TENTATIVE LIST SUBMISSION FORMAT

STATE PARTY: JAPAN **DATE OF SUBMISSION: 12/02/2013**

Submission prepared by:

Name:	Tetsuo Itoh	Yukimasa Shinoda
E-mail:	[redacted]	worldheritage@nm. maff. go. jp
Institution:	Ministry of the Environment	Forestry Agency
Address:	1-2-2 Kasumigaseki, Chiyoda-ku, Tokyo, 100-8975, JAPAN	1-2-1 Kasumigaseki, Chiyoda-ku, Tokyo, 100-8952, JAPAN
Fax:	+81-(0)3-3591-3228	+81-(0)3-3502-2887
Telephone:	+81-(0)3-5521-8275	+81-(0)3-3501-3845

Name of Property: AMAMI-RYUKYU

State, Province or Region: Kagoshima Prefecture and Okinawa Prefecture

Latitude and Longitude, or UTM coordinates: 24 - 29°N, 123 - 130°E

Description:

The proposed Amami-Ryukyu, for the purpose of this submission, refers to an area located at the south-western end of the Japanese Archipelago which forms a pendent island arc off the eastern shores of the Eurasian Continent. It consists of several islands and surrounding waters, and spreads about 850 km from north-east to south-west and range in latitude from 24° to 29° north and in longitude from 123° to 130° east. A warm, humid, subtropical climate prevails in the islands because of their latitude and the influences of the Kuroshio Current (which has an annual mean temperature 2 to 3 °C higher than that on land) and the subtropical high pressure in the western North Pacific Ocean.

The area in which Amami-Ryukyu is located is at the boundary of the Eurasian plate and the Philippine Sea plate. The Ryukyu Trench (5,000 to 7,000 m deep), Ryukyu Outer Arc Slope, Ryukyu Outer Arc Prominent Band (non-volcanic), Ryukyu Inner Arc Prominent Band (volcanic), Ryukyu Inner Arc Slope (1,000 to 2,000 m deep), and East China Sea Continental Shelf (less than 200 m deep) spread from the Pacific side to the continent in that order; each of these forms an arc toward the Pacific side.

The present islands' configuration of the Amami-Ryukyu is considered to have been formed mostly through the initial formation and expansion of the Ryukyu Inner Arc Slope and through other radical tectonic movements both involved in the subduction of the Philippine Sea plate underneath the Eurasian plate along the Ryukyu Trench since the Middle Miocene in the Neogene (about 15 million years ago). Subsequently there were eustatic sea-level fluctuations caused by climate change and sedimentation of the Ryukyu Limestone associated with the development of coral reefs since the Early Pleistocene in the Quaternary (about 1.7 million years ago).

This area is isolated from the Eurasian Continent by these tectonic movements, and the component islands have undergone further repeated isolations from, and reunions with, each other through eustatic sea-level fluctuations. These alterations in the arrangement of dryland areas and submerged areas have, on the one hand, supposedly caused various terrestrial lineages of the region to enter the relict state; on the other hand, they have caused a series of allopatric speciations at a fine scale with or

without subsequent secondary sympatries. As a result, the islands currently harbour diverse fauna and flora that are characterized by high proportions of endemic and rare species.

Justification of Outstanding Universal Value:

The area corresponding to the current Amami-Ryukyu has experienced marked, complex changes in land configuration. These have involved palaeogeological dynamics such as the tectonic movements leading to the start of the formation of the Ryukyu Inner Arc Slope 15 million years ago; these movements particularly accelerated during the last 1.7 million years. The changes have also involved palaeoenvironmental dynamics such as alternations of glacial and inter-glacial periods leading to prominent eustatic sea-level alterations during the last 1.7 million years. Such a series of historical events has made this assemblage of continental islands an area that offers outstanding examples of speciation and phylogenetic diversification of terrestrial organisms at various stages through varying extents of geographic isolation. Not only have numerous endemic species emerged through relatively recent vicariance events, but also a large number of relict species that have no close relatives on the Japanese mainland or Eurasian Continent occur on the Amami-Ryukyu.

Furthermore, because the Amami-Ryukyu is located between the tropical and warm–temperate zones, their current fauna and flora include not only representatives of long-standing subtropical lineages but also those of East Asian temperate lineages and South East Asian and Oceanian tropical lineages. Moreover, the high proportion of endemic and threatened species in this area indicates that they deserve a major conservation focus. The Amami-Ryukyu encompasses a set of important, essential habitats for these species.

