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SINHARAJA FOREST RESERVE SRI LANKA

Sinharaja in south-west Sri Lanka is of national significance as the country's last large viable area of the virgin primary tropical rainforest, which used to cover the island. 64% of its trees are endemic and many of them are rare. The reserve is also home to 23% of Sri Lanka's endemic animals, including 85% of the country's endemic birds and over 50% of its endemic mammals, reptiles and butterflies.

COUNTRY

Sri Lanka

NAME

Sinharaja Forest Reserve

NATURAL WORLD HERITAGE SITE

1988: Inscribed on the World Heritage List under Natural Criteria ix and x.

STATEMENT OF OUTSTANDING UNIVERSAL VALUE [pending]

INTERNATIONAL DESIGNATION

1978: Recognised as a Biosphere Reserve under the UNESCO Man & Biosphere Programme (11,187 ha).

IUCN MANAGEMENT CATEGORY

II National Park

BIOGEOGRAPHICAL PROVINCE

Ceylonese Rainforest (4.02.01)

GEOGRAPHICAL LOCATION

Situated in the southwest lowlands of Sri Lanka 90 km southeast of Colombo, in Sabaragamuwa and Southern provinces. Bounded on the north by the Napola Dola and Koskulana Ganga, south and south-west by the Maha Dola and Gin Ganga, west by the Kalukandawa Ela and Kudawa Ganga and east by an old footpath near Beverley Tea Estate and the Denuwa Kanda: 6°21' to 6°26' N, 80°21' to 80°34' E.

DATES AND HISTORY OF ESTABLISHMENT

- 1875: Most of the area was declared the Sinharaja-Makalana Forest Reserve under the Waste Lands Ordinance (Gazette 4046); the rest was proposed as a forest reserve in the early 20th century;
- 1926: Sinharaja Forest Reserve of 9,203 ha set aside for watershed protection;
- 1978: Declared a UNESCO Biosphere Reserve, comprising the existing and proposed forest reserves;
- 1988: Notified a National Heritage Wilderness Area (7,648.2 ha) in Gazette 528/14. Inscribed as a World Heritage site (8,864 ha), 6,092 ha being forest reserve and 2,772 ha a proposed forest reserve.
- 1992: The State Party included an adjoining forest extension within the World Heritage site, creating the Sinharaja National Heritage Wilderness Area of 11,187 ha, formerly the Sinharaja Forest Reserve and coterminous with the Biosphere Reserve. It does not yet form an extension of the World Heritage site (Forest Dept., 2003)

LAND TENURE

State. Administered by the Forest Department under the Ministry of Lands and Land Development. Coordinated with the Biosphere Reserve by a National Steering Committee.

AREA

8,564 ha.

ALTITUDE

300m to 1,170m (West Hinipitigala Peak).

PHYSICAL FEATURES

This 21 by 4 km strip of undulating piedmont consists of a series of ridges and valleys around the Rakwana mountain massif. It is drained by an intricate trellis of streams, which flow into two major rivers; via the Maha Dola into the Gin Ganga (river) along the southern boundary and into the Kalu Ganga to the north, via the Napo Dola, Koskulana Ganga and Kudawa Ganga rivers. The Reserve lies in the transition zone of two major rock types characteristic of Sri Lanka. A group of formations in the southwest consists of metasediments, charnockites and scapolite-bearing calc-granulites; the highland group comprises khondalites of metamorphosed sediments and charnockites (Cooray, 1978). There is an unusual large outcropping of basic rocks in the centre, the Sinharaja Basic Zone. This consists of hornblende, pyroclasts, basic charnockites, pyroxene amphibolites and scapolite-bearing calc-granulites with small amounts of quartzite, garnet-biotite gneisses and intermediate charnockites (Hapuarachi *et al.*, 1964). This zone coincides with an aeromagnetic anomaly which has probably contributed to the desilication responsible for the gem fields in the area (Katz, 1972; Munasinghe & Dissanayake, 1980). The soils, which are largely red-yellow podzols, except for alluvium in the valleys, are impermeable, weathering to laterite in places and show very little accumulation of organic matter. This is attributed to the combination of climatic conditions, a diverse soil microflora which rapidly breaks down organic matter into its constituent nutrients, and to accelerated uptake and recycling of the nutrients by the trees (de Zoysa & Raheem, 1987).

