Udawattakele: A Sanctuary Destroyed From Within

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Introduction

In the heart of the busy city of Kandy there is an extraordinary, green, wild space called Udawattakele. This forest sanctuary contains remnants of the primeval forest that used to cover the hills and mountains of Sri Lanka. Many of the inhabitants of that forest, plants as well as animals, often scarce and unknown, still live here. Due to its diversity of wildlife, its location and accessibility and the level of protection bestowed on it by the Forest Department, it serves as a major centre for nature study and education.

The Udawattakele is within walking distance of the centre of Kandy town and has well maintained easily accessible paths that provide pleasant walks. Parties of school and university students regularly visit both the forest and the Nature Education Centre near the District Forest Office where they deepen their understanding of this rainforest. It is a popular attraction for foreign tourists—especially bird watchers who appreciate the great diversity of birds that inhabit the forest. Scientists and university students have used the forest for carrying out research on trees and animals. It is also a place of religious and historical significance because it flanks the Temple of the Tooth, contains three Buddhist monasteries, two ancient forest Sangha cave dwellings (Fig. 1) and the remains of two fortresses from the colonial period. It is also a catchment area for some streams.

At the time of the Kandyan Kingdom the area was a protected Royal Forest. In 1816, at the start of British colonial rule, the royal forest stretched from the Kandy Lake right up to the Mahaweli river to the north and east and was more than 400 hectares (1,000 acres) in extent. By 1893, the forest had been reduced to 153 hectares (377 acres). It is currently 104 hectares (257 acres) and covers a hill ridge running from the Kandy Lake towards the north. It became a reserve in 1856 and a sanctuary in 1938. Karunaratna (1986) provides a comprehensive account of its history and biodiversity in his book *Udavattakālē: The Forbidden Forest of the Kings of Kandy*, now out of print.

Despite being well protected against hunters and loggers by its guardian, the Forest Department, which has two offices in the reserve, its health is not as good as it may at first appear. Uninformed visitors entering the forest are impressed by the stately trees enveloped by large creepers along the path around the Royal Pond and think themselves in unspoilt virgin rainforest. To the discerning naturalist, however, the sight is increasingly disconcerting. The naturalist instead will see a forest rampant with foreign, invasive plants that are choking it and threatening its precious wildlife.

The invasive plants were mostly introduced in the British colonial period. In the 19th and early 20th centuries, large amounts of timber were extracted from Udawattakele to supply firewood for the adjoining British Governor's residence. Due to this logging the forest became quite thin and, as Karunaratna (1986: 45–47) relates, it was replanted with "fast growing trees" presumed to be "useful in time to come", i.e., exotic trees such as Mahogany, Peru Balsam and Panama Rubber. The British—in accordance with the horticultural standards of the time and influenced by the Judeo-Christian idea that animals and plants were created by God to be useful to man and to be mastered by him—preferred a formal park-like forest with straight large trees and no undergrowth—a forest clear of "crooked stems …, which did not enhance the beauty of the locality." Lianas overhanging paths were perceived as "untidy". Thus the original, native forest with its many "untidy" and "crooked" strangling figs, small and curved trees, shrubs, creepers and lianas, was in parts replaced with plantations of large, straight and fast growing exotics that were perceived to be more beautiful and could be harvested for future timber extraction and used for other economic purposes.[1] After independence, reforestation with exotic species continued in accordance with standard forestry practices that aim at maximum short-term economical benefit. The Caribbean Pine tree plantation in the Udawattakele near the Uplands Housing Estate, planted in the 1960s or '70s, is an example of this.[2]

[1] A map at the Udawattakele Exhibition Centre shows that 48 acres of the Udawattakele, around and north of the Royal Pond, were in reforested in stages between 1921 and 1931. The timber trees used were Mahogany (*Alstonia macrophylla*), Jak (*Artocarpus heterophyllus*), Pihimbia (*Filicium decipiens*), Sapu (*Michelia champaca*), Na (*Mesua ferea*), Etdemata (*Gmelina arborea*). Also an unidentified tree called "Karurmbul" was planted, perhaps the Peru Balm tree.

[2] Binggeli (1998:19–30) describes the history of and motivation for the introduction of exotic tree species in the tropics.

Fauna and Flora

Despite the reserve being completely surrounded by Kandy and its suburbs, and having been planted with and invaded by exotic tree species in large areas, it still incorporates a great wealth of biodiversity including several mammals. Since Karunaratna did not document this extensive mammal fauna in his book there has been a positive developments in the last 25 years. Wild boar and Muntjac deer (Fig. 2), not seen in the forest until about ten years ago, are now regularly sighted. Mammals that inhabit the forest include the Pale-fronted Toque Macaque, Indian Muntjac, Indian Wild Boar, Indian Porcupine, the Sri Lankan Spotted Chevrotain, Sri Lankan Dusky Palm Squirrel, Indian Pangolin, Small Indian Civet, Asian Palm Civet, the endemic Golden Palm Civet, Indian Giant Flying Squirrel, and Greater False Vampire Bat. There are a few colonies of Schneider's Leaf-nosed Bat in clefts among large rocks. Reportedly, the endemic Slender Loris is also present here (see Sandun & Perera 2008).