Criteria considered to be met:

(i) (ii) (iii) (iv) (v) (vi) (vii) (viii) (ix) √ (x) √

Criterion (ix): Before the Middle Miocene (about 15 million years ago), when the area corresponding to most of the current islands in East Asia (including the area of the proposed Amami-Ryukyu) composed the eastern edge of the Eurasian Continent, the terrestrial organisms occurring in this area likely had broad continental distributions. In the course of the area's conversion to a chain of continental islands separated from the continent by the East China Sea and Sea of Japan, the terrestrial organisms isolated on each island, with its distinctive environment, have evolved in various unique directions. This has been enhanced by the effects of population fragmentation.

In particular, on the Amami and Okinawa Groups of the central Ryukyus, a number of terrestrial organisms with limited ability to disperse across the sea, such as non-volant tetrapods, have been isolated from their continental relatives since no later than the Early Pleistocene (between 2 and 1.7 million years ago). This, along with the subsequent extinction of the continental relatives, despite the survival of many of the insular representatives to the present because they have been protected by the sea barrier from recently emerging predators and competitors, has made the region the centre of relict endemism. Such relict species are generally characterized by prominent geographical and genetic gaps from extant sister populations in other areas. Prominent faunal representatives of such relict endemisms include the Amami rabbit *Pentalagus furnessi*; the Ryukyu long-tailed giant rat *Diplothrix legata*; three spiny rat species of the genus *Tokudaia*; the Amami jay *Garrulus lidthi*; the Ryukyu black-breasted leaf turtle *Geoemyda japonica*; Kuroiwa's ground gecko *Goniurosaurus kuroiwae*; Anderson's crocodile newt *Echinotriton andersoni*; and Namiye's frog *Limnonectes namiyei*. Floral representatives include *Arisaema heterocephalum* (Araceae), *Viola amamiana* (Violaceae), *Polystichum obae* (Dryopteridaceae), *Platanthera sonoharae* (Orchidaceae) and *Solenogyne mikadoi* (Asteraceae . The Amami rabbit is estimated to have diverged from the other extant members of the family Leporidae in the Middle Miocene (about 10 million years ago). Since then, it seems to have evolved a suite of distinctive ecological traits while maintaining its largely primitive morphological features. There are no other extant congeners at all, thus making the rabbit endemic to the Amami Group at the generic level.

On the Amami-Ryukyu, speciations and phyletic divergences are still ongoing at various stages among island populations with close historical affinity. As a result of genetic differentiation in each lineage through geographic isolation caused by insularization of the region (see above), there are numerous cases of between-island *in-situ* speciation and sub-speciation. Typical examples are a group of tip-nosed frogs that has differentiated into five species on the subtropical islands between the Amami Group and Taiwan, and Kuroiwa's ground geckos, which are distributed only on limited numbers of islands of the Tokunoshima Island and Okinawa Groups and have differentiated into five subspecies. The high frequencies of occurrence of endemic taxa among the amphibians and terrestrial reptiles deserve particular attention. Forty-seven out of the 59 species of native terrestrial reptiles in the Amami-Ryukyu are endemic to this region, making the endemism ratio about 80%. Likewise, at least 19 out of the 24 native amphibians in the proposed area are endemic to the region, giving an endemism ratio nearly 80%. More than 1,000 flowering plant species grow in each of the major island groups composing the Amami-Ryukyu; about 127 of these species are endemic to the region.

Speciation and further diversification of a number of evolutionary lineages at the Amami-Ryukyu have therefore supposedly been enhanced. Indeed, many endemic species occur on these islands, most likely as a result of geohistorical processes in the region that involved the initial isolation of insular populations from their continental relatives and subsequently repeated vicariance and secondary sympatry among the former. Moreover, several islands harbour taxa that represent the stage of relict endemism as a result of long insular isolation from the formidable predators or competitors that started to prevail on the continent after the islands became isolated. This is particularly true for some major islands of the Amami and Okinawa Groups of the central Ryukyus in which relict species are particularly frequent because of the islands' long isolation. These aspects of the Amami-Ryukyu collectively constitute an outstanding example of the effects of long-standing geohistorical processes on speciation and phylogenetic diversification of terrestrial organisms.

Fossil evidence indicates that on the islands of the Amami and Okinawa Groups of the central Ryukyus there have been no, or have long been no endothermic vertebrates such as carnivorous mammals and large-bodied resident birds of prey to occupy the position as the top predators in the indigenous food web. Instead, the biotic community of this region is characterized by a high frequency of relict species (see above) and constitutes a unique food web in which a few large-bodied snakes occupy the top predator position.

The subtropical forests of the Amami-Ryukyu are sustained by abundant rainwater from the humid air brought to the land by the warm Kuroshio Current, which flows alongside the islands. The annual precipitation in the Amami-Ryukyu area exceeds 2,000 mm—higher than in most other areas at comparable latitudes. This humid subtropical forest has nurtured a number of endemic or endangered species. Moreover, various types of organic matter and nutrient salts brought by the river systems from the subtropical forests to the river mouths and adjacent coasts nourish mangroves, tidal flats, seagrass beds, and coral reefs. On each island there is an uninterrupted ecosystem that ranges from the inland forests to the coastal environments.