CLIMATE

The forest receives rain from both the northeast monsoon between November to January and the southwest monsoon from May to July. Almost all of it lies between the 3810mm and 5080mm isohyets. The average annual rainfall is over 2500mm with no dry spell: even the driest month, February, has an average of 189mm (Gunatilleke & Gunatilleke, 1983). There is little seasonal variation in temperature, but a high diurnal range: temperatures fluctuate between 19°C and 34°C (de Zoysa & Raheem, 1987) but the impact is minimised by the constant rainfall.

VEGETATION

Sinharaja is an undisturbed fragment of the ancient tropical rainforest of Sri Lanka, part of a 47,000ha dense lowland forest three-quarters of which was logged until recently (de Zoysa & Simon, 1999). It contains over 50% of the remaining such forest in Sri Lanka. Of the 337 species which occur there, 116 are globally threatened. Three main types of forest are found there: remnant Dipterocarp forest below about 500m, *Shorea* forest, climax vegetation over most of the reserve on the middle and upper slopes to 900m, and a transitional zone to tropical montane forest above about 900m. 220 species of trees and woody climbers are recorded of which 40% have low population densities (10 or fewer individuals per 25 ha) and 43% have restricted distribution, making them vulnerable to further encroachments into the reserve (Gunatilleke & Gunatilleke, 1981). Of Sri Lanka's 217 endemic wet lowland trees and woody climbers, 139 (64%) have been recorded in Sinharaja, 16 of which are considered to be rare (Peeris, 1975; Gunatilleke & Gunatilleke, 1981, 1985). Details of the structure and composition of the vegetation are summarised in de Zoysa & Raheem (1987), and a list of 202 plants, together with their endemism and uses was given in the 1986 Conservation Plan by the Forest Department.

In the valleys and on the lower slopes the dominant canopy trees are *Dipterocarpus hispidus* (*bu-hora*) (CR) and *D. zeylanicus* (*hora*) (EN), present in some almost pure stands but generally scattered as a result of encroachment by rubber and tea plantations. Other trees include *Messua* spp. (*na*), *Doona* (*dun*), *Camposperma zeylanica* (*aridda*), *Vitex altissima* (*milla*), *Wormia* sp. (*diyapara*) and *Chaetocarpus* (*hadawaka*). This forest type is characterized by the presence of scattered emergents rising clear of the main canopy to 45m. Secondary forest and scrub grow widely where the original forest cover was removed by shifting cultivation or by rubber and tea plantations (de Rosayro, 1954).

The middle slope forest is the most extensive. This starts at about 500m according to de Rosayro (1942) or above 335m (Gunatilleke & Gunatilleke, 1985). It is characterized by the *Mesua-Doona* (*na-dun*) community, including *Mesua nagassarium* (*batu-na*), *M. ferrea* (*diya-na*) and several species of *Shorea* (*dun*). The tree canopy reaches 30-40m, is unbroken and without emergents. The subcanopy is co-dominated by a range of species; the understorey is invariably dominated by *Garcinia hermonii* followed by *Xylopia championii*; groundcover is sparse (Gunatilleke & Gunatilleke, 1985).

On the upper slopes and ridges the vegetation is transitional between the tropical wet evergreen and tropical montane forests and trees decrease in size. In the section to the east added in 1988 the vegetation is sub-montane evergreen forest, and on exposed summits the stunted trees are typical of montane conditions. Characteristic species are *Celtis cinnamomea* (*gurenda*), *Carallia calycina* (*ubberiya*) (VU), *Calophyllum calaba* (*keena*), *C. thwaitesii* (VU), *Diospyros sylvatica* (*sudu kadumberiya*), *Terminalia parviflora* (*hampalanda*), *Mastixia nivali* (VU), *Doona gardneri* (*dun*) and *Oncosperma fasciculatum* (*katu kitual*). Relative rarities include *Lindsea repens*, *Tectaria thwaitesii*, *Glycosmis cyanocarpa*, calamander ebony *Diosporus quaesita* and *Antidesma pyrifolium*. The undergrowth consists of many indigenous herbs and shrubs, of which common species are *Schizostigma* sp., *Paspalum confugatum*, bamboo orchid *Arundina gramimifolia*, *Lycopodium* sp. (*badalvanassa*) and *Dicranopteris linearis*.

