



Biocultural diversity of Yakushima Island: Mountains, beaches, and sea

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Abstract Yakushima Island, which has been designated a Biosphere Reserve and World Heritage Site, has rich biodiversity and a culture that depends on the local ecosystem. The biodiversity of this island is characterized by a unique biota because the island is located at a biogeographic boundary.

The inhabitants revere nature and use natural resources from the sea, lowlands, and mountains. They have inherited a bioculture that they use throughout their lives and have close relationships with deer (*Cervus nippon*), sea turtles (*Caretta caretta*), and spotted mackerel (*Scomberomorus niphonius*).

The number of tourists visiting Yakushima Island increased after it was inscribed on the World Heritage List. However, most visitors do not visit the villages in the lowland areas and are not interested in the traditional biocultural diversity on the island. The residents are faced with decreasing agricultural and fishery production and the economic effects of sightseeing are limited. To conserve biocultural diversity on Yakushima and to enhance sustainability, it is necessary to create a plan for the entire island. We hope that the biocultural diversity of this island will be passed on to future generations with pride, utilizing the concept of a Biosphere Reserve.

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Introduction

Biosphere reserves are sites established by countries and recognized under UNESCO's Man and the Biosphere (MAB)

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Programme to promote sustainable development based on local community efforts and sound science, since 1976. As places that seek to reconcile conservation of biological and cultural diversity and economic and social development through partnerships between people and nature, they are ideal to test and demonstrate innovative approaches to sustainable development from local to international scales. There are currently 621 biosphere reserves in 117 countries, including 12 transboundary sites (UNESCO, 2013).

There are 5 Biosphere Reserves in Japan. Shiga Highland, Mt Hakusan, Mt Odaigahara & Mt Omine and Yakushima Island were designated in 1980. Aya was designated in 2012.

Yakushima Island lies on the biogeographic boundary of the northern limit of the subtropical zone and southern limit of the Palearctic zone; consequently, it has a varied biota and rich biodiversity (Ministry of the Environment et al., 2012). The primeval forests, which include evergreen broadleaf forests, in the warm-temperature zone and large natural forest of the Japan cedar, which include trees over 2000 years old, are reasons why Yakushima Island has been designated a Biosphere Reserve (Okano, 2012).

Biome formation on the Yakushima Island has long been accompanied with human artifacts since eruption of a neighbor sea mountain heavily damaged vegetation on the island ca. 6000 years ago. The fauna and flora on the island are certainly affected by inhabitants who use the natural resources of this island. There have never been top predators such as Japanese wolves. Only hunters and hounds kills Yaku deer. (*Cervus nippon yakushimae*). Consequently, It certainly affects culture of the island.

This paper reports on the biological and biocultural diversity of Yakushima Island, which has been designated a Biosphere Reserve and World Heritage Site.

Brief description of nature

Yakushima Island, located at latitude 30°15′–30°23′N and longitude 130°23′–130°38′E (Fig. 1), has an area of ca. 500 km² and an approximately circular perimeter of 132 km. The Yakushima Biosphere Reserve was designated in 1980 and covers 18,958 ha of the island (Japanese Coordinating Committee for MAB, 2009). The Biosphere Reserve consists of a 7559-ha core and an 11,399-ha buffer zone, with no transition zone (Fig. 2).

1. Biodiversity

The biodiversity of Yakushima Island is described mainly according to “Yakushima World Heritage Area Management Plan” (Ministry of Environment et al., 2012).

Yakushima Island, at the northern end of the Ryukyu archipelago, is separated from the southernmost tip of the main Japanese island of Kyushu by a 120-m-deep, 60-km-wide strait. The island is also characterized by mountainous landscape, with more than 30 peaks higher than 1000 m, including Miyanouradake (1936 m) that is the highest mountain in Kyushu Region (Japanese Coordinating Committee for MAB, 2009). Due to the proximity of the warm Kuroshio Current, rainfall is abundant on Yakushima, averaging 4000 mm annually in lowland areas and 8000–10,000 mm in the mountains (Eguchi, 2006).

