological formation processes as a continental island group. The nominated property is recognized as an important area for in-situ conservation of biological diversity from a global perspective.

More specifically, the nominated property provides important and irreplaceable natural habitats for numerous terrestrial creatures, including 88 threatened species on the IUCN Red List of which 70 species (80%) are endemic species. For example: Iriomote cat (*Prionailurus bengalensis iriomotensis*) (classified as CR in IUCN Red List 2016, "IUCN Red List 2016" omitted hereunder); Amami rabbit (EN); Okinawa spiny rat (*Tokudaia muenninki*) (CR); Amami spiny rat (*Tokudaia osimensis*) (EN); Tokunoshima spiny rat (*Tokudaia tokunoshimensis*) (EN); Ryukyu long-haired rat (EN); Okinawa rail (EN); Okinawa woodpecker (*Sapheopipo noguchii*) (CR); Amami jay (VU); Ryukyu black-breasted leaf turtle (EN); Yaeyama yellow-margined box turtle (*Cuora flavomarginata evelynae*) (EN); Kuroiwa's ground gecko (EN); Anderson's crocodile newt (EN); Okinawa Ishikawa's frog (*Odorrana ishikawae*) (EN); Amami Ishikawa's frog (*Odorrana splendida*) (EN); Utsunomiya's tip-nosed frog (*Odorrana utsunomiyaorum*) (EN); Ryukyu ayu-fish (*Plecoglossus altivelis ryukyuensis*) (EN); Yanbaru long-armed scarab beetle (*Cheirotonus jambar*) (EN); an endemic dragonfly (*Chlorogomphus brunneus brunneus*) (EN); 11 species of wild gingers (*Asarum*, Aristolochiaceae) (3 CRs, 6 ENs, 2 VUs); and two species of the plants of genus *Arisaema* (Araceae) (1 CR and 1 EN).

Among the species listed above, Okinawa rail is one of the 19 non-flying species of the rail family that still remains in the world to date. Iriomote cat is a wildcat that only inhabits Iriomote Island. It has the smallest distribution in the world among species of the Felidae family. Five mammal species, three bird species, three amphibian species have been identified from the nominated property as Evolutionarily Distinct and Globally Endangered (EDGE) species by the Zoological Society of London. Of these, the Amami rabbit and Okinawa spiny rat are ranked (Amami rabbit: 42nd, Okinawa spiny rat: 48th) in the Top 100 EDGE Species given the highest priority for conservation among all mammals (Zoological Society of London, http://www.edgeofexistence.org/species/).

The biological composition of the area, particularly the flora and insects of the nominated property make up a characteristic biota displaying a mixture of elements of East Asia, Southeast Asia and Oceania. This biota reflects the subtropical climatic conditions, the history of separation from the continent and past climate changes

(glacial-interglacial periods), the history of diverse dispersion mediated by the Kuroshio Current and migratory birds, and the geographical position of the islands in a biogeographic transition zone. In particular, the flora of the nominated property is extremely diverse with 950 to 1,300 species of vascular plants on each of the four regions within the nominated property. Despite the four regions having a land area of less than 1 % of the total national land of Japan, approximately 19% of threatened vascular plant species in Japan inhabit the area. Therefore, the area is recognized as one of the most important areas for conservation of threatened plant species in Japan. Likewise, more than 1,000 to 3,000 insect species inhabit each of the four regions containing the nominated property, representing about 10% of threatened insect species in Japan.

In addition, the nominated property is internationally recognized as a global conservation priority as follows;

1) Alliance for Zero Extinction (AZE) has identified Tokunoshima Island (as a habitat of the Tokunoshima spiny rat) and the northern part of Okinawa Island (as habitats of the Okinawa spiny rat, Okinawa rail, Okinawa woodpecker, Okinawa tip-nosed frog and Namie's frog) as AZE sites for conservation priorities.

2) Birdlife International has identified the three areas of Amami Islands, Yambaru–northern Okinawa forest and Yaeyama Islands (all three overlapping the nominated property) as Important Bird Areas (IBA). IBAs are chosen on the basis of occurrence of key bird species that are vulnerable to global extinction or whose populations are otherwise irreplaceable including important stopover points or wintering spots for migratory birds.

3) Based on above identification as AZE and IBA sites, Conservation International advocates the designation of Amami Islands, Yambaru and Yaeyama Islands, all including the nominated property, as Key Biodiversity Areas (KBA) (Natori et al. 2012).

As demonstrated above, the nominated property is a globally unique area and home to many threatened and endemic species, containing extremely important natural habitats for in-situ conservation of biological diversity.

Arisaema heterocephalum var. *majus* (Photo: Shosaku Hattori)

3.1.c. Statement of integrity

As described below, the nominated property includes all the elements necessary to express its Outstanding Universal Value as a serial nomination, is of adequate size to ensure the complete representation of its biodiversity values, and does not suffer from adverse effects of development or neglect. As such, it satisfies the conditions of integrity for inscription on the World Heritage List, as described in Paragraphs 87–95 of the Operational Guidelines.

3.1.c.1. Scope of the nominated property

This is a serial nomination under criteria (ix) and (x). The nominated property comprises four regions: Amami-Oshima Island and Tokunoshima Island which belong to the Amami Island Group of the Central Ryukyus, the northern part of Okinawa Island which belongs to the Okinawa Island Group of the Central Ryukyus, and Iriomote Island which belongs to the Sakishima Island Group of the South Ryukyus. It does not include the North Ryukyus which, separated by the Tokara Strait, belong to a considerably different biogeographic region from the rest of the Ryukyu Chain.

The key values of the nominated property lie in that it presents outstanding examples of distinct and unique processes of biological evolution and speciation that are different between the Central and South Ryukyus. This is due to: the difference in the period of separation from the continent (reflecting the geological history of the Ryukyu); and its important and significant habitats for many endemic and threatened species that have evolved through the above mentioned processes. By including both the Central and South Ryukyus (each with rather different characteristics), and by selecting the four regions of Amami-Oshima Island, Tokunoshima Island, the northern part of Okinawa Island and Iriomote Island that have abundant endemic and threatened species and concentration of typical species demonstrating the outstanding universal value of the property, it helps comprehensive understanding of the diverse patterns and processes of speciation that take place on continental islands (see Table 2-32 for the speciation patterns and typical species of each island). As such, all the elements of the property are complementary to one another and if any of the four regions were to be omitted, it would be impossible to understand the whole picture of the ongoing evolutionary and ecological processes or conserve the biodiversity of the area.

The four regions containing the nominated property are large in size among the numerous islands of the Central and South Ryukyus and are inhabited by approximately 90% of the native species including the largest number of endemic species and threatened species (Table 3-1 and Figure 3-1). These islands consist of mountains and hills with relatively high altitudes, meaning that rivers and streams are well developed, and the subtropical rainforests, which are the main habitats for endemic or endangered species, exist in relatively large clusters. Some parts of these rainforests have been affected by human activities in the past, but have recovered to an almost natural state, thanks to the vigorous germination capacity of the dominant species, *Castanopsis sieboldii*. They provide habitats to rare species.

Each component of the nominated property is located at the core of the subtropical rainforest, and encompasses a wide variety of environments including: non-limestone areas from the Mesozoic/Cenozoic and limestone areas from the Palaeozoic/Mesozoic; cloud forests at the top of the mountains; mountains/hills with intricate mazes of small ridges, valleys and rivers; and lowland wetlands around river mouths. It contains habitats of about 90% of

all the endemic species of vascular plants, terrestrial mammals, birds, reptiles, amphibians, inland fish, insects and inland water decapod crustaceans and over 90% of threatened species on the IUCN Red List 2016 that inhabit the Central and South Ryukyus. It also contains extremely important areas where 20% of all threatened plant species in Japan (listed on MOEJ-Red List 2015) are concentrated.

Liparis viridiflora (Photo: JWRC)

Table3-1: Number and rate of indigenous, endemic, and endangered species in the Central and South Ryukyus

	Number of indigenous species			Number of endemic species			Number of endangered species (IUCN-RL)		
	Central & South Ryukyus	Four islands	Proportion of four islands (%)	Central & South Ryukyus	four islands	Proportion of four islands (%)	Central & South Ryukyus	Four islands	Proportion of four islands (%)
Terrestrial mammals	24	22	92	14	13	93	10*	10	100
Birds	469	394	84	4	4	100	12	12	100
Terrestrial reptiles	46	36	78	29	23	79	7	5	71
Amphibians	22	21	95	18	18	100	12	12	100
Inland water fishes	268	267	99.6	13	13	100	6*	6	100
Insects	6,780	6,148	91	1,844	1,602	87	20*	19	95
Inland water decapod crustaceans	61	47	76	27	15	56	2	0	0
Vascular plants*	2,059	1,808	88	207	185	90	27	24	88
Total	9,729	8,743	90	2,156	1,873	87	96	88	92

* : including subspecies, varieties, and hybrids

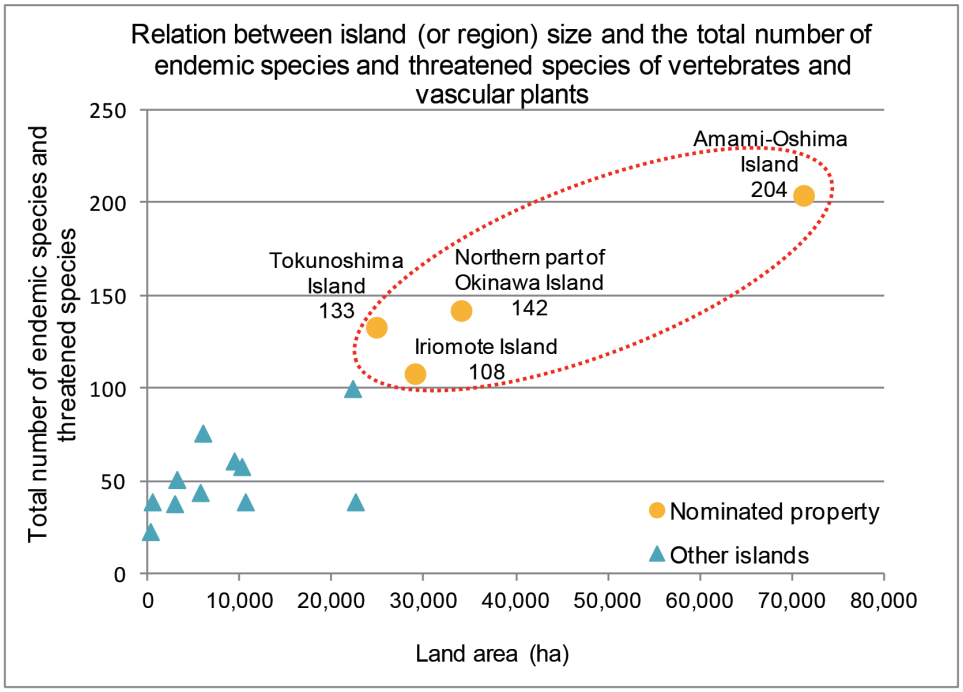

Figure 3-1: Comparison of area and the total number of endemic species and threatened species among islands (except for Okinawa Island which shows only northern part of the island) in the Central and South Ryukyus.
The symbols mark the total number of endemic species and threatened species (on IUCN Red List) of vertebrates and vascular plants.

3.1.c.2. Controlling threats to integrity of the property

Key threats to the biodiversity of the nominated property include: the impact of alien species such as small Indian mongoose and cats; traffic accidents; and the illegal collection of wild species. While there is some impact from these threats, the risks are prevented or mitigated through the following measures implemented through collaboration between related administrative organs and civilian organizations (see 4.a.2 for details).

- Small Indian mongoose control projects on Amami-Oshima Island and the northern part of Okinawa Island.
- Ordinances regulating the safe keeping and management of pet cats and measures to control feral cats in habitats of rare species (in forests) on the four islands.
- Designation of protected species based on laws and ordinances, and monitoring/patrols to control illegal harvesting on the four islands.

The four regions, namely Amami-Oshima Island, Tokunoshima Island, the northern part of Okinawa Island and Iriomote Island, are rather small islands containing human inhabitants. Residents have settled down on these islands for generations, engaging in agriculture and forestry as the islands' main industries. Tourism such as eco-tours has also become a major industry in recent years. Some of the endemic and threatened species of the nominated property, such as Iriomote cat, Amami jay, Okinawa rail and Okinawa woodpecker, appear not only in the nominated areas (which are the main habitats for them) but also in the surrounding secondary forests and farmlands. Therefore, the secondary natural environment surrounding the nominated property will be managed as buffer zones. In the buffer zone, industrial activities will be carried out using sustainable methods so as to avoid direct impact on the nominated property, aiming to balance the conservation of the World Heritage property and residents' livelihood (see Chapter 5 for details).

3.1.d. Statement of authenticity

Not applicable because this nomination does not claim cultural values.

3.1.e. Protection and management requirements

The nominated property is appropriately managed based on relevant Acts and regulations. The area is designated as Special Protection Zone and Class I Special Zone of National Park of Amami Gunto National Park, Yambaru National Park, and Iriomote-Ishigaki National Park; and Presearvation Zones of Forest Ecosystem Reserve of Amami Gunto Forest Ecosystem Reserve and Iriomote Forest Ecosystem Reserve. In addition, it is designaged as National Wildlife Protection Area and Natural Monument Protectioin Area (Table 3-2) (See Chapter 5 for details). The nominated property is thereby protected by the highest-ranked strict protection measures in the Japanese system, and ensured of long-term appropriate protection. Moreover, most parts of the four region of the nominated property are national, prefectural or municipal lands owned and managed by a public body (national or local government). Although Amami Gunto National Park currently includes some private lands, these will gradually be transitioned to public ownership. The four islands containing the nominated property are inhabited by people, and the places for residents' lives and industrial activities are close to habitats for endemic species and rare species. To carefully protect the property and enable the coexistence with people's livelihoods, buffer zones were set up mainly in the Class II Special Zone of the National Park and Conservation and Utilization Zone of the Forest Ecosystem Reserve, adjacent to the nominated property.

Many of the endemic threatened species that inhabit the nominated property, including the Amami rabbit, Okinawa rail and Iriomote cat are designated as National Endangered Species of Wild Fauna and Flora or National Natural Monuments, and are subject to legal protection. In addition, monitoring is conducted as part of the protection and recovery program of the National Endangered Species and the program for controlling mongoose.

The nominated property is a serial property covered by multiple legal protection schemes. The administrative organs responsible for each scheme have established the "Regional Liaison Committee for Natural World Heritage Nominated Property". They are managing the nominated property in a consistent manner based on "Comprehensive Management Plan for Natural World Heritage Nominated Property." In addition, four sub-local meetings have been set up under the Regional Liaison Committee to effectively carry out conservation and management of the nominated property through collaboration and cooperation with the local stakeholders. The "Scientific Committee for World Heritage Nominated Property" comprised of academic experts and "Local Working Groups" have been established to provide scientific advice to the Regional Liaison Committee and promote adaptive conservation and management in light of scientific knowledge and insight (Figure 3-2).