Trees of over 300cm in girth seen in Sinharaja are: *Mesua ferrea*, *Mesua thwaitesii* (*diya na*), *Dipterocarpus zeylanicus*, *D. hispidus*, *Pseudocarpa championii* (*gona pana*) (VU), *Vitex altissima*, *Shorea stipularisi* (*hulan idda*), *S. trapezifolia* (*yakahalu*), *Mangifera zeylanica* (*etamba*), *Scutinanthe brunnea* (*mahabulu mora*), *Syzygium rubicundum* (*maha kuratiya*), *Hopea discolor* (*mal-mora*) (EN), *Palaquium petiolare* (*kirihambiliya*) and *Cryptocarya membranacea* (*tawwenna*) (EN). Rare endemics include the palm *Loxococcus rupicola* (*dotalu*) (CR) and *Atalantia rotundifolia*, found only at Sinhagala at 742m. 169 wild plants are still known to be used by local villagers (Manikrama, 1993). Major plants used intensively are *kitul* palm *Caryota urens*, for *jaggery*, a sugar substitute, and bamboo *Ochlandra stridula* (*bata*), *Calamus ovoideus*, and *C. zeylanicus* (*wewal*) for cane, cardamom *Elattaria ensal* for spice, *Shorea* sp. (*dun*) for flour, *Shorea* sp. (*beraliya*) and *Vatima copallifea* (*hal*) for varnish and incense and *Cosciniium fenestratum* (*weni wal*) for medicinal uses (Gunatilleke *et al.*, 1994; Lubowski, 1996).

FAUNA

Preliminary lists of the fauna are included in the Forest Department's 1986 Conservation Plan. Endemism is high. Of 270 vertebrate animal species recorded by the Forest Department, 60 (23%) are endemic. There are 39 mammals, 8 being endemic, 147 birds - 19 endemic, 20 amphibians - 10 endemic, 72 reptiles - 21 endemic and 20 fish - 7 endemic. 95% of the bird species endemic to Sri Lanka occur in Sinharaja, over half of which are rare or found in low densities. Endemism among mammals, reptiles, and butterflies is especially high. Of the 65 butterfly species present, 21 are endemic.

A small group of Indian elephants *Elephas maximus* (EN) survives in the north-east. The dominant though little seen predator is the Sri Lankan leopard *Panthera pardus kotiya* (EN). Other mammals include the endemic purple-faced langur *Trachypithecus vetulus* (EN), western toque macaque *Macaca sinica aurifrons* (EN), jackal *Canis aureus lanka*, rusty-spotted cat *Prionailurus rubiginosus* (VU), fishing cat *Zibethailurus viverrina*, crested wild boar *Sus scrofa cristatus*, sambar *Rusa unicolor* (VU), northern red muntjac *Muntiacus vaginalis malabaricus* and white-spotted mouse deer *Moschiola meminna*. 20 smaller mammals include Eurasian otter *Lutra lutra nair*, and Indian pangolin *Manis crassicaudata*. Birds which are endangered or rare are Sri Lanka whistling thrush *Myophonus blighi* (EN), Sri Lanka wood pigeon *Columba torringtoniae* (VU), green-billed coucal *Centropus chlororhynchus* (VU), Sri Lanka white-faced starling *Sturnus albofrontatus* (VU), Sri Lanka blue magpie *Urocissa ornata* (VU), and ashy-headed laughingthrush *Garrulax cinereifrons* (VU), all of which are endemic, and the red-faced malkoha *Phaenicophaeus pyrrhocephalus* (VU) (Hoffmann, 1984). Sightings of the Sri Lanka broad-billed roller *Eurystomus orientalis irisi* have decreased markedly in the last five years (de Zoysa & Raheem, 1987).