A variety of reptiles also inhabit the forest. Among snakes are the endemic Green Pit Viper, Sri Lanka Cat Snake, Banded Kukri, and Boie's Rough-sided Snake. Lizards include the rare and endemic Hump-nosed Lizard, Sri Lanka Kangaroo-lizard and the Whistling Lizard. There are also several endemic species of geckos such as the Kandyan Gecko and Kandyan Day Gecko, and endemic skinks, frogs and toads.[3]

Less documented and researched, invertebrates abound in the forest including butterflies such as the Blue Mormon, King Scorpions, fireflies, beetles, jewel bugs, bees and wasps, and spiders such as the poisonous Sri Lankan Ornamental Tarantula.[4] At least nine species of endemic land snails live in the forest.[5]

The forest is an important bird-watching site. Endemic birds that are often observed include the Brown-capped Babbler, Ceylon Shikra, Crested Serpent Eagle, Dull-blue Flycatcher, Yellow-fronted Barbet, White-rumped Shama, Layard's Parakeet, Sri Lanka Hanging Parrot and in the cool season the Sri Lanka Paradise Flycatcher. Common birds that are present include the Hill Myna, Emerald Dove, Indian Pitta, Forest Wagtail, White-rumped Munia, Brown Fish Owls, woodpeckers, orioles, leafbirds, sunbirds, bee-eaters and bulbuls.

Floristically, Udawattakele contains a great variety of native and endemic shrub and small tree species, many with medicinal and economical value. Some of the species that Nyanatusita has recorded are (with Sinhala names) the rare endemic wild Betel nut palm (*Areca concina,* Lenatheriya), Orangeberry (*Glycosmis pentaphylla,* Doda-pana), the fragrant Orange Jessamine (*Murraya paniculata,* Etteriya) Wild Pepper (*Piper zeylanica* and *P. sylvestre*) and Horsewood (*Clausena anisata*). Herbs, native and/or endemic, that grow here include two species of wild cardamom (*Amomum graminifolium* & *A. echinospermum*), and several genera that are of horticultural value including orchids, mostly epiphytic, such as the One Piece Lip *Aerangis hologlottis* (the sole *Aerangis* species occurring outside of Africa, and only so in Sri Lanka) and the Two Coloured Cymbidium, *Cymbidium bicolor*. Dozens of fern species and many species of mushrooms grow in the forest.

Native trees include Jak (*Artocarpus heterophyllus*, Kos), Kitul Palm (*Caryota urens*), Cinnamon (*Cinnamomum verum,* Kurundu), Longan (*Dimocarpus longan,* Mora), Soapnut (*Sapindus emarginatus,* Penela) and the rare endemic Ceylon Paper Mulberry (*Broussonetia zeylanica,* Alandu). Large, old native canopy trees, notably the Blackboard Tree (*Alstonia scholaris* Rukattana), *Aphananthe cuspidata* (Wal-munamal), *Artocarpus nobilis* (Wal Del), Red Silk-cotton (*Bombax ceiba,* Katu imbul), Indian Mahogany (*Chukrasia tabularis,* Hulan-hik), Ebony (*Diospyros ebenum*, Kaluwara), *Ficus nervosa* (Kala maduwa), *Sterculia balanghas* (Nawa), Beleric (*Terminalia bellirica*, Bulu), and the threatened endemic Wild Mango (*Mangifera Zeylanica*, Etamba) indicate what the original canopy of the Udawattakele would have looked like. All these trees have ecological, economic, medical, or cultural importance (see Ashton et al 1997).

The forest is also known for its many lianas and vines, of which there are more than forty species. Most notable is the endemic giant creeper *Entada zeylanica* (Puswel, Fig. 3), of which there are huge representatives hanging over the tracks. Lianas with medical and other uses, include *Anamirta cocculus* (Tittawel), *Cansjera rheedii*, *Cyclea peltata* (Kahi pittam), *Diploclisia glaucescens*, *Naravelia zeylanica* (Naraveli), Cat's Claw, *Uncaria elliptica* and several kinds of wild grapes (*Cissus* & *Ampelocissus*). Udawattakele is probably the best place in Sri Lanka for seeing large rattan palms, *Calamus spp.* (Wewel), which are elsewhere often cut down

[3] For an excellent overview of reptiles in the Udawattakele, see Somaweera et al, 2001.

[4] For lists of butterflies, insects and birds observed in the Udawatattakele, see Karunaratne 1986: 149–152.

[5] *Acavus superbus castaneus, Ratnadvipia irradians, Corilla carabinata, Cyclophorus menkeanus, Aulopoma itieri and/or A. grande, Cryptozona bistrialis, Theobaldius annulatus, Glessuta sp., Satiella sp.* Thanks to Dr. D. Raheem for helping with the identification.

prematurely for making furniture. The climbing palms can be over 40 meters tall, growing up and over trees. Visitors have to watch out for their vicious barbed tendrils that hang over paths.

A complete list of plant and animal species in the Udawattakele is given in the Appendix below.