Evergreen broadleaved forest, Northern part of Okinawa Island (Photo: MOEJ)

Table 3-2: Protection and safeguarding measures of the nominated property

	Designation for protection
Amami-Oshima Island	Amami Gunto National Park Mt. Yuwandake National Wildlife Protection Area Amami Gunto Forest Ecosystem Reserve Kamiya and Mt. Yuwandake Natural Monument
Tokunoshima Island	Amami Gunto National Park Amami Gunto Forest Ecosystem Reserve
Northern part of Okinawa Island	Yambaru National Park Yambaru National Wildlife Protection Area Mt. Yonahadake Natural Monument Protection Area
Iriomote Island	Iriomote-Ishigaki National Park Iriomote National Wildlife Protection Area Iriomote Forest Ecosystem Reserve Nakama River Natural Monument Protection Area Natural Monument: Ubundul *Satakentia liukiuensis* community

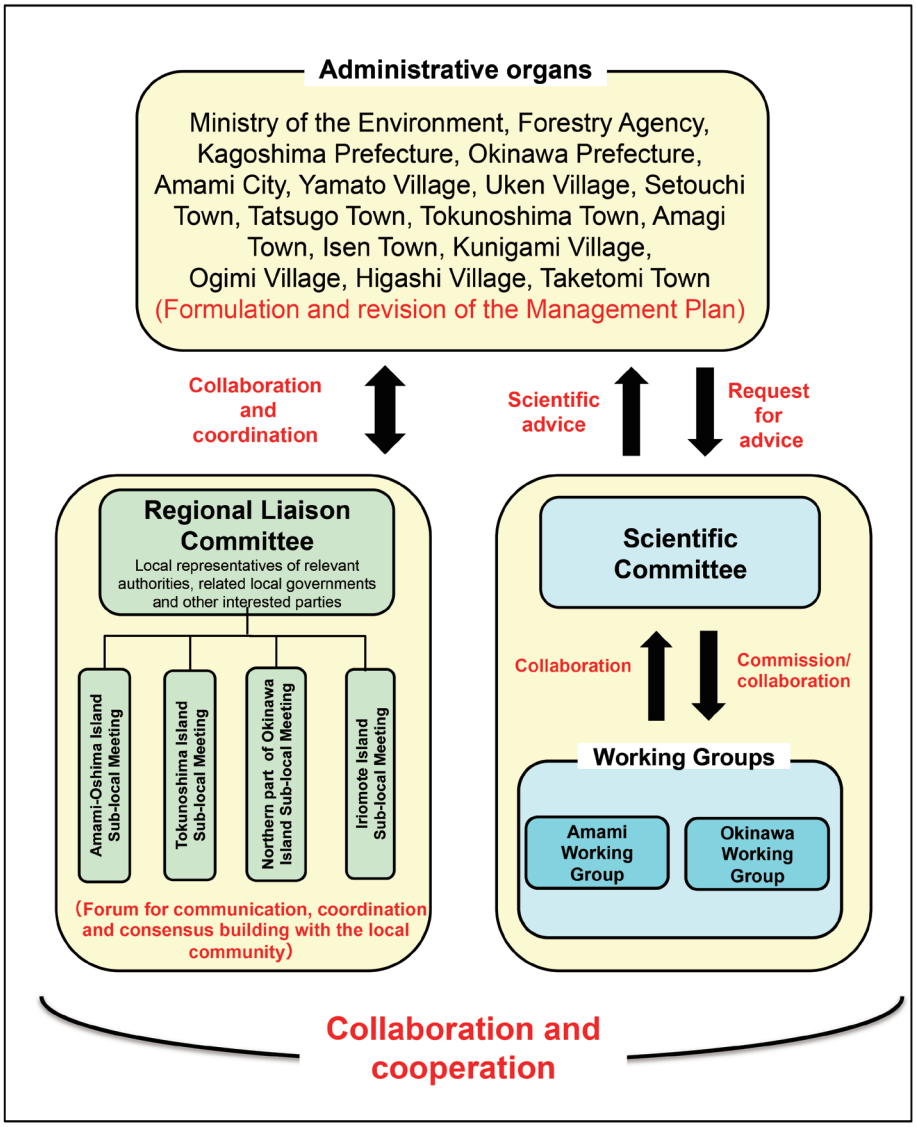

Figure 3-2: Management system of the nominated property

3.2. Comparative Analysis

A comparative analysis is conducted between the nominated property and existing World Heritage properties that are similar to the nominated property. Comparative properties are indicated in Figure 3-3.

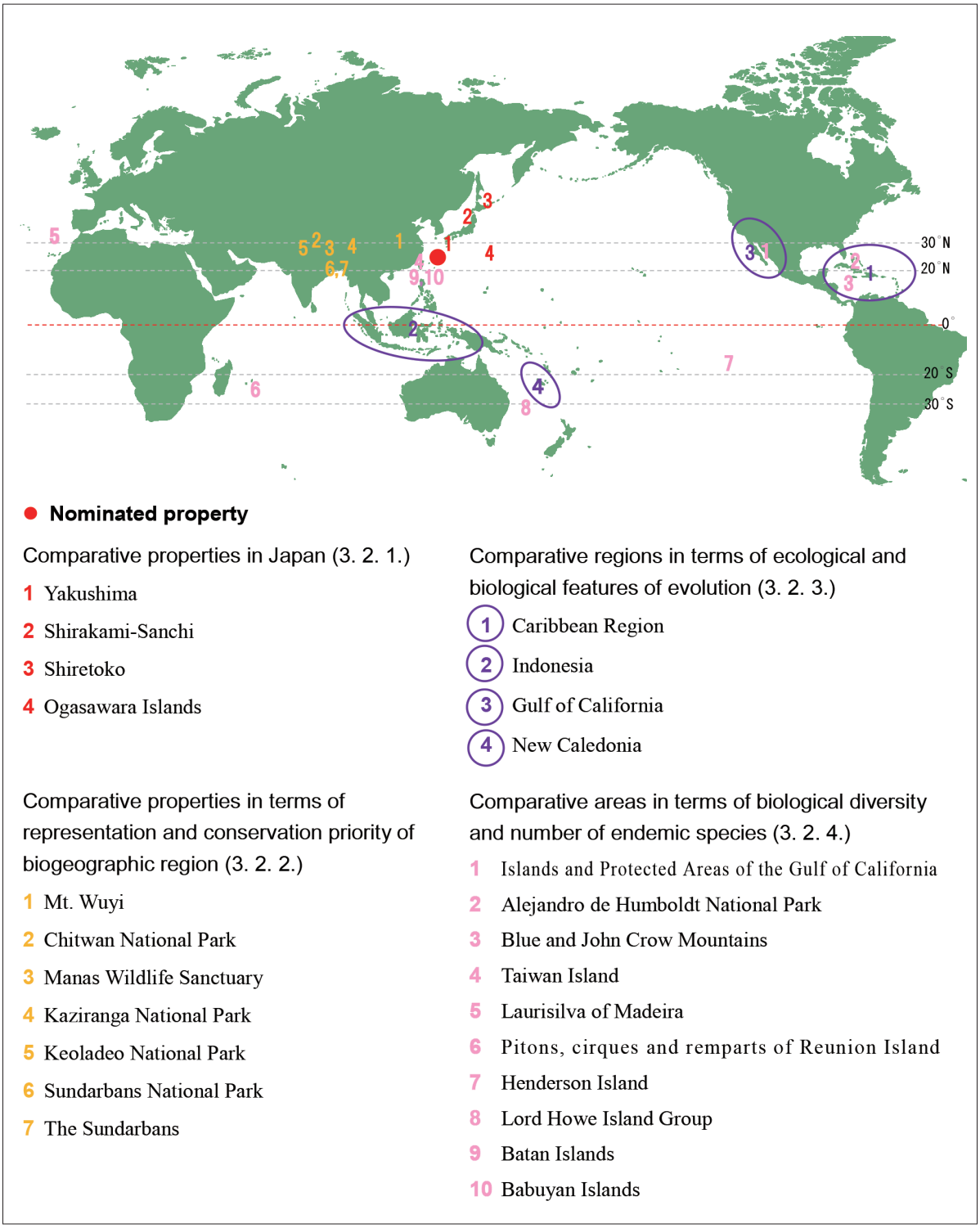

Figure 3-3: Distribution of comparative properties covered in the comparative analysis

3.2.1. Comparison within Japan

1) Yakushima

Among the islands of the Ryukyu Chain (including the nominated property), Yakushima (part of the North Ryukyus) is already inscribed on the World Heritage List under criteria (vii) and (ix). It is considered that, by the late Miocene (approximately 11.6 to 5.3 Ma), the biota of Yakushima Island had already been separated from that of the Central Ryukyus by the Tokara Strait which is over 1,000 m in depth (Okamoto 2017). On the other hand, the strait between Kyushu and Yakushima Island is only around 100 m deep, and it is thought that Yakushima Island became connected with mainland Kyushu during the last glacial period which occurred about 20 thousand years ago, when the sea surface declined by 120 to 140 m (Kaizuka and Naruse 1977; Tsukada 1983). Therefore, the biota of Yakushima Island has a strong relation with Kyushu and other parts of mainland Japan, and represents a subset of the biota of Kyushu. The terrestrial biota of the nominated property clearly differs from that of Yakushima Island in North Ryukyu divided by the Tokara Strait. From a regional biogeographic perspective, the Watase Line, which coincides with the Tokara Strait, has been proposed as a boundary between the Palearctic and Indomalayan zones for the distribution of mammals, reptiles, and amphibians (Tokuda 1969).

The Outstanding Universal Value of Yakushima lies in that a distinct vertical distribution pattern in the vegetation and biotic communities of the island (from the subtropical zone along the coast to the subarctic zone on the mountain tops) and in the stunning natural scenery dominated by huge and ancient specimens of Yakusugi (Japanese cedar, *Cryptomeria japonica*) which are several thousand years old. These biodiversity features and natural phenomena are quite different from the values of the nominated property.

According to the Udvardy's biogeographic classification system (1975) which was based on Numata (1969), the Amami Island Group and the Okinawa Island Group are classified as "Ryukyu Islands province of Palaearctic Realm, of the mixed island system biome" whereas Yakushima Island is classified under "Japanese evergreen forest province of Palaearctic Realm, biome of subtropical and temperate rain forests or woodlands (2.2.2)." This means that although they fall under the same realm, the province and biome are different. However, there are various theories concerning the biogeographic classification of the Amami and Okinawa Island Groups. The terrestrial vertebrate fauna of the Amami and Okinawa Island Groups are considered of southern origin (the Indomalayan Realm) suggesting that the biogeographic classification may also be different from that of Yakushima Island at the realm level (Ota 2009). Meanwhile, when categorizing the area based on the concept of terrestrial ecoregion (Olson et al. 2001), the entire Ryukyu Chain including Yakushima Island is classified in the Indomalayan Realm based on its flora (Miyawaki 1975).

2) Ogasawara Islands

The Ogasawara Islands, which are another island group in the subtropical region in Japan with a unique endemic biota and ecosystem, are also inscribed on the World Heritage List under criterion (ix). They are in a relatively dry subtropical island chain belonging to "Micronesia province of Oceanian Realm, biome of mixed island system (5.2.13)" according to the Udvardy's biogeographic classification (1975), differing in realm and province from the nominated property which has a different set of climatic conditions and ecosystems.

The Ogasawara Islands were inscribed on the basis of the Outstanding Universal Value of the process of biological evolution on oceanic islands, particularly the significant and ongoing ecological process of speciation through adaptive radiation in land snails and plants. While the nominated property is similar to the Ogasawara Islands in that it represents ongoing speciation processes on the islands, it differentiates itself from the Ogasawara Islands by excellent examples of speciation resulting from vicariance, with endemic species (both relict and new) reflecting the geological history of continental islands. Moreover, it represents ecological processes different from those of the Ogasawara Islands, particularly its high biological diversity due to its humid climate and its geological evolution as a group of continental islands.

3) Comparison of the number of species with other natural World Heritage sites in Japan

The nominated property is home to one of the largest number of species in Japan including endemic and endangered species (see Table 2-6). Comparing the number of resident species with the existing four Natural World Heritage properties, the nominated property has the second largest number of plant species next to Yakushima and terrestrial mammals next to Shiretoko, and the largest number of species of other taxonomic groups, demonstrating its biological diversity (Table 3-3).

Table 3-3: Comparison of the number of species inhabiting Natural Heritage properties in Japan

Name of property	Udvardy's biogeographic classification	Area (ha)	Criteria	Vascular plants	Terrestrial mammals	Birds	Reptiles	Amphibians	Inland water fish	Insects
Nominated property	2.41.31 4.27.13	37,946	(ix, x)	1,808	22	394	36	21	267	6,148
Yakushima	2.2.2	10,747	vii, ix	> 1,900	16	150	15	8	–	1,900
Shirakami-Sanchi	2.15.6	16,971	ix	> 500	14	84	7	9	–	> 2,000
Shiretoko	2.14.5	71,100	ix, x	817	35	264	7	3	42	2,500
Ogasawara Islands	5.2.13	7,939	ix	441	1	195	2	0	40	1,380

* Information on existing heritage properties is based on relevant nomination documents.

3.2.2. Biogeographical representativity and conservation priority

According to the biogeographic classification by Udvardy (1975), Amami-Oshima Island, Tokunoshima Island and the northern part of Okinawa Island are included in the "Ryukyu Islands Province of Palaearctic Realm, biome of mixed island system (2.41.13)" while Iriomote Island belongs to "Taiwan province of Indomalayan Realm, biome of mixed island system (4.27.13)." There are no inscribed World Heritage properties or properties included in the Tentative List in these provinces at present (Table 3-4).

Table 3-4: Biogeographic representativeness

	Nominated property	Existing World Heritage properties in the same region	Properties on the Tentative List assumed to be in the same region
Udvardy's biogeographic classification (province)	・Ryukyu Islands (2.41.13) ・Taiwan (4.27.13)	・None	・None
Terrestrial realm - system (Olson et al. 2001)	・Indo-Malayan Realm Tropical and subtropical moist broadleaved forests *	・Mt. Wuyi ・Chitwan National Park ・Manas Wildlife Sanctuary ・Kaziranga National Park ・Keoladeo National Park ・Sundarbans National Park ・The Sundarbans	
Terrestrial ecoregion (Olson et al. 2001)	・East Asia: Nansei-Shoto (Ryukyu) Islands in the south of Japan	・None	・None

* Since there are many existing World Heritage properties in this system, those properties in the same latitude region (at latitude 20°N to 30°N) listed under criteria (ix) and/or (x) are listed here.

According to a classification based on terrestrial ecoregion (Olson et al. 2001), the entire Ryukyu Chain is classified as a unique ecoregion named "Nansei Shoto" belonging to the Indo-Malayan Realm (Table 3-4). Areas classified as tropical and subtropical moist broadleaved forests of the Indo-Malayan Realm are distributed across India, Southeast Asia and China, but when narrowed down to the subtropical portion (latitude 20°N to 30°N), there are seven existing World Heritage properties listed under biodiversity criteria (ix) and/or (x) as listed in Table 3-4, all of which are located in the Eurasian Continent and none on islands.

When comparing the main vegetation and number of species components against these seven existing World Heritage properties, the nominated property shows the distinct characteristics of an island ecological system (Table 3-5). While subtropical moist evergreen broadleaved forests dominate Mt. Wuyi, similar to the nominated property, Mt. Wuyi is a continental inland site encompassing a wide area and difference of elevation with a large number of resident species inhabiting the area including large carnivores such as leopards. The other properties consist of semi-evergreen forests, a mixture of tropical/subtropical deciduous forests and grasslands and savannas, or mangrove wetlands, where large mammals like rhinoceros, tigers and elephants commonly inhabit. In contrast, the nominated property has an ecological system dominated by subtropical moist evergreen broadleaved forests mainly inhabited by small and medium-sized endemic mammals such as Amami Rabbit (*Pentalagus furnessi*), Ryukyu long-haired rat (*Diplothrix legata*) and genus *Tokudaia*, lacking any apex predator

carnivores other than the Iriomote cat (*Prionailurus bengalensis iriomotensis*) on Iriomote Island.

Table 3-5: Comparison of main vegetation and number of resident species against existing World Heritage properties in the same latitude in "tropical and subtropical moist broadleaved forests systems" of Indo-Malayan Realm*

Name of property	Nation	Area (ha)	Criteria	Main vegetation	Vascular plants	Terrestrial mammals	Birds	Terrestrial reptiles	Amphi-bians	Inland water fish	Insects
Nominated property	Japan	37,946	(ix, x)	Subtropical moist evergreen broadleaved forest	1,808	22	394	36	21	267	6,148
Mt. Wuyi	China	99,975	vii, x	Subtropical moist evergreen broadleaved forest	2,888	71	256	73	35	40	4,635
Chitwan National Park	Nepal	93,200	vii, ix, x	Subtropical deciduous forest, wet grassland	–	56	565	47	–	126	–
Manas Wildlife Sanctuary	India	39,100	vii, ix, x	Semi-evergreen forest, moist and dry mixed deciduous forest, wet grassland	513	55	450	50	3	–	–
Kaziranga National Park	India	42,996	ix, x	Wet grassland, savanna woodland, tropical moist deciduous forest, semi-evergreen mixed forest	–	35	> 300	–	–	–	–
Keoladeo National Park	India	2,873	x	Tropical dry deciduous forest, dry grassland and savanna	350	29	375	25	7	50	–
Sundarbans National Park	India	133,010	ix, x	Mangrove wetland	334	49	315	53	8	400	–
The Sundarbans	Bangladesh	139,500	ix, x	Mangrove wetland	334	49	315	53	8	400	–

* Source of vegetation and species information on existing heritage properties: UNEP-WCMC (2016) World Heritage Information Sheets. Sections marked "–" indicate that data on the number of resident species was not available.

The nominated property has also been selected among the Global 200 Ecoregions and Endemic Bird Areas as areas to be prioritized for global conservation (Table 3-6).