Among the reptiles and amphibia, Asiatic python *Python molurus* is nationally vulnerable and several endemic species are threatened. Noteworthy species include spineless forest lizard *Calotes liocephalus* (EN), the rarest of all the island's agamid, the rare rough-nosed horned lizard *Ceratophora aspera* (VU), restricted to part of Sri Lanka's wet zone, and *Ramella palmata*, a rare endemic microhylid frog (de Zoysa & Raheem, 1987). Threatened freshwater fish are combtail *Belontia signata*, smooth-breasted snakehead *Channa orientalis*, black ruby barb *Puntius nigrofasciatus*, cherry barb *Puntius titteya* and the endemic red-tail goby *Sicyopterus halei*, the conservation status of which is considered in Evans (1981). Of 65 species of butterfly, 21 are endemic. A striking swallowtail, the Sri Lanka rose *Atrophaneura jophon* (CR),

and the five-bar swordtail *Graphium antiphates ceylonicus*, elsewhere considered very rare, are not uncommon in Sinharaja at certain times of the year (Collins & Morris, 1985; J. Banks, pers. comm., 1986). An early account of the fauna was given by Baker in 1937 and a comprehensive summary is given in de Zoysa & Raheem (1987).

CONSERVATION VALUE

Sinharaja Forest Reserve is one of the richest areas of the southern Indian biological 'hotspot'. It is the last and largest viable remnant of lowland tropical rain forest in Sri Lanka. 64% of endemic Sri Lankan trees are found there with many beneficial plants; also 23% of its endemic animals including 85% of its endemic birds and over 50% of its endemic mammals and reptiles, many of them rare, (IUCN, 2000). The Park lies within a Conservation International-designated Conservation Hotspot, in a WWF Global 200 Freshwater Eco-region and is one of the world's Endemic Bird Areas.

CULTURAL HERITAGE

The region has a history dating back to the ancient kings of Sinharaja and is featured in the legends and lore of the people. The name, literally meaning lion (*sinha*) king (*raja*), may refer to the original kingly or royal forest of the Sinhala people, a legendary 'lion-race' of Sri Lanka (Hoffmann, 1979). Respect for this symbolic role halted its logging in the 1970s (de Zoysa & Simon, 1999).

LOCAL HUMAN POPULATION

Sinharaja forest is surrounded by 32 medium to large villages found on the southern, northeastern, northern and northwestern margins of the forest. The population is growing along the northern boundary (Barathie & Widanapathirana, 1993) and some villages in the south were established on state land without approval. The southwestern, eastern, northeastern and northern sections of the forest are surrounded by private estates and natural forests. The number of families in the villages around Sinharaja was estimated in 1993 at 1297 and the population at about 7,000. The villages' infrastructure is poor, and the road network, often very poor so the people have to carry their produce over long distances to market. Several community-based organizations exist in each buffer zone village. In one formed by the Forest Department called Friends of Sinharaja (*Sinharaja sumithuro*) the members help to manage and protect the forest. Another is the Sinharaja Village Trust funded by international NGOs which links training, private enterprise and marketing to improved biodiversity and promoting ecotourism (de Zoysa & Simon, 1999).

The main occupation is growing tea, rubber & coconut, rice and *chena*, with a little livestock husbandry and some cinnamon, cardamom, coffee and cloves. In almost all the villages, cropland is being converted to tea cultivation due mainly to attractive prices for tea, the availability of government subsidies for tea smallholdings, and to a well developed marketing infrastructure. This has not diminished the pressure on the forest resources local dependence on which varies, but when studied by de Silva in 1985, about 8% of all households may have been completely dependent on forest products, both timber and non-timber. Such use is increasing. All around Sinharaja the main activity is *kitul* palm tapping and the preparation of treacle and *jaggery*, for which there is a well developed market of traders who visit the villages and buy it for sale in the towns. Other forest products collected are *hal*, *beraliya*, *weni wal*, mushrooms, tree barks, rattan, wild cardamom, resins, honey, areca nut and a range of medicinal plants. But knowledge about the last is fast eroding (Manikrama, 1993).