The biota is similar to that of Kyushu, because the two were connected until about 20,000 years ago (Davison et al., 2005). However, Yakushima is located at the biogeographic boundary between the tropical and temperate regions, and all of the climatic zones of the Japanese islands, from Hokkaido to Kyushu, are condensed on this one island. The vegetation shows a vertical distribution with elevation (Fig. 3). The subtropical coastal area is home to flora such as the Japanese sea fig (*Ficus superba*) and Chinese banyan (*F. microcarpa*). Evergreen broadleaf forests grow in the warm-temperature zone from the coastline to 700–800 m a.s.l., while warm-temperature zone conifer forests composed of Japanese cedar

(*Cryptomeria japonica*) grow above this to 1200 m. Elevations above 1200 m are home to cool-temperate conifer forests and scrub forests of dwarf bamboo (*Pseudosasa owatarii*), and Yakushima dwarf rhododendron (*Rhododendron degronianum*) grow near the summits. In the cool-temperature zone near elevations of 1600 m, there are high moors composed of peat moss and Yakushima-koke-sumire (*Viola verecunda* var. *yakusimana*). These are high moors at the southern edge of Japan. Noticeably missing on Yakushima are representative tree species of the mainland cool-temperature zone, such as Japanese beech (*Quercus crispula* Blume) (Research Group on Biodiversity Estimation on Biosphere Reserves in Japan, 2007).

Natural Japanese cedar grows at elevations of 600–1800 m in the center of the island. These trees live up to 800 years in other areas in Japan. However, on the island, they can be older than 2000 years due to the abundant rain and high humidity, leading to slow growth. In addition, the trees high resin content makes them resistant to rot. Such trees are called *yakusugi*, where younger trees are called *kosugi*. Old-growth forests with *yakusugi* over 2000 years old provide unique, beautiful scenery.

There are more than 1900 plant species including ca. 600 species of moss (Ministry of the Environment et al., 2012). Yakushima Island is the southern limit for more than 230 species of plants, such as Japanese fir (*Abies firma*), southern Japanese hemlock (*Tsuga sieboldii*), and Japanese cedar, and the northern limit for ca. 70 species, such as fever nut (*Caesalpinia crista*) and “*oni hinoki shida*” (*Asplenium × kenzoii*) (Research Group on Biodiversity Estimation on Biosphere Reserves in Japan, 2007). Many endemic and endangered species have been confirmed on Yakushima, including species restricted to the highlands and species that grow in specific environments, such as rocky areas and mountain streams (Ministry of the Environment et al., 2012). Sixteen species of mammal have been confirmed, including four endemic subspecies: the Yakushima sika deer (*Cervus nippon yakushimae*), Yakushima macaque (*Macaca fuscata yakui*), Yakushima Dsinezumi shrew (*Crocidura dsinezumi umbrina*), and Yakushima small Japanese field mouse (*Apodemus argenteus yakui*). It is home to 167 confirmed bird species, including two endemic subspecies (Eurasian jay [*Garrulus glandarius orill*] and varied tit [*Parus varius yakushimensis*]); four species have been designated natural monuments: the Ryukyu robin (*Erithacus komadori*), Japanese wood pigeon (*Columba janthina*), Izu leaf warbler (*Phylloscopus iljimae*), and Izu thrush (*Turdus celaenops*). In addition, 15 species of reptile, 8 species of amphibian, and approximately 1900 species of insect have been confirmed on Yakushima Island, which is an extremely large biota for such a small island.

The fish of Yakushima Island were surveyed comprehensively during 2008–2009, by 10 Japanese agencies, including Kagoshima University Museum and the National Museum of Nature and Science. The survey recorded 951 species of marine (including brackish water) fish in 24 orders, 112 families, and 382 genera (Motomura and Matsuura, 2010).

2. Protected areas

Given the unique nature of Yakushima Island, it has been protected in several pieces of legislation, and is one of the most

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