Ryukyu long-haired rat *(Diplothrix legata)*
(Photo: MOEJ)

Table 3-6: The nominated property and the global conservation priorities

Priority areas classification	Nominated property	Exisiting World Heritage properties in the same priority area	Properties on Tentative List assumed to be in the same priority area
Terrestrial hotspots	・Japan	・Yakushima ・Ogasawara Islands ・Shirakami-Sanchi ・Shiretoko	・None
High Biodiversity Wilderness Areas	Not applicable	–	–
The Global 200: Priority Ecoregions - Terrestrial Realm (Olson and Dinerstein 2002)	・32 Nansei Shoto Archipelago Forests	・Yakushima	・None
The Global 200: Priority Ecoregions - Freshwater Realm (Olson and Dinerstein 2002)	Not applicable	–	–
The Global 200: Priority Ecoregions - Marine Realm (Olson and Dinerstein 2002)	Not applicable (217 Nansei Shoto (Tropical Coral))	–	–
Global Priorities for Marine Biodiversity Conservation (Selig et al. 2014)	Not applicable (Japan (EEZ))	・(Shiretoko) ・(Ogasawara Islands)	–
EBA (Endemic Bird Areas of the World)	・148 Nansei Shoto	・Yakushima	・None
Centers of Plant Diversity	Not applicable	–	–

The nominated property have been identified as priority areas for conservation, including Alliance for Zero Extinction (AZE) sites and Important Bird Areas (IBA) (Table 3-7).

Table 3-7: The nominated property in the context of site-scale global conservation priorities

	Nominated property
AZE sites	Tokunoshima Island, Yambaru
KBAs other than AZE sites: IBA, etc.	IBA JP158 Amami islands IBA JP159 Yambaru, northern Okinawa forest IBA JP166 Yaeyama islands

3.2.3. Comparison of ecological and biological features of evolution

Comparison was also tried between the nominated property and other regions of the world representing ongoing speciation processes reflecting the geological history of islands. Other such regions of the world are considered to be the Caribbean Region, Indonesia, Gulf of California and New Caledonia.

1) Caribbean Region

The Caribbean Islands are an arc of continental islands formed on the boundaries of three tectonic plates, the North American Plate, Caribbean Plate and South American Plate. The region has a unique ecological system and rich biodiversity that evolved in association with the geological formation process of the islands. Particularly, reptiles and amphibians inhabiting these islands are highly specific to the region, with 494 (95%) out of 520 reptile species and all of 189 amphibian species being endemic to the islands, indicating a large scale example of adaptive radiation (Critical Ecosystem Partnership Fund 2010). While the above described characteristics of the

Caribbean Islands are very much similar to the biological invasion, isolation and speciation processes of continental islands claimed for the nominated property, there is ongoing academic debate about the relation between the formation of the island arc and biological invasion and isolation of the Caribbean Islands, because new findings have been reported that suggest the possibility of dispersed distribution that may have occurred across the sea in a more recent period (middle Eocene (37–49 Ma) or later) than can be inferred from geological history (Heinicke et. al. 2007; Ricklefs and Bermingham 2008).

On the other hand, the nominated property can be characterized by a simpler and well-studied model of geological formation and biological evolution, given the north-south linear alignment of the island arc and the Kuroshio Current that ensures the surrounding waters flow in the same direction. Therefore the nominated property can present the geological formation and biological evolution of an island arc in a scientific and specific way.

Existing World Heritage properties in the Caribbean Region inscribed under criterion (ix) include Alejandro de Humboldt National Park (Cuba, criteria (ix) and (x)). This property was inscribed for its size, altitude range, landform diversity, and complex lithology that gave rise to its diverse ecosystems and biodiversity. It provided a safe haven for flora and fauna of the Caribbean Region during the glacial age from Miocene to Pleistocene and served as the center of the subsequent biological distribution and evolution. The site is considered as an area showing one of the world's highest plant endemism richness, with more than 70% of the flora endemic to the area. One of the factors behind this high endemism rate is the unique ongoing adaptive evolution of plant species and plant associations. Many of the underlying rocks are toxic to plants, so species have had to adapt to survive in these hostile conditions (UNEP-WCMC 2012). However, this is a different evolutionary process from the endemism and speciation of species associated with the geological island formation claimed for the nominated property.

Of the three Caribbean properties listed on the Tentative List of the World Heritage claiming for criterion (ix), Tobago Main Ridge Forest Reserve (Trinidad and Tobago) suggests as its outstanding universal value, endemism associated with the geological history of the island. First born as a volcanic island, Tobago was once joined to the South American continent and separated from it some one million years ago, more recently than the nominated property. The other nominated properties consist of mangrove wetlands and coastal ecosystems. They do not present their Outstanding Universal Value as the ecological process of speciation that occurred in association with isolation from the continent and the process of repeated separation and joining of the islands which yielded many endemic species including relict ones as in the case of the nominated property.

2) Indonesia

Indonesia is comprised of numerous islands spreading 5,000 km east to west in the tropical region of Southeast Asia and Oceania, and is rich in biodiversity. Its biota has been formed through the process of isolation and speciation associated with geological interaction between continents and nearby islands. Many of Indonesia's islands were joined to the continent during the Pleistocene glacial period, meaning that its history of geographic isolation and speciation is relatively young. In western Indonesia, Sumatra, Java, Borneo and other islands located on the Sunda Continental Shelf used to be connected to the Malay Peninsula, thereby having a biota common to the Eurasian Continent. Likewise, New Guinea Island in eastern Indonesia, located on Sahul

Continental Shelf, was connected to Australia while the sea levels fell in the glacial period, allowing it to share a common biota with Australia. Sulawesi and Lesser Sunda Islands in central Indonesia were the only islands that stayed isolated even during the glacial period, because they are not located on any continental shelf.

Currently, there are four existing natural World Heritage properties in Indonesia, and the Tropical Rainforest Heritage of Sumatra and Lorentz National Park are the ones inscribed under criterion (ix).

Of these two, the Tropical Rainforest Heritage of Sumatra is a serial property comprising three national parks on Sumatra Island inscribed under criteria (vii), (ix) and (x). It is highly valued for its critical importance for the conservation of lowland and montane tropical rainforests rich in endemic species and biodiversity. One factor that gave rise to the highly endemic biota of this area is said to have been the process of formation of land bridges and barriers between Sumatra and the Eurasian Continent due to changes in sea level during the Pleistocene glacial period. In the case of the nominated property, the separation from the continent due to plate movements occurred from late Miocene to Pliocene in the Tertiary Period, and the isolation of the site's biota happened much earlier than Sumatra and followed a different process.

Lorentz National Park is located in western New Guinea Island. It includes a glacier-covered mountain range nearly 5,000 m high, formed by tectonic plate collision. The flora and fauna of the high altitude area are highly endemic. These endemic species, such as the ancient plants of Gondwanaland (e.g., Nothofagaceae), were isolated in the high altitude area of the tropics as refugia during the warmer interglacial periods that occurred intermittently until the most recent glacial period. Their isolation were also affected by the ongoing orogenic movements. This represents a different process from that of the nominated property.

3) Gulf of California

Like the nominated property, the Islands and Protected Areas of the Gulf of California (Mexico, criteria (vii), (ix) and (x)) is located in the subtropical latitude zone and is a serial property comprising over 200 islands in nine protected area clusters. The Outstanding Universal Value of this property lies in that it contains ecologically distinct "bridge islands," populated across past land bridges created during the Pleistocene glacial period when sea levels were low, and "oceanic islands" populated by sea and air.This represents a different evolutionary and ecological process from the endemism and speciation of species associated with the continental island formation claimed for the nominated property. In addition, the depth and distance of the sea that lies between the islands of the Gulf of California and the North American Continent is shallow and short. The bridge islands were populated across land bridges mainly during the Pleistocene glacial period when sea levels were low, meaning that its history of isolation of species on the islands started some 150 thousand years ago, relatively recent in age. The islands experienced waves of invasion by predators and competing species while the land bridges were formed, so the ancient lineages of species could not persist to form endemic species. In addition, the climate of the area falls under the desert type, largely different from the humid rainforests of the nominated property.

4) New Caledonia

The Lagoons of New Caledonia: Reef Diversity and Associated Ecosystems (France, criteria (vii), (ix) and (x)) feature an exceptional diversity of coral and fish species and a continuum of habitats from mangroves to seagrasses with the world's most diverse concentration of reef structures. The lagoons display intact ecosystems, with healthy populations of large predators, and a great number and diversity of big fish. They provide habitat to a number of emblematic or threatened marine species such as turtles, whales or dugongs whose population here is the third largest in the world. Their outstanding universal values as described above are all related to the coastal and sea areas, whereas the outstanding universal values of the nominated property are based on the terrestrial ecosystems and biological evolutionary processes.

Taking a look at the genesis of the Islands of New Caledonia and their terrestrial biota, they were formed from part of the Gondwanaland that separated 80 Ma. They have never become connected with a continent ever since. Therefore the terrestrial biota of the islands is of extremely old origin and has been formed through a very unique and isolated path of biological evolution, resulting in numerous examples of endemic and endangered species. However, no native mammals or amphibians inhabit the Islands of New Caledonia except bats that can fly as in the case of oceanic islands, and geological studies suggest the possibility that the islands may have submerged under sea level multiple times and for extended periods of time in the past (Trewick et al. 2007). Moreover, molecular phylogenetic studies of several taxonomic groups (reptiles, beetles, etc.) suggest that the speciation of those species occurred rather recently (Grandcolas et al. 2008). Based on these findings, it has been proposed that the Islands of New Caledonia should be considered as extremely old "Darwinian islands" (Gillespie et al. 2002), for although they were initially formed from "pieces" of Gondwanaland 80 Ma, their terrestrial biota started to form all over again following submersion 37 Ma (Grandcolas et al. 2008). This represents a different evolutionary and ecological process from the endemism and speciation of species associated with continental island formations claimed for the nominated property.

Okinawa tip-nosed frog (*Odorrana narina*)
(Photo: MOEJ)

3.2.4. Comparison of biodiversity

There are 49 existing island World Heritages properties, 31 of which fall under Biome 13 (mixed island system) and 18 belong to other types of biomes based on Udvardy's biogeographic classification (1975). Of these 49, there are 23 properties that have been inscribed under criterion (x) for their terrestrial biodiversity. Among these 23 properties, seven are located in the zone between latitudes 20 and 30, roughly corresponding to the subtropical region in which the nominated property is located. Thsese incude: Islands and Protected Areas of the Gulf of California (Mexico); Alejandro de Humboldt National Park (Cuba); Blue and John Crow Mountains (Jamaica); Laurisilva of Madeira (Portugal); Pitons, cirques and remparts of Reunion Island (France); Henderson Island (United Kingdom of Great Britain and Northern Ireland); and Lord Howe Island Group (Australia). In addition to these seven World Heritage properties, some other islands in the neighboring areas of the nominated property were included in the comparison analysis: Taiwan Island (continental island); Batan Islands (oceanic islands of Philippines, included in the Tentative List in 1993); and Babuyan Islands (oceanic islands of Philippines). Table 3-8 shows the respective area, island type, and number of resident species of the nominated property and comparison properties. The number of resident species of each island represents the number of terrestrial native species (to the best possible extent) based on source literature. However, comparison could not be performed for some areas and taxonomic groups because detailed information was not available.

As Table 3-8 shows, the nominated property consisting of continental islands has a greater number of resident species in all taxonomic groups compared to oceanic islands inscribed on the World Heritage List in the same latitude zone (4 sites, i.e. Laurisilva of Madeira; Pitons, cirques and remparts of Reunion Island; Henderson Island; and Lord Howe Island Group) and neighboring oceanic islands chosen for comparison (2 sites, i.e. Batan Islands; and Babuyan Islands). Therefore the following detailed comparison focused on the three areas (i.e. Islands and Protected Areas of the Gulf of California; Alejandro de Humboldt National Park; and Blue and John Crow Mountainsas continental island groups) inscribed on the World Heritage List in the same latitude zone and a neighboring continental island (one site, i.e. Taiwan Island). The comparison was made in vascular plants, terrestrial mammals, birds, terrestrial reptiles and amphibians for which information on the number of resident species, endemic species and rate of endemic species is available.

Barbour's blue-tailed skink (*Plestiodon barbouri*)
(Photo: MOEJ)

Table 3-8: Comparison of biodiversity among nominated property, existing World Heritage properties and neighboring island areas[*1]

Name of property	Country	Land area[*2] (ha)	Criteria[*3]	Latitude	Island type[*4]	Vascular plants	Terrestrial mammals	Birds[*5]	Terrestrial reptiles	Amphi-bians	Source
Nominated property	Japan	37,946	(ix, x)	N24°-28°	C	1,808[*6]	22	394	36	21	1)
Islands and Protected Areas of the Gulf of California	Mexico	382,841	vii, ix, x	N27°	C, O	695	45	154	115	–	1), 2)
Alejandro de Humboldt National Park	Cuba	68,572	ix, x	N20°	C	1,447	10	95	45	21	2)
Blue and John Crow Mountains	Jamaica	26,252	x	N18°	C	1,620	10	101	20	13	1), 2)
Taiwan Island	Taiwan	3,598,000	–	N23°	C	4,077	78	534	89	37	3), 4), 5), 6)
Laurisilva of Madeira	Portugal	15,000	ix, x	N32°	O	150	2	43	1	–	2)
Pitons, cirques and remparts of Reunion Island	France	105,838	vii, x	S21°	O	840	5	78	6	–	2)
Henderson Island	UK	3,700	vii, x	S24°	O	71	0	23	4	–	2)
Lord Howe Island Group	Australia	1,540	vii, x	S31°	O	241	1	168	2	–	2),7)
Batan Islands	Philippines	23,347	–	N20°	O	–	10	60	16	1	8), 9), 10)
Babuyan Islands	Philippines	58,200	–	N19°	O	–	13	126	44	4	8), 9), 11)

*1: The number of resident species represents the number of terrestrial native species (to the best possible extent). "–" indicates that data on the number of resident species was not available.
*2: "Land area" represents land area of the specified site for nominated property and existing World Heritage properties, and land area of the entire islands for Taiwan, Batan and Babuyan Islands.
*3: Only the criteria for natural values are indicated for mixed World Heritage sites.
*4: C: Continental island, O: Oceanic island
*5: Number of identified species (including vagrants)
*6: Includes subspecies, variant species and crossbred species
1) Annexes of respective nomination documents, 2) UNEP-WCMC 2016, 3) Peng and Ynag 2008, 4) Lin 2008,
5) Yan 2008, 6) Lue et al. 2008, 7) Australian Government 2007, 8) Heaney et al. 2010,
9) Oliveros et al. 2011, 10) Gonzalez et al. 2008, 11) Brooke et al. 2004.

1) Vascular plants

Table 3-9 shows the number of resident species, endemic species, and rate of endemic species of vascular plants of the four areas for comparison. The nominated property has 1,808 vascular plant species of which 185 are endemic (endemic rate of 10%). Taiwan Island has 4,077 species, outstanding from the rest of sites compared. This is considered because the land area and altitudinal range are remarkably larger than the other sites compared. When comparing the nominated property with the three existing World Heritage properties, the nominated property has the largest number of resident vascular plant species. As for the rate of endemic species, Alejandro de Humboldt National Park of Cuba stands out at 63%, as it is known to have one of the highest endemic rate of vascular plants in the world. The rate of endemic vascular plant species of the nominated property is lower compared to Blue and John Crow Mountains and Taiwan Island at 20% and 26% respectively. This is because the flora of the nominated property is diverse in origin reflecting the geological history, past climate changes, and geographical arrangement of the islands and Kuroshio current as mentioned in Chapter 2. a. 2. 1. However, when compared to the Islands and Protected Areas of the Gulf of California, where species have become established through both continental and oceanic island processes as with the nominated property, it has a higher number of resident species, number of endemic species, and endemic rate (2.6 times for the number of resident species and endemic rate, 6 times or above for number of endemic species).

Table 3-9: Comparison of vascular plant species diversity among nominated property, existing World Heritage properties and neighboring island areas *1

	Nation	Land area (ha) *2	Altitude (m)*3	Criteria*4	Vascular plant species	Endemic species	Endemic rate	Source
Nominated property (total of four regions)	Japan	37,946	0 – 694	(ix, x)	1,808*5	185*5	10%	1)
Amami-Oshima Island	–	11,544	0 – 694	–	1,306*5	124*5	9%	1)
Tokunoshima Island	–	2,434	60 – 645	–	956*5	79*5	8%	1)
Northern part of Okinawa Island	–	5,133	100 – 503	–	1,029*5	71*5	7%	1)
Iriomote Island	–	18,835	0 – 470	–	1,162*5	58*5	5%	1)
Islands and Protected Areas of the Gulf of California	Mexico	382,841	0 – 990	vii, ix, x	695	28*5	4%	1), 2)
Alejandro de Humboldt National Park	Cuba	68,572	220 – 1,168	ix, x	1,447	905	63%	2)
Blue and John Crow Mountains	Jamaica	26,252	850 – 2,250	iii, vi, x	1,620	316	20%	1), 2)
Taiwan Island	Taiwan	3,598,000	0 – 3,952	–	4,077	1,067	26%	3)

*1: The number of resident species represents the number of terrestrial native species to the best possible extent.
*2: "Land area" represents land area of the specified site for nominated property and existing World Heritage properties, and land area of the entire island for Taiwan.
*3: The lowest-highest altitudes for nominated property and existing World Heritage properties, and coastal line-highest altitude for Taiwan.
*4: Only the criteria for natural values are indicated for Mixed Cultural and Natural Heritage sites.
*5: Includes subspecies, variant species and hybrid species.
1) Appendices of respective nomination documents, 2) UNEP-WCMC 2016, 3) Peng and Yang 2008.