VISITORS AND VISITOR FACILITIES

In 1994 there were some 17,000 visitors. In 2000, at least 12,099 school children, 9,327 domestic visitors, and 2,260 foreigners visited the site. In 2002 the 36,682 visitors included environmentalists, university students, school children and foreigners, a pressure which is beginning to degrade the environment. (Forest Dept, 2003). There are three entrances: Kudawa, Morningsite and Pitadeniya, from the northern, eastern and southern sides respectively. Kudawa is the main entrance point, with a conservation office, an information centre, a Research, Education and Extension Centre, accommodation for 102 people in six dormitories and lodges, and tour guides. The Mulawella, Waturawa, Nawada tree trail, Gallen Yaya and Sinhagala nature trails start at this entrance. The Morningsite entrance, in the quite different submontane forest, has accommodation for ten people. Pitadeniya, south of Sinharaja, is being developed under the Southwest Rainforest Conservation Project funded by the Global Environmental Facility Programme of the UNDP. This is building an Information Centre, a dormitory, a bridge over the Gin Ganga river and opening up four nature trails. Eight guides should be available to assist visitors.

SCIENTIFIC RESEARCH AND FACILITIES

Among the early studies are those of Baker who in 1936 recognised Sinharaja as "the only considerable patch of virgin tropical rain-forest in the island" (Baker, 1937, 1938), and of de Rosayro (1954, 1959), Andrews (1961) and Merritt & Ranatunga (1959) whose aerial and ground surveys assessed the area's potential for selective logging. Gunatilleke & Gunatilleke in 1980, 1981 and 1985 examined the floristic composition and phyto-sociology of the woody vegetation and assessed its conservation value. Research on the endemic fauna has been undertaken by WWF/IUCN Project 1733 and by March for Conservation (Karunaratne *et al.*, 1981). Conflicts over the local use of forest resources have been examined by McDermott (1985), McDermott & Gunatilleke (1990) and de Silva (1985). An annotated vegetation-land use map of the reserve at 1:40,000 has been produced by the Forest Department.

The Natural Resources Energy and Science Authority of Sri Lanka provides a field research station with basic facilities in the northern part of Sinharaja. The Forest Department building at Kudawa outside the reserve, is also used by scientists and visitors. Researchers from the Universities of Peradeniya, Harvard and Yale have studied the potential uses of plants, and there have been researchers from the Universities of Peradeniya, Colombo, and Sri Jayawardanapura as well as independent and foreign scientists and from the National Science Foundation of Sri Lanka. Research is mainly into the flora, fauna and ecology, though the southern and newly annexed eastern sections have not yet received much attention. There are well-funded UNEP/GEF national programmes for the conservation and sustainable use of medicinal plants and the inventorying of wild relations of crop species.

MANAGEMENT

Sinharaja is administered by the Forest Department under the Ministry of Lands and Land Development, and governed principally by the National Heritage Wilderness Areas Act of 1998, with special powers for World Heritage protection. It is a National Heritage Wilderness Area any excision from which is permissible only with the concurrence of parliament and the President of the country. The site is also partially protected under the provisions of the Forest Ordinance. Owing to its inaccessibility and steep terrain, the reserve remained untouched until 1968 when the government permitted timber extraction for plywood and chipwood. About 1,400 ha of forest in the western sector were selectively logged (Gunatilleke, 1978; Forest Department, 1986). From 1971 there was public opposition led by the Wildlife and Nature Protection Society until in 1977 logging was banned (Hoffmann, 1972, 1977). The Reserve has 6,500-7,000ha of unlogged virgin forest. Since 1977, the Forest Department has given high priority to protecting the Reserve and in 1978 began planting *Pinus caribaea* along the periphery to establish a live boundary. More recently, betel-nut palm *Areca catechu* has been used for this purpose (de Zoysa & Raheem, 1987). The 1992/94 management plan emphasized conservation, scientific research, buffer zone management, benefit-sharing, and community participation and is being updated. Conservation activities include biodiversity surveys, enrichment of degraded areas, reforestation of adjoining land and acquisition of private land in the site and has been updated (Forest Dept., 2003).