Criterion (x): The Amami-Ryukyu contains important habitats for a large number of internationally recognized threatened species that are listed on the IUCN Red List. Furthermore, the islands provide diverse instances of neo- and relict endemism that are most explicitly represented by non-volant, inland-water-dependent taxa such as amphibians, the dispersal ability of which across the ocean is very limited by physiological constraint. From the global point of view, therefore, the Amami-Ryukyu can obviously be regarded as among the most important areas for biodiversity conservation.

The Amami-Ryukyu contains irreplaceable habitats for more than 50 terrestrial species listed on the IUCN Red List in the Vulnerable (VU), or higher, threatened categories. These include the Iriomote leopard cat *Prionailurus bengalensis iriomotensis* (IUCN Red List 2012: critically endangered, CR), Amami rabbit (endangered, EN), Okinawa spiny rat *Tokudaia muenninki* (CR), Amami spiny rat *Tokudaia osimensis* (EN), Tokunoshima spiny rat *Tokudaia tokunoshimensis* (EN), Ryukyu long-tailed giant rat (EN), Okinawa rail *Gallirallus okinawae* (EN), Okinawa woodpecker *Dendrocopos 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), and Utsunomiya's frog *Odorrana utsunomiyaorum* (EN). They also include two sibling *Odorrana* species, namely the Okinawa Ishikawa's frog *Odorrana ishikawae* and the recently described Amami Ishikawa's frog *Odorrana splendida*, which are still listed as one species (Ishikawa's frog *Odorrana ishikawae* (EN)) on the IUCN list. Most of the threatened species seen in the Amami-Ryukyu are endemic to the area at the generic, specific, or subspecific level. Furthermore, a characteristic mixture of East Asian, South East Asian, and Oceanian floral elements can be seen on the islands, reflecting the climatic conditions and various historical processes of dispersals. The diversity of flora on the Amami-Ryukyu is quite high: more than 1,000 flowering plant species grow in each of the major island groups of this region. The Amami-Ryukyu accounts for less than 1% of the whole land area of Japan, yet it accommodates about 20% of the nation's endangered vascular plants. This area is therefore of the utmost importance for the conservation of Japan's endangered plants.

The area range of Amami-Ryukyu has therefore been selected as an internationally important region, as described below.

Conservation International has selected Japan as a Biodiversity Hotspot and has referred to this area, in particular, as the sole natural habitat for a number of endemic species in danger of extinction.

BirdLife International has designated this area as one of the Endemic Bird Areas of the World in recognition of its importance in providing habitats for several distinct endemic species, including the Okinawa rail and the Ryukyu woodcock *Scolopax mira*. Also, BirdLife has selected eight areas within this area as Important Bird Areas, because these areas are habitats of globally threatened species or species with restricted ranges, or they act as stopover or wintering sites for congregations of migratory birds.

Furthermore, the World Wildlife Fund (WWF) has included the forest ecosystem and coastal ecosystem of this region in its Ecoregions - Global 200 list.

As described above, the Amami-Ryukyu contains extremely important and significant natural habitats for the *in-situ* conservation of biological diversity, including those of endangered species of global importance.

Statement of authenticity and/or integrity:

Integrity: The proposed Amami-Ryukyu contains distinctive island ecosystems that reflect its geological history and the effects of the warm, humid climate brought by the Kuroshio Current and the monsoon. These ecosystems contain examples of well-preserved processes of evolution on continental islands, and they provide habitats for internationally important endangered species. The proposed area also contains diverse and endemic animal and plant species and a sufficient area of subtropical forest to ensure these species' survival and continuities of ecosystems through river systems from the upland forests down to the coastal seagrass beds, tidal flats, and coral reefs. The site not only covers all of the elements that constitute the outstanding universal value described above; it also has an area of sufficient size to maintain its values.

In addition, relevant organizations are working together on measures to counter alien species. This includes pest control and eradication projects that are based on the Invasive Alien Species Act and aim to conserve the unique island ecosystems, including their threatened faunal and floral elements.

Comparison with other similar properties:

Of the Nansei Islands, which include the Amami-Ryukyu, Yakushima has already been inscribed on the World Heritage List as a natural property. However, with the formation of the Tokara Strait, which is currently deeper than 1,000 m, Yakushima was separated from the Amami-Ryukyu area by the time of the Early Pleistocene (between 2 and 1.7 million years ago). In contrast, the strait between Yakushima and Kyushu Island of the mainland Japan, is no deeper than 100 m, so it is almost certain that Yakushima and Kyushu were connected through eustatic sea-level lowering by 120 to 140 m during the latest glacial period about 20,000 years ago, and that various terrestrial organisms such as deer and macaques migrated freely between the two islands. For this reason, the biota of Yakushima

has very close affinity with that of Kyushu, being an almost complete subset of the latter. Yakushima was inscribed on the basis of criteria (vii) and (ix), with its outstanding universal value for extensive, successive vertical plant distributions ranging from coastal vegetation dominated by subtropical elements up to a cold temperate bamboo grassland at the central peaks, together with its natural landscape characterized by abundant huge Japanese cedar trees, including those that are thousands of years old.