2) Mammals

Table 3-10 shows the number of resident species, endemic species, and rate of endemic species of terrestrial mammals of the four areas for comparison. The nominated property has 22 terrestrial mammal species of which 13 are endemic (endemic rate of 59%). Taiwan Island and the Islands and Protected Areas of the Gulf of California have a large number of terrestrial mammal species as their land areas are much larger than the other sites compared, but have a low rate of endemic species at 27% and 7% respectively. This is thought to be because many mammal species migrated from the continent to these islands via land bridges during the last glacial period when the sea level declined. Both Alejandro de Humboldt National Park and Blue and John Crow Mountains have 10 mammal species and an endemic rate of 30%. The nominated property has about twice as much terrestrial mammal species and endemic rate compared to these two existing World Heritage properties.

Table 3-10: Comparison of terrestrial mammal diversity among nominated property, existing World Heritage properties and neighboring island areas *1

	Nation	Land area (ha) *2	Altitude (m)*3	Criteria*4	Terrestrial mammal species*5	Endemic species	Endemic rate	Source
Nominated property (total of four regions)	Japan	37,946	0 – 694	(ix, x)	22	13	59%	1)
Amami-Oshima Island	–	11,544	0 – 694	–	14	8	57%	1)
Tokunoshima Island	–	2,434	60 – 645	–	13	8	62%	1)
Northern part of Okinawa Island	–	5,133	100 – 503	–	12	7	58%	1)
Iriomote Island	–	18,835	0 – 470	–	8	3	38%	1)
Islands and Protected Areas of the Gulf of California	Mexico	382,841	0 – 990	vii, ix, x	45	3	7%	1), 2)
Alejandro de Humboldt National Park	Cuba	68,572	220 – 1,168	ix, x	10	3*6	30%	2)
Blue and John Crow Mountains	Jamaica	26,252	850 – 2,250	iii, vi, x	10	3	30%	1), 2)
Taiwan Island	Taiwan	3,598,000	0 – 3,952	–	78	21	27%	3)

*1: The number of resident species represents the number of terrestrial native species to the best possible extent.
*2: "Land area" represents land area of the specified site for nominated property and existing World Heritage properties, and land area of the entire island for Taiwan.
*3: The lowest-highest altitudes for nominated property and existing World Heritage properties, and coastal line-highest altitude for Taiwan.
*4: Only the criteria for natural values are indicated for Mixed Cultural and Natural Heritage sites.
*5: The original literature only gave the rate of endemic species. The number of endemic species was calculated from the number of resident species and the rate of endemic species.
1) Appendices of respective nomination documents, 2) UNEP-WCMC 2016, 3) Lin et al. 2008.

3) Birds

Table 3-11 shows the numbers of recorded species, resident species, endemic species and rate of endemic species of birds of the four areas for comparison. 394 bird species have been identified in the nominated property, of which 49 are resident bird species and four are endemic species (endemic rate of 8%). Taiwan has a large number of both recorded and endemic species. This is considered because the land area and altitudinal range are remarkably larger than the other sites compared. Regarding the rate of endemic species, however, the nominated property and Taiwan are roughly the same level at 8% and 9% respectively. This is probably because the two sites both have a high rate of migratory birds and vagrants in the bird fauna, given that they are both located on the same bird migratory pathways and typhoon routes.

The other three sites compared have a rather high rate of endemic species with Blue and John Crow Mountains at the highest at 56% (32 species), followed by Islands and Protected Areas of the Gulf of California at 25% (12 species) and Alejandro de Humboldt National Park at 21% (20 species). The number of recorded species, however, is as low as between one fourth (95 species) to half (181 species) of that of the nominated property (394 species) whereas the number of resident species is roughly at the same level. Thus it can be concluded that the rate of migratory birds in the bird fauna is relatively low in these existing World Heritage properties, meaning that the bird fauna of these sites is different from that of the nominated property in terms of the life history (migratory or not) of the birds.

Table 3-11: Comparison of bird species diversity among nominated property, existing World Heritage properties and neighboring island areas [*1]

	Nation	Land area (ha) [*2]	Altitude (m)[*3]	Criteria[*4]	Recorded bird species	Resident species	Endemic species	Endemic rate[*5]	Source
Nominated property (total of four regions)	Japan	37,946	0 – 694	(ix, x)	394	49	4	8%	1)
Amami-Oshima Island	–	11,544	0 – 694	–	315	42	2	5%	1)
Tokunoshima Island	–	2,434	0 – 645	–	196	38	1	3%	1)
Northern part of Okinawa Island	–	5,133	0 – 503	–	195	38	3	8%	1)
Iriomote Island	–	18,835	0 – 470	–	312	44	0	0%	1)
Islands and Protected Areas of the Gulf of California	Mexico	382,841	0 – 990	vii, ix, x	181	48	12	25%	1), 2)
Alejandro de Humboldt National Park	Cuba	68,572	220 – 1,168	ix, x	95	–	20[*6]	21%	2)
Blue and John Crow Mountains	Jamaica	26,252	850 – 2,250	iii, vi, x	100	57	32	56%	1), 2)
Taiwan Island	Taiwan	3,598,000	0 – 3,952	–	534	156	14	9%	3)

*1: The number of resident species represents the number of terrestrial native species to the best possible extent.
*2: "Land area" represents land area of the specified site for nominated property and existing World Heritage properties, and land area of the entire island for Taiwan.
*3: The lowest-highest altitudes for nominated property and existing World Heritage properties, and coastal line-highest altitude for Taiwan.
*4: Only the criteria for natural values are indicated for Mixed Cultural and Natural Heritage sites.
*5: The rate of endemic species was calculated against resident birds that stay in the area all year long.
*6: The original literature only gave the rate of endemic species. The number of endemic species was calculated from the number of resident species and the rate of endemic species
1) Appendices of respective nomination documents, 2) UNEP-WCMC 2016, 3) Yan et al. 2008.

4) Terrestrial reptiles

Table 3-12 shows the number of recorded species, endemic species, and rate of endemic species of terrestrial reptiles of the four areas for comparison. The nominated property has 36 terrestrial reptiles of which 23 are endemic (endemic rate of 64%). Taiwan and the Islands and Protected Areas of the Gulf of California have the first and second largest land area among the sites compared and large numbers of reptile species accordingly, but have a low rate of endemic species (89 species, 24% and 115 species, 42% respectively). This is thought to be because many reptile species migrated from the continent to these islands via land bridges during the last glacial period when the sea level declined.

Alejandro de Humboldt National Park and Blue and John Crow Mountains in the Caribbean Region have roughly the same level of reptile species as the nominated property (36 species) at 45 and 20 species respectively, but their rate of endemic species is higher than that of the nominated property (64%) at 90% and 83%, reflecting the length of history since isolation of the fauna. In comparison, one of the characteristics of the nominated property is that it clearly represents ongoing speciation processes taking place on the islands, demonstrated by the high rate of endemic species of 87% (as high as the endemic rate of the Caribbean sites), when endemic subspecies are included in the count.

Table 3-12: Comparison of terrestrial reptile diversity among nominated property, existing World Heritage properties and neighboring island areas [*1]

	Nation	Land area (ha) [*2]	Altitude (m)[*3]	Criteria[*4]	Terrestrial reptile species	Endemic species	Endemic rate	Source
Nominated property (total of four regions)	Japan	37,946	0 – 694	(ix, x)	36 (38)[*5]	23 (33)[*5]	64% (87%)[*5]	1)
Amami-Oshima Island	–	11,544	0 – 694	–	16	10	63%	1)
Tokunoshima Island	–	2,434	60 – 645	–	17	11	65%	1)
Northern part of Okinawa Island	–	5,133	100 – 503	–	18	13	72%	1)
Iriomote Island	–	18,835	0 – 470	–	19	8	42%	1)
Islands and Protected Areas of the Gulf of California	Mexico	382,841	0 – 990	vii, ix, x	115	48	42%	1), 2)
Alejandro de Humboldt National Park	Cuba	68,572	220 – 1,168	ix, x	45	37[*6]	83%	2)
Blue and John Crow Mountains	Jamaica	26,252	850 – 2,250	iii, vi, x	20	18	90%	1), 2)
Taiwan Island	Taiwan	3,598,000	0 – 3,952	–	89	21	24%	3)

*1: The number of resident species represents the number of terrestrial native species to the best possible extent.
*2: "Land area" represents land area of the specified site for nominated property and existing World Heritage properties, and land area of the entire island for Taiwan.
*3: The lowest-highest altitudes for nominated property and existing World Heritage properties, and coastal line-highest altitude for Taiwan.
*4: Only the criteria for natural values are indicated for Mixed Cultural and Natural Heritage sites.
*5: Figures in parentheses indicate the number/rate of species including endemic subspecies.
*6: The original literature only gave the rate of endemic species. The number of endemic species was calculated from the number of resident species and the rate of endemic species.
1) Appendices of respective nomination documents, 2) UNEP-WCMC 2016, 3) Lue et al. 2008.

5) Amphibians

Table 3-13 shows the number of recorded species, endemic species, and rate of endemic species of amphibians of the four area for comparison. The nominated property has 21 amphibian species of which 18 are endemic (endemic rate of 86%). Taiwan has by far the largest land area among the sites compared and a large number of amphibians accordingly, but has a low rate of endemic species (89 species, 21%). This is thought to be the same reason as reptiles.

Alejandro de Humboldt National Park and Blue and John Crow Mountains in the Caribbean Region have roughly the same level of amphibian species as the nominated property (21 species) at 21 and 13 species respectively, but their rate of endemic species is higher than the nominated property (86%) at 96% and 92%, reflecting the length of history since isolation of the fauna. When looking at the endemic rate of individual islands including the nominated property, the endemic rates for Amami-Oshima Island and the northern part of Okinawa Island are approximately 90%, almost as high as the Caribbean sites. This reflects the fact that the nominated property is a serial property comprised of two distinct parts: the Central Ryukyus (Amami-Oshima Island, Tokunoshima Island and the northern part of Okinawa Island) with a long history of isolation from the continent and rest of Japan and high endemism; and the South Ryukyus (Iriomote Island) that have a relatively recent history of separation from the continent and Taiwan with subspecies and related species distributed in Taiwan and the continent.

Although information on the specific number of resident and endemic amphibian species could not be obtained for the Islands and Protected Areas of the Gulf of California, it is assumed that amphibians are very few in this site because it belongs to dry desert climate.

Table 3-13: Comparison of amphibian diversity among nominated property, existing World Heritage properties and neighboring island areas [*1]

	Nation	Land area (ha) [*2]	Altitude (m)[*3]	Criteria[*4]	Amphibian species	Endemic species	Endemic rate	Source
Nominated property (total of four regions)	Japan	37,946	0 – 694	(ix, x)	21	18	86%	1)
Amami-Oshima Island	–	11,544	0 – 694	–	10	9	90%	1)
Tokunoshima Island	–	2,434	60 – 645	–	7	6	86%	1)
Northern part of Okinawa Island	–	5,133	100 – 503	–	11	10	91%	1)
Iriomote Island	–	18,835	0 – 470	–	8	5	63%	1)
Islands and Protected Areas of the Gulf of California	Mexico	382,841	0 – 990	vii, ix, x	–	–	–	1), 2)
Alejandro de Humboldt National Park	Cuba	68,572	220 – 1,168	ix, x	21	20[*5]	96%	2)
Blue and John Crow Mountains	Jamaica	26,252	850 – 2,250	iii, vi, x	13	12	92%	1), 2)
Taiwan Island	Taiwan	3,598,000	0 – 3,952	–	89	21	24%	3)

*1: The number of resident species represents the number of terrestrial native species to the best possible extent.
*2: "Land area" represents land area of the specified site for nominated property and existing World Heritage properties, and land area of the entire island for Taiwan.
*3: The lowest-highest altitudes for nominated property and existing World Heritage properties, and coastal line-highest altitude for Taiwan.
*4: Only the criteria for natural values are indicated for Mixed Cultural and Natural Heritage sites.
*5: The original literature only gave the rate of endemic species. The number of endemic species was calculated from the number of resident species and the rate of endemic species.
1) Appendices of respective nomination documents, 2) UNEP-WCMC 2016, 3) Lue et al. 2008.

3.3. Proposed Statement of Outstanding Universal Value

a) Brief synthesis

Belonging to the Ryukyu Chain located at the south end of the Japanese Archipelago, the nominated property has a land area of 37,946 ha comprised of four regions: Amami-Oshima Island, Tokunoshima Island and the northern part of Okinawa Island in the Central Ryukyus; and Iriomote Island in the South Ryukyus. Influenced by the Kuroshio Current and subtropical high-pressure, the nominated property is in warm, humid subtropical climate and covered mainly with evergreen broadleaved rainforests.

The Ryukyu Chain is believed to have been formed through the formation and expansion of the Okinawa Trough and associated tectonic uplift and subsidence caused by subduction of the Philippine Sea plate beneath the Eurasian plate that had occurred since the middle Miocene of the Neogene. The Ryukyu Chain was then divided into the North Ryukyus, the Central Ryukyus and the South Ryukyus by deep straits lying between islands. Then since the early Pleistocene of the Quaternary, changes repeated the process of separation and unification of neighboring islands.

This geological history created opportunities for speciation and endemism for non-flying terrestrial creatures in the Central and South Ryukyus. Also, the Central and South Ryukyus have differences in their patterns of speciation and endemism in the terrestrial biota because of differences in the distance from the continent and the timing of separation. The nominated property comprises representative four regions of the Central and South Ryukyus which are home to especially large number of endemic species and subspecies of various organisms. By examining them collectively, we can understand the ongoing processes of speciation and diversification of evolutionary lineages that reflect the geological history of the entire Ryukyu Chain.

The nominated property is also an irreplaceable habitat for at least 1,808 vascular plant species, 740 terrestrial and freshwater vertebrate species, 6,148 insect species, 47 freshwater decapod species, and 88 threatened species listed on the IUCN Red List.

As such, the nominated property is a good example of the ongoing process of speciation and endemism that reflects its formative history as a continental island involving long-period isolation. It also has an invaluable natural environment, including habitats for various endemic species and threatened species of international significance.

b) Justification for criteria

Criterion (ix)

As part of the Eurasian Continent, the Central and South Ryukyus containing the nominated property used to share the same continental terrestrial biota. Thereafter, in the process of separation from the continent driven by the formation of the Okinawa Trough and two deep straits and in the repeated process of separation and unification of islands affected by sea-level changes, the nominated property has given rise to speciation and endemism in various evolutionary lineages.

In the Central Ryukyus, which were separated from the continent around the late Miocene of the Neogene, many relict endemic species, whose related species cannot be found in the neighboring regions, still survive on the islands. The South Ryukyus, which separated from Taiwan and the continent during the Pliocene, have endemic species and subspecies with their related species distributed in Taiwan and the continent. Those processes are particularly evident in plants and non-flying terrestrial vertebrates that cannot easily cross the ocean gaps. Various patterns of endemism and each stage of speciation on the continental islands can be seen in the area.

The nominated property comprises four regions that characterize the Central and South Ryukyus, and is an outstanding example clearly representing distinctive, ongoing processes of speciation and diversification of evolutionary lineages on the continental islands that reflect the geological history of the entire Ryukyu Chain. It can be deemed as one of the best natural laboratory in the world for studying the relation of the formation history of continental islands and biological evolution processes.

Criterion (x)

The nominated property is a crucial area from the viewpoint of biodiversity conservation, as it constitutes an irreplaceable habitat for threatened and endemic species that are of global importantance. There are 88 threatened species listed on the IUCN Red List, and 70 of these are endemic to Central and South Ryukyus.

Reflecting its geological history, the nominated property shows diverse examples of relict and new endemic species. Among others, five mammal species, three bird species, and three amphibian species have been identified as Evolutionarily Distinct and Globally Endangered (EDGE) species.

One example of the EDGE species is the Amami rabbit (*Pentalagus furnessi*) in Amami-Oshima Island and Tokunoshima Island, it comprises a genus by itself with no other related species. The Okinawa rail (*Gallirallus okinawae*) in the northern part of Okinawa Island is one of the non-flying species of the rail family on an island, which is known to be prone to extinction. *Tokudaia* is an endemic genus of spiny rats, with three species endemic to each of the three regions in the Central Ryukyus. Iriomote cat (*Prionailurus bengalensis iriomotensis*) only inhabits Iriomote Island, the world's smallest island inhabited by wildcats.