A conservation plan by the Forest Department, officially approved in 1986, was implemented under an agreement between IUCN and the Sri Lankan government with additional funding from the Norwegian government (Hails, 1989). The preferred strategy has been to freeze resource use within the area at 1985 levels when the conservation plan was prepared and to gradually eliminate future resource dependency on the Reserve by relocating villages to areas outside its boundaries (Ishwaran & Erdelen, 1990). In 1993, to ensure the Reserve's strict protection for science, for aesthetic reasons and to eliminate dependence on its resources, a Forestry Department management program was launched with IUCN and GEF assistance within a 3.2 km-wide buffer zone which included development of degraded state lands, underplanting of indigenous species in existing pine plantations, homestead development, a rural development program, a health camp and the strengthening of community-based organizations, public and school awareness programs and training on alternative income-generating activities. This participation of local people with NGOs in conservation-linked developments is an important model. The traditional use of minor forest products, the most important of which are firewood, *kitul* for *jaggery* and *wewal* or cane for basket weaving, is now restricted to forest surrounding the Reserve except for *kitul* which may still be legally collected, under permit (de Silva, 1985; McDermott, 1985). Collection of specimens without permit is strictly prohibited. However, there is some controversy over the possible acceptance of a nature swap for debt reduction program proposed under the U.S. Tropical Forest Conservation Act for fear of the loss of genetic material to foreign companies (Liyanage, 2001).

MANAGEMENT CONSTRAINTS

Shifting cultivation and mechanised logging have been the great threats to the forest in the past, although hunting and poaching have also been a threat and illegal use of its resources by local villagers is

increasing. Encroaching cultivation, especially for tea, particularly along the southern boundary is probably still the biggest problem (McDermott, 1985). No felling is permitted within 1.6km of the reserve boundary, but contractors clear routes for timber operations which makes the Reserve more accessible to illicit logging. Alleged malpractices by the State Timber Corporation are a source of concern to the Forest Department. Private land owners along the periphery continue to request permits for timber and may harvest trees within the reserve, having felled all the saleable timber on their own land (Hathurusinghe, 1985). Clear-felling the forest, in which most of the essential nutrients are locked up, impoverishes the soils which then become incapable of supporting both sustained commercial forestry and agriculture (Forest Department, 1986). Planting the prolific seed-producing Honduran mahogany *Swietenia macrophylla* along abandoned logging trails as an enrichment species may displace natural species (de Zoysa & Raheem, 1987). Illegal gem mining organised by wealthy merchants from outside the region is a serious problem in the eastern parts of the reserve. The lack of a uniform land-use policy and the multiplicity of governmental and semi-governmental agencies involved in land-use planning remain administrative constraints to the effective protection of Sinharaja. The impacts of tourism are increasing.

STAFF

Under the Deputy Conservator of the Forest Department there are 6 range officers; 11 beat forest officers, 8 field assistants, and 20 field guides at three visitor centres at Kudawa, Pitadeniya, and Morningside (Forest Dept., 2003).

BUDGET

The Forest Department in 1987 allocated higher than average funding for Sinharaja totalling Rs4 million (US\$ 130,000) and in 1986 WWF/IUCN granted US\$35,000 for a conservation awareness program and the purchase of equipment in. Annual government funding is roughly US\$ 10,500 received directly from the Forestry Sector Development Programme. It is considered inadequate. UNEP/GEF have funded national programs for the conservation of medicinal and wild crop plants. Other assistance has included NORAD funds from 1992-97, and WHF funding for training. US\$ 1 million was allocated under the UNDP-GEF 2000-2004 South West Rain Forest Conservation Project to develop and upgrade park infrastructure and logistic facilities. The Sinharaja Village Trust was granted US\$279,000 in 1999-2110 for sustainable buffer zone development by a USAID project of WWF, the Nature Conservancy, the World Resources Institute and the MacArthur Foundation (de Zoysa & Simon, 1999). Visitor revenues in 2001 totalled Rs1.8 million (US\$18,950) (Forest Dept, 2003).

LOCAL ADDRESSES

Deputy Conservator, Forest Department, Colombo, Sri Lanka.

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