In contrast, the marked universal value of the proposed area lies primarily in its offering a number of outstanding examples of speciation at various stages in terrestrial organisms, as enhanced by their isolation on these continental islands. The value of the area is further strengthened by the fact that the area accommodates many endangered endemic species by having habitats suitable for them. It is therefore obvious that the area deserves high priority for preservation in terms of not only evolutionary biology but also biodiversity conservation. Thus, the source of value of the Amami-Ryukyu is completely different from that of Yakushima.

In the biogeographical classification of the whole World, Udvardy (1975) assigned the Amami and Okinawa Groups of the central Ryukyus to the "Ryukyu Islands" Province (2.41.13) of the Palaearctic realm in the "Mixed island systems" biome. Yakushima was assigned to the "Japanese Evergreen Forest" Province (2.2.2) in the "Subtropical and temperate rain forests or woodlands" biome; both areas were assigned to the Palaearctic realm but to different Provinces and Biomes. As mentioned above, however, it is currently obvious from the presence of many relict species that the Amami and Okinawa Groups were separated from the other island groups of the Nansei Islands and adjacent continent at least by the time of the Early Pleistocene (between 2 and 1.7 million years ago). Also, the terrestrial biota of the Amami and Okinawa Groups clearly differs from that of the Palaearctic realm, with the boundary being located along the Tokara Strait. Furthermore, the herpetofauna of the Amami and Okinawa Groups is closer to that of the southern Ryukyus, including the Miyako and Yaeyama Groups, than to that of the Kyushu area, including Yakushima. Such a pattern of faunal similarity strongly suggests that the terrestrial vertebrate fauna of the Amami and Okinawa Groups was related to that from the more southern regions (i.e., the Indomalayan realm), and that these island assemblages are biogeographically different from that of Yakushima at the realm level. There is a need for further accumulation of biological, palaeogeographical, and palaeoenvironmental data to define the biogeographical relationships among the Amami-Ryukyu and adjacent regions with certainty.

In Japan, there is another subtropical island group, the Ogasawara Islands, which was inscribed as a natural World Heritage on the basis of criterion (ix). The Ogasawara Islands feature ongoing evolutionary processes in oceanic island ecosystems—in particular speciation through adaptive radiation in land snails and plants—as outstanding universal values. For this reason, the ecological process of the Ogasawara Islands differs completely from that of the proposed Amami-Ryukyu where there is neo- and relict endemism of biota as a result of separation during the process of formation of continental islands.

Existing World Heritage islands that lie at similar latitudes as the Amami-Ryukyu, that have been inscribed on the basis of criterion (ix), and that have geohistorical relationships with adjacent continents include Alejandro de Humboldt National Park (Cuba), the Islands and Protected Areas of the Gulf of California (Mexico), Coiba National Park and its Special Zone of Marine Protection (Panama), and the Lagoons of New Caledonia: Reef Diversity and Associated Ecosystems (France). Unlike in the case of the Amami-Ryukyu, however, for none of these others is it explained under criterion (ix) that the property provides a clear example of the processes of speciation and diversification of various evolutionary lineages and production of many endemic species, including relicts, during the formation of the current island assemblage through isolation from the adjacent continent and the repetition of separation and reunion among the component islands.

Other tropical or subtropical island arcs that may have significant geohistorical relationships with adjacent continents but are nevertheless not inscribed on the World Heritage List include the Caribbean Islands. The Caribbean Islands form an arc of continental islands at the boundary of the North American Plate, the Caribbean Plate, and the South American Plate; they consist of the Bahama Islands, Greater Antilles, and Lesser Antilles. Each of these island assemblages has unique ecosystems

and biodiversities as a result of their processes of land formation. New findings have recently been reported in regard to the relationship between island-arc formation in the Caribbean Islands and the origin and separation of the biota there. These findings suggest that animals dispersed across the sea in an age more recent than was presumed from the islands' geological history, although the academic dispute continues.

On the other hand, because of its background conditions (including the presence of an island arc with the islands aligned north and south, and the Kuroshio Current, which flows in one direction), the Amami-Ryukyu serves as a plain model of the history of island-arc formation and evolutionary diversification of biota, and the history of their formation have been studied in detail. The Amami-Ryukyu is therefore the only such area that can be used, at least to a certain extent, to present the relationships between geological and biological history in a scientific and concrete manner.