Further, the nominated property has high levels of diversity within its vascular plants and insects. On each of the four regions containing the nominated property, there are 950 to 1,300 species of vascular plants; these represent about 20 % of threatened vascular plant species of Japan. There are also more than 1,000 to 3,000 insect species; these represent about 10 % of the threatened insect species in Japan.

c) Statement of integrity

The nominated property includes Amami-Oshima Island, Tokunoshima Island, and the northern part of Okinawa Island in the Central Ryukyus; and Iriomote Island in the South Ryukyus. It contains about 90% of the endemic and threatened species in Central and South Ryukyus and their important habitats, and thus includes all elements necessary to express its Outstanding Universal Value as serial World Heritage islands. All the components of the property are complementary to one another and if any of the four regions were to be omitted, it would be impossible to understand the whole picture of the ongoing evolutionary and ecological processes of the Ryukyu Chain or conserve the biodiversity of the area.

Also, the nominated property consists of islands that are large in comparison with other islands in the Central and South Ryukyus, and subtropical rainforests exist there in large clusters. The property contains diverse habitat environments, including different geologies, cloud belts around the summit areas, mountains and hills involving complex microtopographies and hydrological systems, and swamps. It has adequate buffer zones. As such, it is of sufficient size and sound environmental conditions to ensure the complete representation and long-term conservation of its Outstanding Universal Values.

While there is some impact from alien species, traffic accidents involving wild animals, and illegal collection of wild species, the risks are prevented or mitigated through coordinated efforts by relevant administrative organs (Ministry of the Environment, Forestry Agency, Agency for Cultural Affairs, Kagoshima Prefecture, Okinawa Prefecture, and local municipalities) and civilian organizations.

d) Statement of authenticity

Not applicable because this nomination does not claim cultural values.

e) Requirements for protection and management

The nominated property is designated as Special Protection Zone or Class I Special Zone of National Park; or Presearvation Zones of Forest Ecosystem Reserve. In addition, it is designated as National Wildlife Protection Area or Natural Monument (See Chapter 5). These are systems for protecting the excellent natural environment of Japan, regulating development projects in a strict legal manner. By these designations, the nominated property is ensured of long-term appropriate protection. Most parts of the nominated property are national or municipal lands owned and managed by national or local governments.

The four islands containing the nominated property are inhabited by people, and the places for residents' lives and industrial activities are close to habitats for endemic species and rare species. To carefully protect the property and enable the coexistence with people's livelihoods, buffer zones were set up mainly in Class II Special Zone of the National Park or Conservation and Utilization Zone of the Forest Ecosystem Reserve, adjacent to the nominated property.

In order to facilitate the multi-layered management and protection of protected areas and designated species, the relevant administrative organs have estabished the "Regional Liaison Committee" and prepared the "Comprehensive Management Plan" describing the management policy common in the four regions. In addition,

four sub-local meetings have been set up under the Regional Liaison Committee, and they formulate regional action plans to effectively carry out the conservation and management of each region containing the nominated property through collaboration and cooperation with the local stakeholders. The "Scientific Committee" comprised of academic experts and its subsidiary "Local Working Groups" have been established to provide scientific advice and promote adaptive conservation and management in light of scientific knowledge and insight.

In addition, major endemic threatened species in the nominated property such as the Amami rabbit, Okinwana rail, and Iriomote cat are legally protected by designation of National Endangered Species and Natural Monuments. Monitoring of these species will be continued as part of protection and recovery program of the National Endangered Species and/or the mongoose control program.

Heritiera littoralis (Photo: MOEJ)

4

State of Conservation and Factors Affecting the Property

4.a. Present State of Conservation

4.b. Impacting Factors

View from the Funaura Bay, Iriomote Island (Photo: MOEJ)

4. State of Conservation and Factors Affecting the Property

4.a. Present State of Conservation

Among the endemic species and threatened species that indicate the value of the nominated property, this chapter describes the current conservation status of the targetted monitoring species shown in Chapter 6.

4.a.1. Present conservation state of species subject to monitoring

1) Amami rabbit (*Pentalagus furnessi*)

The Amami rabbit is a monospecific endemic speciess that is found only on Amami-Oshima Island and Tokunoshima Island. This species makes burrows mainly on slopes in primary forests and uses adjacent streams and secondary forests, etc., where many herbaceous plants and other food can be found, as a feeding ground (Sugimura 1990; Ministry of the Environment 2014).

(Photo: MOEJ)

Their distribution range of the Amami rabbit is estimated to be about 37,000 ha on Amami-Oshima Island and about 6,700 ha on Tokunoshima Island. On Amami-Oshima Island, the distribution range has been diminished in comparison to the 1970s, while the range of this animal is fragmented into two areas on Tokunoshima Island (Ministry of the Environment 2014).

It is estimated that the population of the Amami rabbit on Amami-Oshima Island, which ranged from 2,500 to 6,100 in 1993 to 1994, dropped to 2,000 to 4,800 in 2002 to 2003, while their population on Tokunoshima Island, which ranged from 120 to 300 in 1998, dropped to 100 to 200 in 2003 to 2004 (Sugimura and Yamada 2004; Ministry of the Environment 2014). Their population on Amami-Oshima Island is on track to recover due to positive results from mongoose control measures that started in 2000 (Watari et al. 2013). There have been indications of decreasing population size in some areas of Tokunoshima Island, but it was reported from unknown habitats in recent years, suggesting expansion of the distribution range.

The Amami rabbit is listed as EN in the IUCN Red List (2016) and MOEJ Red List (2015). The factors threatning this species are thought to be their predation by mongooses, an invasive alien species, and forest operations in its habitats, recently coupled with growing problems of predation by feral cats (*Felis catus*) and feral dogs (*Canis familiaris*), and an increasing number of traffic accidents.

The Ministry of the Environment, Foresty Agency and other relevant agencies developed a plan for a protection and recovery program in 2004 under which a variety of efforts have been underway. These include the work of monitoring to track the distribution range and habitat density status, tracking ecological data (including breeding season estimation), taking traffic accident prevention measures, and implementing mongoose control projects on Amami-Oshima Island.

2) Okinawa rail (*Gallirallus okinawae*)

The Okinawa rail is an almost flightless rail that was inscribed as a new species in 1981 (Yamashina and Mano 1981), and a species endemic to the northern part of Okinawa Island (Ornithological Society of Japan 2012). They live year-round as resident birds on the forest floor of evergreen broadleaved forests or surrounding grasslands.

(Photo: MOEJ)

In 1985, the area of Okinawa rail distribution was approximately 320 km^2 and their population was estimated to be 1,500 to 2,100, but both the distribution range and estimated population fell thereafter until 2005. It was estimated that over the course of 20 years, their inhabitable range dropped by about 34% and their population dropped by about 40% (580 to 930 birds) (Ministry of the Environment 2014). Starting in 2011, a trend of recovery has been observed in the distribution range and estimated population of Okinawa rail, due to positive results from mongoose control and other measures, resulting in the estimated population in subsequent years hovering around 1,500.

The species is listed as EN in the IUCN Red List (2016) and as in the MOEJ Red List (2015). While the main threat to this species is believed to be predation by mongooses, feral cats, feral dogs and other such animals, the increasing number of traffic accidents in recent years is also considered one of the factors causing the decline.

Relevant government agencies including the Ministry of the Environment and Okinawa Prefecture jointly embarked on an effort to deal with mongooses in 2000, and feral cats in 2002. The Ministry of the Environment, Forestry Agency and other relevant agencies developed a plan for a protection and recovery program in 2004 under which they have been conducting studies and research, conservation activities, the rehabilitation of injured and sick animals, captive breeding, and other actions in cooperation with municipal governments and NPOs.

3) Iriomote cat (*Prionailurus bengalensis iriomotensis*)

The Iriomote cat, a leopard cat (*Prionailurus bengalensis*) subspecies endemic to Iriomote Island, is adapted to the small environment of Iriomote Island, where there are no small mammals native to the island. These cats typically feed on native flying foxes and alien black rats (*Rattus rattus*) as well as birds, reptiles, amphibians, insects, crustaceans, etc. in different combinations according to the season. Approximately 80 species have been confirmed as being their prey (Nakanishi and Izawa 2015).

(Photo: MOEJ)

The Iriomote cat prefers environments with hydrological systems, such as forest peripheries, lowland areas, riversides, and wetlands, and also uses mangrove forests and areas in the vicinity of agricultural land to the seashore (Okinawa Prefecture 2006; Ministry of the Environment 2014). Ecological data used to be skewed towards lowland areas on the coastal side and, accordingly, the Iriomote cat population was estimated to be around 100; however, recent studies have reported that there is a resident and breeding population also living in mountainous land on the inland side (Izawa et al. 2003; Nakanishi and Izawa 2014), with implications suggesting a similar level of habitat density distribution as in the lowland areas.

While the IUCN Red List (2016) categorizes the leopard cat as LC, its subspecies—the Iriomote cat—is listed as CR and the MOEJ Red List (2015) lists it under CR. The factors threatening their habitation include traffic accidents, the disappearance or modifications of favorable habitats, and transmission of diseases from domestic cats (*Felis catus*) and competition with them.

The Ministry of the Environment, Forestry Agency and other relevant agencies developed a plan for a protection and recovery program in 1995, under which they have been implementing in cooperation with researchers, studies and research, conservation activities, the rehabilitation of injured and sick Iriomote cats, and other actions.

4.a.2. Major current threats and countermeasures

The major current threats are the predation and competition caused by alien species, traffic accidents, and illegal capture and collection.

4.a.2.1. Invasion of alien species

A large number of endemic species occur in the Central Ryukyus and the South Ryukyus, both being isolated island groups. In particular, the Central Ryukyus can be characterized by an ecological system that lacks high-level predators and consequently are very vulnerable to highly predacious alien species. This section provides a summary description of the steps taken to deal with mongooses and feral cats, both of which have been found to have a strong impact on native species, including endemic species, and are currently subject to control.

1) Small Indian mongoose (*Herpestes auropunctatus*)

The small Indian mongoose is native to the region extending from West Asia to Southeast Asia, and designated as a Specified Invasive Alien Species under Act on the Prevention of Adverse Ecological Impacts Caused by Specified Invasive Alien Species (Specified Invasive Alien Species Act). With the aim of eliminating habu vipers (*Protobothrops flavoviridis*) and rats, small Indian mongooses were released on Okinawa Island and Amami-Oshima Island, where there were no native carnivorous mammals, without sufficient impact studies being conducted. As a result, on both islands, the expected effect could not be obtained, and endemic species and rare species have been seriously impacted.

Mongoose Busters setting a trap (Photo: JWRC)

Efforts to capture small Indian mongooses began around 2000 in an attempt to eliminate them, and since the enactment of the Specified Invasive Alien Species Act in 2005, their capture has been performed both strategically and systematically pursuant to a control plan. A team consisting of about 40 project staff members was formed on each island (Mongoose Busters), and they now carry out capture according to the plan and also engage in awareness-raising activities. As the project outcomes and progress are scientifically assessed by a review committee on a regular basis, the control project is implemented adaptively with improvements being made to both plans and methods such as use of search dogs. The project has been underway for over 10 years and is now producing good results including expansion of the Amami rabbit and Okinawa rail distribtution. Table 4-1 lists the developments of the control project. Efforts will be continued to eradicate mongooses. In the northern part of Okinawa Island in particular, monitoring to prevent re-invasion will be implemented after eradication is completed, and immediate dispersion prevention measures will be taken in case re-invasion is confirmed.

Table 4-1: Developments of the mongoose control project on Amami-Oshima Island and Okinawa Island*

Event	Amami-Oshima Island	Okinawa Island
Introduction	Introduced from Okinawa Island in 1979; 30 mongooses released in the northwestern part.	Introduced from Bangladesh in 1910; 17 mongooses released in the southern part of Okinawa Island.
Study started	Impact study started in 1989 by a study group. Distribution spread eastwards and westwards from the spot where they were introduced.	Basic study started in 1985. Mongooses reached the northern part of Okinawa Island at the beginning of the 1990s; distribution spread further north.
Elimination started	Capture by municipal governments started in 1993. Capture by the prefecture started in 1996. Study by the Environment Agency and the prefecture started in 1996.	Capture by the prefecture started in 2000.
Elimination project fully underway	Elimination project by the Environment Agency started in 2000. Estimated number of mongooses: approximately 10,000	capture project by the Ministry of the Environment started in 2001.
Control plan	Developed in 2005.	Developed in 2005.
Control project	Amami Mongoose Busters formed in 2005. Search dogs introduced in 2007. Population growth of Amami rabbits, Amami spiny rats (*Tokudaia osimensis*), Ryukyu long-haired rats (*Diplothrix legata*) and endemic frogs reported from 2003 to 2011 (Fukasawa et al. 2013; Watari et al. 2013). Estimated number of mongooses in 2012: less than 300	Erection of first northward migration prevention fences completed in 2006. Yambaru Mongoose Busters formed in 2008. Search dogs introduced in 2009. Number of captures dropped in and after 2010; Okinawa rail distribution expanded. Erection of second northward migration prevention fences completed in 2013.
Phase 2 control plan	Started in 2013; aiming to achieve complete elimination from Amami-Oshima Island by FY2022. Estimated number of mongooses in 2016: less than 100	Started in 2013; aiming to achieve eradication from the northern part of Okinawa Island by FY2022.

*: Compiled with reference to the brochures below.
http://kyushu.env.go.jp/naha/files/mongoose_amami_E.pdf
http://kyushu.env.go.jp/naha/files/mongoose_yambaru_E.pdf

Mongoose search dogs with handlers (Photo: MOEJ)

2) Feral cats (*Felis catus*)

Captured feral cat (Photo: MOEJ)

Feral cats have been spotted in mountains located away from human dwellings on Amami-Oshima Island, Tokunoshima Island, and the northern part of Okinawa Island, where there are no carnivorous mammals. As a result of fecal pellet analyses and automatic photography-based studies, it has been confirmed that rare endemic species, including the Amami rabbit, Ryukyu long-haired rat, Amami spiny rat, and Okinawa rail, are preyed on. On Iriomote Island, there are also concerns over such issues as the competition between Iriomote cats and feral cats, and the transmission of diseases from feral cats to Iriomote cats. For those reasons, each island has actions underway, in cooperation with related organizations, which include capturing feral cats in the habitat range of rare species and promoting the appropriate keeping of pet cats as a step to deal with their source origin (making it obligatory by an ordinance to register pet cats; recommending neutering them and keeping them indoors; and prohibiting abandonment) (Table 4-2). However, the removal from the wild has been suspended on Amami-Oshima Island since 2014 due to the difficulties in dealing with individuals captured, and efforts are undertaken to resolve the problem.

Table 4-2: Countermeasures against feral cats in four regions containing the nominated property

Region	Promotion of appropriate keeping	Implementation status of feral cat capture and estimated number in rare species habitats (in forests)
Amami-Oshima Island	Ordinance on the Proper Keeping and Management of Pet Cats (five municipalities 2011)	2009 to 2013 Estimated number of feral cats: 600 to 1,200 (2014)
Tokunoshima Island	Ordinance on the Proper Keeping and Management of Pet Cats (three municipalities 2014)	2014 - Estimated number of feral cats: 150 to 200 (2014)
Northern part of Okinawa Island	Regulation Concerning Cat Keeping (Ada-Ku, Kunigami Village, 2002) Ordinance on Cat Welfare and Management (three villages 2004)	2001 -
Iriomote Island	Taketomi Town Ordinance on the Keeping of Cats (Taketomi Town 2001, revised 2008)	Currently feral cats are not confirmed in rare species habitats (in forests)

4.a.2.2. Traffic accidents, etc.

Impacts brought by road development might include environmental changes to the land form, etc., traffic accidents involving animals, fragmention of habitats, etc., water contamination resulting from landslides at the time of construction, and alien species and illegal collectors gaining easier access. Table 4-3 shows the road development status on the four regions containing the nominated property.

Table 4-3: Road development status in four regions containing the nominated property

	National roads (km)*1 (Number of routes)	Prefectural roads (km) (Number of routes)	Municipal roads (km)	Public road density*2 (m/ha)	Forest roads*3 (km)	Forest road density*4 (m/ha)	Sources
Amami-Oshima Island*5	73.0 (1)	286.3 (14)	1,093.1	18	364.5	4 (5)	1)
Tokunoshima Island	–	98.6 (6)	918.8	41	35.6	1 (3)	1)
Northern part of Okinawa Island	60.6 (2)	75.8 (22)	212.0	10	155.5	5 (6)	2), 3), 4)
Iriomote Island	–	54.2 (1)	43.9	3	–	–	5)

*1: Of a road segment for which public notice of commencing services has been given pursuant to the provisions of the Road Act, the actual length counted as its total length minus any length that overlaps with another route, is not available for service yet or is ferry-serviced.
*2: Road density is the density relative to the area of the island.
*3: "Forest roads" applicable herein are only those pursuant to the forest road standards of the Forestry Agency and do not include any skid roads or skid trails. A figure that represents the total of prefecture-operated and municipality-operated forest roads.
*4: Forest road density is the density relative to the area of the island or the density relative to the area of the forest (in brackets).
*5: This includes Kakeromajima Island, Ukejima Island, and Yorojima Island.
Sources: 1) Oshima Branch Office, Kagoshima Prefecture (2015); 2) Civil Engineering and Construction Unit, Okinawa Prefecture (2014); 3) Okinawa General Bureau, Cabinet Office (2009); 4) Local Regions and Remote Islands Promotion Division, Okinawa Prefecture (2014) and; 5) Yaeyama Office, General Affairs Department, Okinawa Prefecture (2013)

Traffic accidents have occurred in and around the nominated property involving endemic species and rare species, such as the Amami rabbit, Ryukyu long-haired rat, Okinawa rail, Iriomote cat, and crested serpent eagle (*Spilornis cheela perplexus*), along with such small animals as Okinawa rail chicks, Anderson's crocodile newt (*Echinotriton andersoni*), the Ryukyu black-breasted leaf turtle (*Geoemyda japonica*), and the Yaeyama yellow-margined box turtle (*Cuora flavomarginata evelynae*) falling into roadside ditches. To address these circumstances, a series of actions has been taken in the four regions of the nominated property in collaboration with related organizations.

With respect to impacts arising from the road structure, related sections of the national and prefectural governments have formulated guidelines for public works with consideration given to the natural environment and developed written instructions, etc. that specifically set out actions in terms of planning, design, and construction work (North National Road Office, Okinawa General Bureau 2008; Yaeyama Regional Public Works Office, Civil Engineering and Construction Unit, Okinawa Prefecture 2009). Pursuant to those instructions, etc., they are working to make improvements to the road structure, including creating underpasses for animal crossings and ditches that are sloped in a way that small animals may crawl out.

The following gives an overview of the status of traffic accidents involving major rare species, along with countermeasures.

1) Amami rabbit

On Amami-Oshima Island and Tokunoshima Island, the Amami Island Group Rare Wildlife Protection Program Council, formed by 16 relevant organizations, including the Ministry of the Environment, Forestry Agency, local governments, and the Amami Nature Experience Promotion Council, formed by 14 organizations, have been running campaigns since 2009 that target islanders, tourists, etc. of both islands for the prevention of traffic accidents involving Amami rabbits and other wildlife. Various actions have been taken, including erecting signs intended to prevent accidents at locations where traffic accidents occur frequently. As a result, fewer incidences of roadkill have been reported since 2009 (Figure 4-1). The Ministy of the Environment and local concerned people are collaborating in rescue and rehabilitation of injured and sick animals.

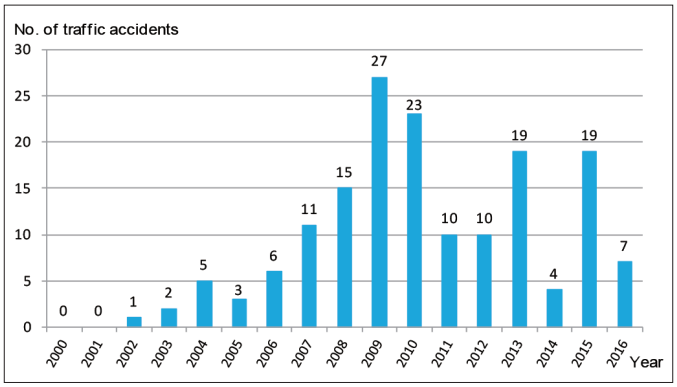

Figure 4-1: Shifts in number of traffic accidents involving amami rabbits (since January 2000 as of June 1, 2016) (Based on data by the Ministry of the Environment 2010)

Traffic accident prevention campaign (Photo: MOEJ)

2) Okinawa rail

As the Okinawa rail population has increased thanks to positive results from actions dealing with alien species, the number of traffic accidents involving this bird is also rising (Figure 4-2).

In the northern part of Okinawa Island, the Liaison Council on Yambaru Region Roadkill Prevention, formed by 25 relevant organizations, including the Ministry of the Environment, Forestry Agency and local governments, engages in the collection and analysis of accident information, placing of warning signs along routes with frequent accidents, and improvement of the road structure, such as creating fences and underpasses to prevent Okinawa rails from entering the road (Nakamatsu and Kinjo 2014). It also takes actions in buffer zones and the living domain of residents, such as traffic accident prevention campaigns targeting islanders, tourists and others. There are also rescue and veterinary care operations for animals involved in an accident that are managed in collaboration between the Ministry of the Environment and the Conservation & Animal Welfare Trust.

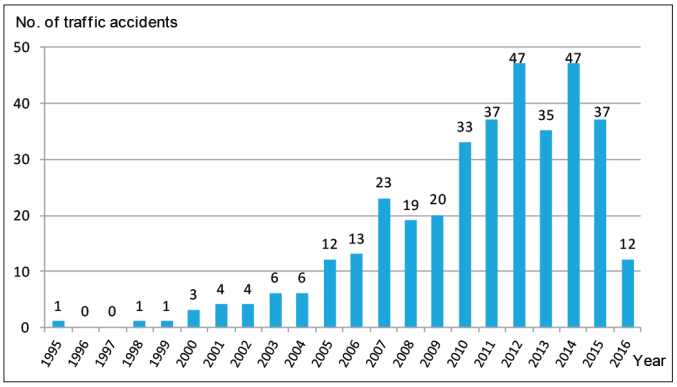

Figure 4-2: Shifts in number of traffic accidents involving Okinawa rails (since 1995 as of June 1, 2016)
(Developed in reference to the website of Yambaru Wildlife Protection Center, the Ministry of the Environment)

Warning sign along routes
(Photo: MOEJ)

3) Iriomote cat

As Iriomote cats have a broad home range, stretching from forests in mountain foothill areas to lowland areas adjacent to agricultural land, etc. to the living domain of residents and coastal areas, there are roads running in their home range. Figure 4-3 shows the number of traffic accidents involving Iriomote cats.

On Iriomote Island, the Liaison Council on Prevention of Traffic Accident Occurrences Involving Iriomote Cats, formed by 23 relevant organizations, including the Ministry of the Environment, Forestry Agency and local governments, works to share information and maintain collaboration so that actions implemented by the respective relevant organizations and others in connection with nature conservation, road administration, road use, etc. may be carried out effectively. It also takes various actions that include placing road signs intended to prevent traffic accidents involving Iriomote cats, making useful changes to the road structure by adding underpasses, anti-vibration pavement, etc. to arterial roads, and running traffic accident prevention campaigns

targeting tourists, residents and others. The Ministry of the Environment and private organizations are also operating programs for accommodating, rehabilitating back to the wild, and monitoring injured and sick animals.

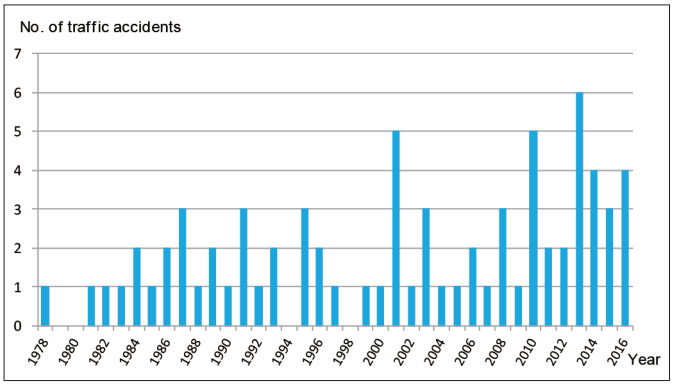

Figure 4-3: Shifts in number of traffic accidents involving Iriomote cats by year (since 1978 as of June 1, 2016)
(From the website of Iriomote Wildlife Protection Center, the Ministry of the Environment)

Example of improvement of road structure (adding an underpass) (Photo: JWRC)

4.a.2.3. Illegal capture and collection

As the Central Ryukyus and the South Ryukyus have many endemic species that are found only in those regions, and because those species have further differentiated into distinct species or subspecies within islands, both regions are the target destinations for amateurs and other interested parties to collect plants as well as animals (to keep or grow, or to collect specimens). Another factor contributing to the escalating collection activities is the development of a road network that has reached forestland areas, thus providing easier access to spots where endemic species and rare species live or grow. The national, prefectural and municipal governments, related local organizations, local NPOs, and others are working in collaboration to address this issue (Table 4-4).

In addition to the statutory protection of the species by the national government discussed in Chapter 5: Protection and Management of the Property, there are municipal systems in place in the Amami Island Group. The Ordinance to Protect Endangered Wild Fauna and Flora which was established by Kagoshima Prefecture, five municipalities of Amami-Oshima Island, and three towns of Tokunoshima Island, respectively, designates particularly important species as “endangered species of wild fauna or flora ” and prohibits the collection thereof (Table 4-5).

Table 4-4: Measures against illegal collection

Region	Actors	Actions
Amami-Oshima Island Tokunoshima Island	Amami Island Group Rare Wildlife Protection Program Council Ministry of the Environment Forestry Agency Kagoshima Prefecture Municipalities Related local organizations Local NPOs, etc.	Placing spotters Installing surveillance cameras Joint patrol Campaigns against illegal collection Making awareness-raising guidebooks
Northern part of Okinawa Island	Local residents, local forestry businesses, Ministry of the Environment	Forest road patrol, information collection
	Yanbaru Long-Armed Scarab Beetle Poaching Prevention Council Ministry of the Environment Forestry Agency Okinawa Prefecture three Yambaru villages Nago City Police Related local organizations, etc.	Forest road patrol Making awareness-raising posters
Iriomote Island	Forestry Agency	Collecting information on the distribution of rare plants, mainly arboreal plants
	Taketomi Town	Rare species protection, alien species control by amending Natural Environment Protection Ordinance

Table 4-5: Number of designated endangered species of wild fauna and flora in the nominated property under the ordinance to protect endangered wild fauna and flora

Local governments	Number of species
Kagoshima Prefecture	22
Five municipalities on Amami-Oshima Island	57
Three towns on Tokunoshima Island	31

Asarum tabatanum (Photo: MOEJ)

4.b. Impacting Factors

This section describes the factors having potential impacts on the nominated property.

4.b.(i) Development pressures

The nominated property is appropriately protected as Special Protection Zone or Class I Special Zone within National Park where any development activities are regulated. The following describes the possible impacts resulting from development activities in and around the nominated property.

1) River and dam construction

As a feature of an island region where the river size is small and rainwater therefore flows out into the ocean in a relatively short time, it is extremely important to secure water for the people living there. In particular, the Central Ryukyus and the South Ryukyus, though being pluvial regions, are relatively affected by frequent droughts. For that reason, coupled with the growing demand for water due to human activities (agriculture, tourism activities, etc.), dam construction has been implemented.

While dams on Amami-Oshima Island, Tokunoshima Island, and Okinawa Island have previously impacted the habitats and breeding sites of animals and plants, development plans administered by the national and prefectural governments have been completed, and there is no construction plan for the future in the nominated property.

Although there is no large dam on Iriomote Island, where water is taken from five water sources (rivers) within the island by building weirs, the island is often exposed to drought and a new water source development project may be planned in order to address the tight water supply. In such a case, it will be necessary to pay attention in terms of planning (site selection and size) and construction methods, etc. so as to eliminate any possible impact inside the nominated property and on the animals and plants that live or grow there.

2) Alien species

The following alien species have invaded into the four regions containing the nominated property and their surrounding islands, as well as the central and southern parts of Okinawa Island. While impact of such species on the nominated property remains unclear, any future impact and further invasion is a concern, which points to the need to monitor and take action to prevent the invasion and spread of alien species.

Species that have invaded into the four regions containing the nominated property, for which there are concerns over future impacts despite not currently having a major effect

• Feral goat (*Capra hircus*)

Goats as livestock have been kept domestically and otherwise as an important source of protein on islands of the Ryukyu Chain, but some have become feral. On Amami-Oshima Island and its surrounding islands, feral goats live mainly in cliff areas along the coast. In some places outside of the nominated property, such as sharply inclined slopes and headlands exposed to the open sea, they have had vegetation destroyed and soil runoff occur as a result their feeding damage. On Amami-Oshima Island, four municipalities are operating feral goat damage control projects.

• Feral dog (*Canis familiaris*)

Feral dogs are found in the habitats of rare species on Amami-Oshima Island, Tokunoshima Island and the northen part of Okinawa Island. Their predation on small and mid-sized endemic mammals and bird have been confirmed, and there are growing concerns about their impacts. Dogs that are not registered by owners or tagged according to the prescribed measures must be removed from the wild based on the Rabies Prevention Act. Local governments are implementing captures and other countermeasures against these dogs.

• Black rat (*Rattus rattus*)

In the northern part of Okinawa Island, black rats have been frequently spotted in the habitat of Okinawa spiny rats, an endemic species, thereby suggesting the possibility of their overlapping habitats and active hours impacting the Okinawa spiny rats (Yamada and Kawachi 2009), which may possibly be replaced by black rats (Ota's personal correspondence 2016).

• White-lipped treefrog (*Polypedates leucomystax*)

Native to Southeast Asia. The white-lipped treefrog is a Specified Invasive Alien Species designated under the Specified Invasive Alien Species Act (see 5.c.6). This species has invaded into many islands in the Okinawa Island Group and the Miyako Islands and became widespread; it has also been spotted in the northern part of Okinawa Island. This species was found on Ishigaki Island in 2007 and, for the first time ever, its invasion into Iriomote Island was confirmed in August 2015 (Ministry of the Environment 2015). There are concerns over competition with Owston's green treefrog (*Rhacophorus owstoni*), an endemic species with a similar life pattern. The Ministry of the Environment has been examining ways to control white-lipped treefrogs and making awareness-raising efforts so as to prevent their spread, and has engaged in various actions on Iriomote Island, including monitoring studies, captures, and removal of eggs masses. As a result, the population of this species is decreasing.

• Lanceleaf tickseed (*Coreopsis lanceolata*)

Native to North America. This species is a Specified Invasive Alien Species designated under the Specified Invasive Alien Species Act. The species had been used for road slope greening purposes or for gardening and spread all over Japan. It is established on Amami-Oshima Island and Tokunoshima Island, and there is a record confirming its existence on Okinawa Island as well. However, it has yet to be spotted on the Yaeyama Islands. Given the concerns over its competition with endemic plants, local environmental NPOs, businesses, local residents, Kagoshima Prefecture, and others annually engage in work to remove this species, which also serves as an awareness-raising activity for residents.

• Bay Biscayne creeping-oxeye (*Sphagneticola trilobata*)

Native to South America. This species is a Specified Invasive Alien Species designated under the Specified Invasive Alien Species Act. The species became rampant after being used for road slope greening purposes, and has been spotted in the four regions containing the nominated property. There are concerns over its effect of suppressing endemic plants, as well as competition and hybridization with endemic plants. Particularly in the case of Iriomote Island, its impacts on communities of *Acrostichum aureum* that is believed to be an endemic new species (Yokota's personal correspondence 2014). Local environmental NPOs, businesses, local residents,

Kagoshima Prefecture, and others annually engage in work to remove this species, which also serves as an awareness-raising activity for residents.

• Mile-a-minute (*Mikania micrantha*)

Native to South and North America. This species is a Specified Invasive Alien Species designated under the Specified Invasive Alien Species Act. This species has been spotted in the part of Okinawa Island and on Iriomote Island (Yokota's personal correspondence). There are concerns over its effect of suppressing endemic plants, as well as competition and hybridization with endemic plants, and over its possible wider distribution in the future (Yokota's personal correspondence 2014).

Removal of alien plants by participation of school children (Photo: MOEJ)

Species that have encroached into islands surrounding the four regions containing the nominated property, for which there are concerns over possible future impacts

• Japanese weasel (*Mustela itatsi*)

Domestic alien species. This species was introduced for the purpose of rat control and has become established on relatively small islands in the Ryukyu Chain. Should this animal encroach into the nominated property, it might prey on endemic small mammals, birds, amphibians, reptiles, insects, and other small animals.

• Indian peafowl (*Pavo cristatus*)

Native to South Asia. This species became established on Ishigaki Island and its adjacent islands. Should this bird encroach into Iriomote Island, it might prey on endemic amphibians, reptiles, insects, and other small animals. The Ministry of the Environment engages in various activities that include studying the status and impacts of this species on the ecosystem, and testing capture methods. Since FY2006, the Ministry has also been implementing a control project on Aragusuku Island, located about 6 km south-east of Iriomote Island. In order to prevent invasion into Iriomote Island by this species, Taketomi Town has been conducting basic studies since 2014 to identify its range and egg-laying sites, as well as implementing a removal project since 2015.

• Green anole (*Anolis carolinensis*)

Native to North America. This species is a Specified Invasive Alien Species designated under the Specified Invasive Alien Species Act. The species has been confirmed in the southern part of Okinawa Island and on the Kerama Islands. It is feared that if these lizards make an inroad to the northern part of Okinawa Island, they might prey on endemic insects and compete with indigenous lizards. In addition to a control project in the area in which they became established, the Ministry of the Environment and Okinawa Prefecture have been investigating the distribution of this species and engage in awareness-raising activities to prevent the spread thereof.

• Green iguana (*Iguana iguana*)

Native to Latin America. This species became established on Ishigaki Island. Should these lizards encroach into Iriomote Island, they might prey on indigenous insects. The Ministry of the Environment tracks the status of this species, engages in trial control, and is examining effective capture methods.

• Taiwan beauty snake (*Elaphe taeniura friesi*)

A Taiwanese-origin distinct subspecies of the Sakishima beauty snake (*E. t. schmackeri*) that lives on the Yaeyama Islands. This species is a Specified Invasive Alien Species designated under the Specified Invasive Alien Species Act. The Taiwan beauty snake has become established in the central part of Okinawa Island. Should this snake make an inroad to the northern part of Okinawa Island, it might prey on endemic small mammals, birds, amphibians and reptiles, and compete with indigenous snakes. The Ministry of the Environment and Okinawa Prefecture track the status of this species, engage in capture tests, etc., and are examining possible actions to take.

• Taiwan habu viper (*Protobothrops mucrosquamatus*)

Distributed in Taiwan, southern and eastern China, and northern Vietnam. The species is a Specified Invasive Alien Species designated under the Specified Invasive Alien Species Act. It is established in the cetral Okinawa Island (Onna Village and Nago City). Shoud this species intrude into the northen part of Okinawa Island, there are concerns they may prey on endemic small mammals, amphibians, reptiles, and birds, and may compete with the indigenous snakes.

• Cane toad (*Rhinella marina*)

Native to Latin America. This species is a Specified Invasive Alien Species designated under the Specified Invasive Alien Species Act. These toads live in almost all parts of Ishigaki Island. On Iriomote Island, unintentionally introduced cane toads have been found, but have yet to be established. Should these toads become established, they might prey on endemic insects and small animals, compete with indigenous amphibians and reptiles, and their venom might affect crested serpent eagles and Iriomote cats, both of which are higher-level predators on the island. The Ministry of the Environment developed the Cane Toad (*Rhinella marina*) Control Plan for the Yaeyama Region of Okinawa Prefecture in an attempt to reduce the density of this species on Ishigaki Island, and monitors their potential invasion into other islands, including Iriomote Island.

3) Genetic disruption

As there are many endemic species in the nominated property, the introduction of any related species or any group with different genetic traits even if belonging to the same species from mainland or another island in the Central Ryukyus and the South Ryukyus might cause genetic disruption as a result of hiybridization.

For example, there are cases of genetic disruption on Tokunoshima Island, the northern part of Okinawa Island, and Iriomote Island that occurred as a result of bybridization between the Ryukyu wild boar (*Sus scrofa riukiuanus*), a subspecies endemic to the region, and livestock pigs and wild boars from the mainland (*Sus scrofa leucomystax*) (Hayashi et al., 2014; Murakami et al., 2014; Ota's personal correspondence 2013, 2014). The Yaeyama yellow-margined box turtle (*Cuora flavomarginata evelynae*) and the Yaeyama pond turtle (*Mauremys*

mutica kami), both of which are distributed naturally on the Yaeyama Islands, had been brought into Okinawa Island and the surrounding islands. Consequently, a hybrid of the Ryukyu black-breasted leaf turtle (*Geoemyda japonica*), a species endemic to the northern part of Okinawa Island, with the yellow-margined box turtle has been found (Otani, 1995), and another hybrid with the Yaeyama pond turtle has been found (Ota and Hamaguchi 2003), indicating that genetic disruption may have occurred relative to the population of the Ryukyu black-breasted leaf turtle. Whenever a hybrid or an alien species is found, control procedures are implemented.

Ryukyu wild boar (*Sus scrofa riukiuanus*) (Photo: MOEJ)

4.b. (ii) Environmental pressures

1) Climate change

It is predicted that effects of climate change on the nominated property include warming temperatures, rainfall shortages, typhoons, and torrential rains (Kyushu Regional Environmental Office, Ministry of the Environment 2012; Fukuoka Regional Headquaters, JMA 2015; Japan Meteorological Agency 2015; Okinawa Regional Headquaters, JMA 2015).

• Warming temperatures

Warming temperatures might cause the southernmost range of species for which the nominated property marks a reduction or northward shift thereof, or a new competitive relationship to be generated as a result of animals of a southern origin making inroads (alien species, etc.), with particularly significant impacts likely to be brought to endemic species and any species having a limited range of distribution.

• Changes in trends of rainfall shortages and droughts, etc.

If the occurrence of rainfall shortages and droughts were to become more frequent as a result of climate change, it would likely become a factor that would pose a direct threat to the habitation of such animals as endemic amphibians that inhabit inland waters and endemic rheophytes that are adjusted to the rhithron zone.

• Typhoons and torrential rains

As has been discussed in 2.a. Description of the Property, the Central Ryukyus and the South Ryukyus constitute one of the zones most vulnerable to tropical cyclones (typhoons) that are among the most powerful even on a global scale; these areas are hit by typhoons very frequently every year, with an annual average over the past approximately 60 years amounting to 7.6 times (with a maximum of 15 times and a minimum of three). Organisms and ecosystems in this region have adapted themselves to those frequent strikes of typhoons and torrential rains over a long period of time, but potential increases in the frequency of powerful typhoons, torrential rains, and other consequences thereof are predictable, as future climate change might cause a greater disruption to forests, rhithron zones, and other environments.

Meteorological data accumulation and analysis will be a critical matter for the purpose of predicting future changes to insular ecosystems caused by climate change that could occur. The Japan Meteorological Agency has been constantly engaged in highly accurate observations over a long period of time in cooperation with the World Meteorological Organization (WMO) and other national and international organizations to monitor climate change by means of data accumulation and analysis. The work of analysis and prediction using such data is performed by organizations and researchers from a wide variety of fields, including disaster prevention, agricultural, forestry and fisheries, and ecological system conservation (Ministry of Education, Culture, Sports, Science and Technology, Japan Meteorological Agency, Ministry of the Environment 2013; Climate Change Impact Evaluation Subcommittee, Global Environment Committee of the Central Environment Council 2015).

2) Acid rain

The Ministry of the Environment is constantly engaged in the wide-area, long-term monitoring of acid rain in

cooperation with national and international organizations, including mainly the Acid Deposition Monitoring Network in East Asia (EANET), with an observation point for the Central Ryukyus and the South Ryukyus, which contains the nominated property, built at Cape Hedo in the northern part of Okinawa Island. While no impact from acid deposition, such as arboreal degradation or soil acidification, has been recognized so far, it is feared that an impact originating in East Asian countries, where air pollutant emissions are rising sharply as a result of rapid economic growth, might become evident in the future (Ministry of the Environment 2014).

4.b. (iii) Natural disasters and risk preparedness

• Earthquakes and Tsunamis

Great East Japan Earthquake in 2011, there is a renewed awareness in Japan of the importance of learning from the history of past earthquakes and tsunamis. The following record exists regarding the earthquakes and resultant tsunamis that have caused relatively serious damage in the vicinity of the nominated property (Table 4-6).

Table 4-6: Earthquakes and tsunamis that caused relatively serious damage in the vicinity of the nominated property

Year	Epicenter	Earthquake scale	Seismic intensity	Tsunami runup height	Notes
1771	Sea near Ishigaki Island	M 7.4 (estimate)	4 (estimate)	Approximately 30 m	Commonly known as the "Great Meiwa Tsunami." Casualties reached approximately 12,000.
1911	Sea near Kikai Island	M 8.0	6	Approximately 5 m	
1960	Off the Chilean coast	M 9.5	–	4.4 m	
1995	Sea near Amami -Oshima Island	M 6.9	5	2.7 m	12- to 24-cm tsunami observed in various locations between Kyushu and Izu Oshima Island.

Sources: Websites of the Naze Weather Station, Okinawa Regional Headquarters, JMA, and Ishigaki Local Meteorological Observatory.

Ryukyu kajika frog (*Buergeria japonica*)
(Photo: MOEJ)

Although according to Goto et al. (2013), boulders brought by tidal waves during a typhoon can be found throughout the Central Ryukyus and the South Ryukyus, tsunami rocks (boulders found on coral reefs or in coastal areas) are only found in the Sakishima Island Group of the South Ryukyus, which suggests that there are no signs indicating that Amami-Oshima Island and the Okinawa Island Group have seen any mega-tsunami large enough to push up a tsunami rock the size of at least 1 m in diameter onto the shore in the past 200 to 300 years. In the meantime, massive tsunamis have repeatedly hit the Sakishima Island Group, with implications of the recurrence period being 150 to 400 years (Araoka et al. 2013).

To address natural disasters, including earthquakes, tsunamis, typhoons and torrential rains (see 4.b.(ii) Environmental Pressures), Kagoshima Prefecture and Okinawa Prefecture have developed disaster prevention plans, respectively, for disaster prevention purposes in an attempt to stay prepared for responding to emergency situations once a disaster strikes (Kagoshima Prefecture Disaster Prevention Council 2015; Okinawa Prefecture Disaster Prevention Council 2015).

Pieris japonica var. *koidzumi* (Photo: MOEJ)

4.b. (iv) Responsible visitation at World Heritage sites

Of the nominated property, Amami-Oshima Island, Tokunoshima Island, and Okinawa Island have regular flight and ferry services from the mainland, and also have a road network in place, including highways on Okinawa Island, for traveling from the airport or seaport. In the case of Iriomote Island, there are regular flight and ferry services from the mainland as well as from Okinawa Island to Ishigaki Island, an island located in its vicinity, from where regular ferry service to Iriomote Island is operated; therefore, any of the islands provides easy access to visit the nominated property.

Factors that might have a negative impact on the nominated property include a sharp increase in visitors, the concentration of visitors in some locations, and traffic accidents involving wildlife as a result of car traffic (see 4.a.2.2).

1) Tourism statistics from the past several years

Table 4-7 shows statistics on the status of visits to the nominated property. There is a substantial difference between the Amami Island Group, which contains Amami-Oshima Island and Tokunoshima Island, and Okinawa Prefecture, which contains the northern part of Okinawa Island and Iriomote Island, in terms of circumstances associated with tourism. While no accurate statistical data exists on the number of tourists in the Amami Island Group, the number of inbound visitors and travelers in 2015, including local residents and business travelers, was approximately 760,000 for the island group as a whole, about 420,000 for Amami-Oshima Island, and about 130,000 for Tokunoshima Island (Oshima Branch Office, Kagoshima Prefecture 2016a, b).

Meanwhile, tourism is positioned as a key industry in Okinawa Prefecture, with the number of inbound tourist visitors to the prefecture in 2015 marking an all-time high of approximately 7.76 million (Okinawa Prefecture Tourism Policy Division 2016). There is no accurate statistical data on how many of those tourists visited the northern part of Okinawa Island (three Yambaru villages); it is estimated that approximately 8% of inbound tourists to Okinawa Prefecture (around 600,000 to 700,000) visited the three Yambaru villages (Okinawa Prefecture Department of Culture, Tourism and Sports 2015). The number of tourists who visited Iriomote Island in 2015 totaled about 390,000 (Taketomi Town Commerce and Tourism Department 2016).

Flower chafer (*Paratrichius duplicatus okinawanus*)
(Photo: MOEJ)

Table 4-7: Changes in number of visitors* in four regions of the nominated property in the past five years

	2011	2012	2013	2014	2015	Source
Amami-Oshima Island	357,103	361,252	370,360	393,654	422,527	1)
Tokunoshima Island	127,290	125,110	126,345	124,275	129,806	1)
Okinawa Island	5,415,500	5,835,800	6,413,700	7,058,300	7,763,000	2)
Iriomote Island	254,011	284,995	346,401	379,727	387,952	3)

Sources: 1) Oshima Branch Office, Kagoshima Prefecture (2016a, b); 2) Okinawa Prefecture (2015), Tourism Policy Division, Okinawa Prefecture (2016); 3) Commerce and Tourism Department, Taketomi Town (2016).

* The number of visitors means: in source 1), the number of inbound visitors and travelers (sum total of the number of people who entered any island of the Amami Island Group from outside of the island group and the number of people who travelled within the island group); in source 2), the number of inbound tourist visitors to Okinawa Prefecture from outside of the prefecture and; in source 3), the number of inbound tourist visitors to Iriomote Island from outside of the island.

2) Major site use

Although circular tourism visiting sightseeing sites and facilities is the main utilization form, in the Amami Island Group and Okinawa Prefecture, ecotourism and other forms of tourism characterized by hands-on experience and extended stays that take advantage of their resources, such as abundant nature and indigenous culture, have been promoted in recent years.

2)-1. Amami Island Group

Major categories of inbound visitors and travelers to the Amami Island Group are local residents and business travelers, and the percentage of tourists is believed not to be substantial (Development Bank of Japan 2014). Figure 4-4 shows the major locations and site use on Amami-Oshima Island and Tokunoshima Island.

- Amami-Oshima Island

  In addition to group sightseeing tours using a large bus, individual tourists renting a car are increasing. Many tourists enjoy visiting natural scenic sites and visitor facilities while others enjoy marine activities such as diving and surfing. The main guided tours include canoeing in mangrove forests and wildlife observations at night. The major visitor destinations and site use on Amami-Oshima Island are shown in Figure 4-4.

- Tokunoshima Island

  In regard to the form of tourism on Tokunoshima Island, there are a number of individual tourists renting a car to visit natural scenic places, while others enjoy marine activities such as diving. In recent years, guided terrestrial ecotours and development of wildlife observation facilities are being promoted. The major visitor destinations and site use on Tokunoshima Island are shown in Figure 4-4.

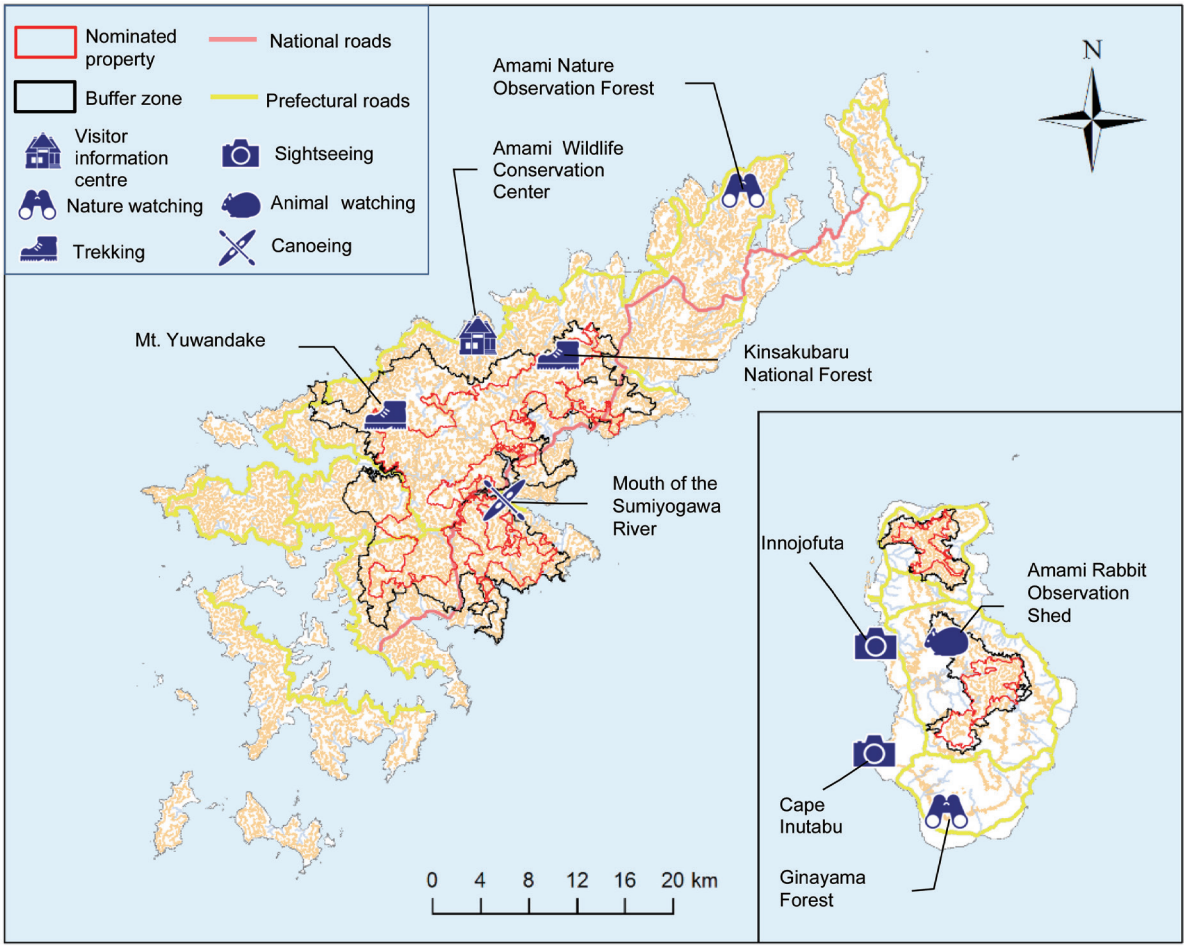

Figure 4-4: Major locations and site use forms on Amami-Oshima Island

2)-2. Okinawa Prefecture

Known as a tourism-oriented prefecture, Okinawa Prefecture has seen more than a tenfold growth in about 40 years since its reversion to Japan in 1972 in terms of the number of inbound tourist visitors to the prefecture as well as its tourism revenues. Over the course of those years, the forms of tourism within Okinawa Prefecture have been constantly changing along with the progress of developments shown in Table 4-8. In the late 1990s, an effort was begun to offer ecotourism and other forms of tourism characterized by hands-on experience and extended stays that take advantage of Okinawa's abundant nature and indigenous culture, driven by private businesses, local public agencies and others, with actions being written into the Act on Special Measures for Okinawa Promotion, including a master plan developed by the Okinawa Prefecture and the formation of a promotional organization.

Table 4-8: Changes in tourism and developments of ecotourism promotion in Okinawa Prefecture

Year	Events - Actions
1972	Reversion to Japan. Number of inbound tourist visitors to Okinawa reaching 560,000, tourism revenues reaching 32.4 billion yen.
1975	Okinawa International Ocean Expo held. Main forms of tourism: multi-stop sightseeing group tours to visit historical sites and battle sites in Naha City and the south-central part of Okinawa Island
1987	Act on Development of Comprehensive Resort Areas enacted. A large number of resort hotels built, particularly in the south-central part of Okinawa Island, leading to dramatic increases in the number of inbound tourist visitors.
1990 -	Number of tourists skyrocketed as a result of airfare deregulation and travel product price reduction. Multi-stop sightseeing tourism in and around Naha City ↓ Tourists spread out to the northern part of Okinawa Island and to isolated islands; repeat visitors increased. Multi-purpose, independent style of tourism taking root.
2002	Act on Special Measures for the Promotion and Development of Okinawa revised. Revised to create provisions on the promotion of environmentally-friendly hands-on nature activities (ecotourism) and on a program for the accreditation of conservation and utilization agreements.
2004	Master Plan "Okinawa Prefecture Eco-Tourism Promotion Plan" developed.
2006	NPO Eco-Tourism Promoting Council Okinawa established.
2015	Number of inbound tourist visitors: 7.76 million; tourism revenues: 591.3 billion yen

Canoe tour on the Nakama River, Iriomote Island (Photo: MOEJ)

The situations in the northern part of Okinawa Island and Iriomote Island, which the nominated property contains, are described below.

• Northern part of Okinawa Island

Multi-stop sightseeing trips represent the major form of tourism in the northern part of Okinawa Island whereby tourists staying in the south-central part of Okinawa Island take day trips to visit tourist sites and establishments, such as Cape Hedo and Hiji-otaki Falls; other patterns include staying in resort establishments in Kunigami Village (approximately 140,000 people per year) and ecotouring that offers hands-on experience in nature, local life and culture. There are probably also a good number of Okinawa Prefecture residents who visit the area as a driving or recreational destination. Figure 4-5 shows the major locations and site use in northern part of Okinawa Island.

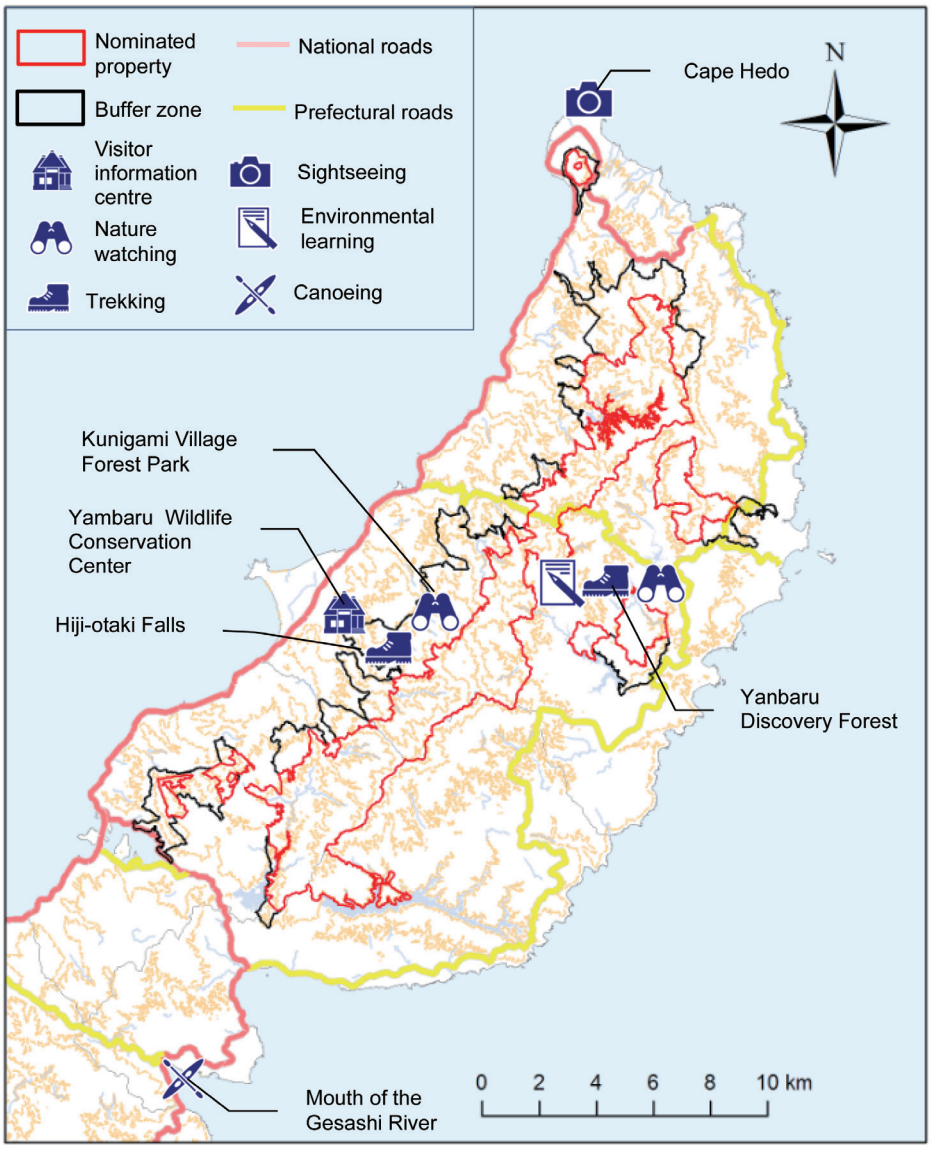

Figure 4-5: Major locations and site use forms in the northern part of Okinawa Island

• Iriomote Island

The features of tourism on Iriomote Island include the presence of many group travelers in wintertime and the prevalence of multi-stop sightseeing trips whereby tourists, during their stay on Ishigaki Island, visit Iriomote Island on day trips to take a boat tour on the Nakama River or the Urauchi River and then move on to another island (Okinawa Development Finance Corporation 2014; Department of Environmental Affairs, Okinawa Prefecture, etc. 2015). Another feature is the growing number of ecotour participants since the mid-1990s, though the percentage to total tourists is small: around 50,000 people per year (Department of Environmental Affairs, Okinawa Prefecture, etc. 2015). Figure 4-6 shows the major locations and site use on Iriomote Island.

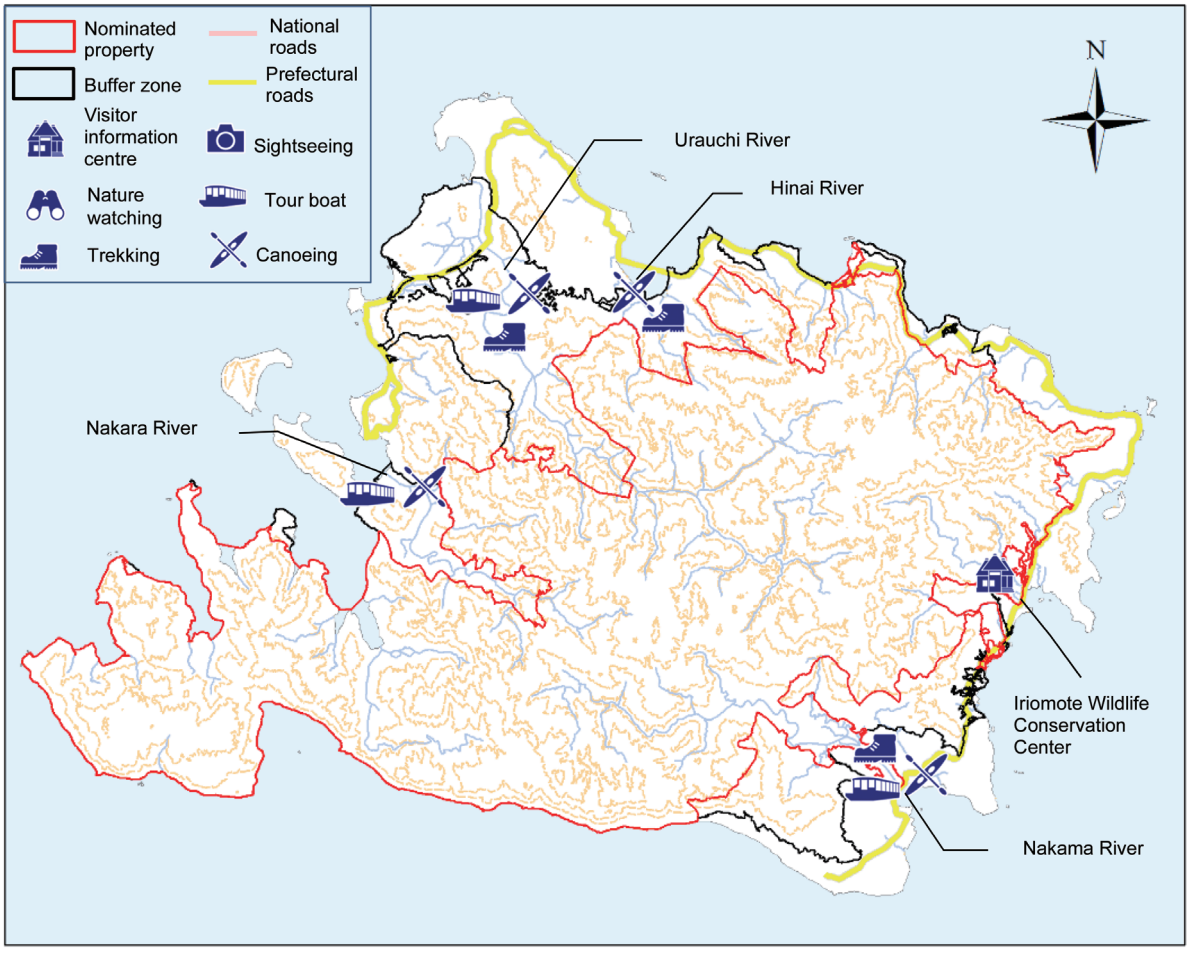

Figure 4-6: Major locations and site use forms on Iriomote Island

3) Promotion of appropriate sustainable use

Increases in tourism visits to the nominated property due to their higher profile as a result of being inscribed on the World Heritage list, and steps to keep them at an appropriate level, are considered one of the critical issues for the purposes of maintaining their heritage values and ensuring sustainable utilization (Kagoshima Prefecture 2015; Okinawa Prefecture 2015). Following the inscription as a World Heritage site, efforts to reduce impact on the natural environment and provide opportunities for deeper natural experiences will be undertaken, such as promoting ecotourism and other types of experience-focused residential tourism in the nominated property and leading round-trip tourists who participate in mass tourism to be accepted in buffer-zones and peripheral areas. With respect to their expected environmental carrying capacity and visitor management, Kagoshima Prefecture and Okinawa Prefecture are in the process of giving specific deliberations to comprehend the actual status of utilization, sorting out issues concerning the conservation and utilization, predicting future utilization, and determining necessary actions. The existing and ongoing actions intended to ensure sustainable tourism utilization in the nominated property are described below.

Amami-Oshima Island and Tokunoshima Island, ecotourism is in its early stage, with a variety of activities currently underway by municipalities, tourism industries, guides and others in an attempt to ensure sustainable utilization, including mainly formulating the "overall concept for promoting Ecotourism of the Amami Island Group" pursuant to the Ecotourism Promotion Act, as well as developing guidelines and voluntary rules, investigating resources and creating programs, developing human resources, and examining a guide certificate system (Table 4-9).

Table 4-9: Status of actions for ecotourism promotion on Amami-Oshima Island and Tokunoshima Island

Year	Actions
2008	Amami-Oshima Island Ecotour Guide Liaison Council established.
2012	Tokunoshima Island Ecotour Guide Liaison Council established.
	Amami-Oshima Island Ecotourism Promotion Council and Tokunoshima Island Ecotourism Promotion Council established.

The Okinawa Prefecture Department of Environment, together with others, declared the following (in 2015): While it is difficult to perform a numerical prediction as to how much growth in demand for inbound tourism should be anticipated by the respective regions following their inscription on the natural World Heritage list, it will presumably be necessary to have examined a variety of steps by assuming, as one measure, the possibility of an approximately 1.5-fold increase in demand in comparison to the present status (approximately 800,000 visitors in the northern part of Okinawa Island and approximately 500,000 visitors on Iriomote Island).

In the northern part of Okinawa Island, promotional organizations have been established by Kunigami Village, Ogimi Village, and Higashi Village, respectively, and are engaged in a variety of actions suited to the actual circumstances of each area, with the aim of ensuring sustainable utilization, including signing conservation and utilization agreements, developing guidelines and voluntary rules, investigating resources and creating programs, and developing human resources (Table 4-10).

Table 4-10: Status of actions for ecotourism promotion in the northern part of Okinawa Island

Year	Actions
1999	Higashi Village Ecotourism Association established.
2001	NPO Kunigami Tourism Association established.
2007	Kunigami Village Environmental Education Center "Yanbaru Discovery Forest" established (operated by Kunigami Tourism Association). Ogimi Village prohibited access to Mt. Tamachiji, for which there were concerns over the issue of overuse.
2008	NPO Ogimi Inside Out Tourism Association established.
2010	NPO Higashi Village Tourism Promotion Council established.
2014	Mt. Ibudake District Conservation and Utilization Agreement (on the specification of an appropriate number of visitors, location-specific rules, donation of environment support funds to the district, etc.) signed between the Ada district of Kunigami Village and an eco-tour operator (a single business), and accredited.

On Iriomote Island, an ecotourism promotional organization was established, which currently has a variety of actions underway with the aim of ensuring sustainable utilization, including signing conservation and utilization agreements, developing guidelines and voluntary rules, investigating resources and creating programs, and developing human resources (Table 4-11).

Table 4-11: Status of actions for ecotourism promotion on Iriomote Island

Year	Actions
1996	Iriomote Island Ecotourism Association established.
1999	Iriomotejima Canoe Association established (35 businesses). (They set limits on the number of users on the Hinai River per day per business.)
2004	Nakama River Conservation and Utilization Agreement signed by tour boat and canoe business operators that use the Nakama River (five businesses). (It contains motor-driven tour boat driving speed limits, limits on the number of canoe users, etc.)

4.b. (v) Number of inhabitants within the property and buffer zone

Table 4-12 shows the number of residents within the property and buffer zones. There are no residents within the property boundaries. There are 10 households with 15 residents within the buffer zones.

Table 4-12: Residents within the nominated property and buffer zones

	Nominated property		Buffer zones	
	Number of residents	Number of households	Number of residents	Number of households
Amami-Oshima Island	0	0	1	1
Tokunoshima Island	0	0	6	3
Northen part of Okinawa Island	0	0	7	5
Iriomote Island	0	0	1	1
Total	0	0	15	10