Invasive Species – threat to the Forest and Wildlife

Owing to the two offices of the Forest Department, the sanctuary is relatively well protected against hunters and woodcutters. Although squatter encroachment and land-grabbing have been notable problems in the past, today the greatest threat facing the sanctuary are the invasive, exotic tree, shrub and creeper species that increasingly crowd away native plant and tree species. In the Udawattakele, several invasive tree, shrub and vine species choke the forest from within. Just as an untended garden overgrown by various kinds of weeds due to neglect, so the Udawattakele has become overgrown by invasive tree and liana weeds.

An "invasive species" is "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health" and "native species" as "with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem."[6] Invasive, exotic plant species provide no nourishment for insects, birds and mammals and severely disrupt the natural food chain: "*Native plant species form complex relationships with native insects that evolve over long periods of time to use them as their food source. If you replace those native plants with exotics, you sever the link and the insects dependent on those native plants no longer can provide their young with a place to feed and grow. In turn, when you drive away the insects, you do the same to the larger animals (such as birds) that feed on the insects.*"[7]

Alien, invasive plant species generally have no natural enemies such as invertebrate pests, disease agents or larger herbivores that consume them; thus they grow, spread and often disperse explosively to a greater degree than from their original habitats and out-compete native Sri Lankan species that are kept in check by locally adapted organisms.

Invasive plant species are a massive problem the world over, causing untold ecological and economic loss. Some species that are rare or inconspicuous in their native natural environment can become highly invasive and dominant elsewhere. *"Globally, exotic naturalized plants that behave invasively and occupy wildlands are responsible for greater losses of biodiversity than any other factor except habitat loss and direct exploitation of plant species by people. About 1 – 2% of naturalized exotic species become invasive in character, infesting and sometimes destroying parks, preserves and refuges."* (Bossard 1999). Steiner, Executive Director of UNEP estimates that invasive species cost the global economy $1.4 trillion or more, a staggering sum (Steiner 2009). Invasive species can lead to the extinction of native plant, insect and animal species that could be potential sources of new medicines, and have other valuable uses, such as in the field of biomimicry and as a tourist attraction. Wild ancestors of crops, or related species, that can be used to develop disease-resistant and more productive crop-varieties can be lost.

The dire situation in the Udawattakele is a grave warning on how exotic plant species can become highly invasive within a Sri Lankan forest environment and crowd away all native vegetation and the animals and invertebrates that comprise its identity and heritage. Similar processes of native vegetation being replaced by invasive weeds are taking place all over Sri Lanka in different environments. For example, the few remaining patches of montane forest left on the Hantana mountain range above Kandy are rapidly smothered by the Pitch Apple tree (*Clusia rosea,* Gal Goraka) from the Carribean and the shrub Koster's Curse (*Clidemia hirta*) from the tropical Americas; Guinea Grass (*Urochloa maximum*, Gini tana) from Africa overgrows native Pattana grasslands on Hantana and the native Iluk grasslands in Wasgamuwa National Park, posing a major fire hazard; and the Prickly Pear Cactus (Katu-pathok) from Central America smothers coastal dune areas between Yala and Hambantota. In his informative book *Invasive Plants*, Dr. Lalith Gunasekara (2009) describes most of the invasive plant species in Sri Lanka, the problems they cause and strategies to remove them.

Given most of the native wet zone and hill country forest has already been directly destroyed by man in the last two centuries, great care has to be taken to preserve what little is left and not let it be indirectly

[6] United States Department of Agriculture, "Federal Laws and Regulations, Executive Order 13112," at www.invasivespeciesinfo.gov.
[7] "Saving Native Species with Green Roofs," Christina Nunez, National Geographic website, May 1, 2013, at www.greatenergychallengeblog.com.

destroyed by invasive species introduced by man. As Binggeli (1998:24) writes: "*The conservation of biodiversity becomes increasingly significant in disturbed areas as areas of natural or semi-natural vegetation steadily decrease. In an overpopulated and resource hungry world secondary vegetation will become more and more important to the conservation of biodiversity.*" If even an easily accessible forest reserve in the middle of Kandy is neglected with respect to invasive species, then this presents a grave sense of foreboding about the future of other, less accessible forests.

Despite the presence of several other invasives in the Udawattakele forest, four comprise the greatest threat: (1) Peru Balsam (*Myroxylon balsamum*), (2) Devil's Ivy (*Epipremnum aureum*),[8] (3) Mahogany (*Swietenia macrophylla*) and (4) Ecuador Laurel or Salmwood (*Cordia alliodora)*.

Peru Balsam, also called Tolu Balsam or Santos Mahogany, is the most aggressively spreading invasive tree, and therefore the most in need of control. Its native range is Central America, where it grows in wet as well as dry forests. The British introduced it for obtaining the fragrant balsam extracted from its bark as well as its durable hard wood. The balsam is widely used in perfumes, shampoos, and medicines.[9] Despite there being relatively few, large, adult Peru Balsam trees, thousands of young trees and seedlings are to be seen in substantial parts of the forest such as along Lady Horton's Drive (Figs. 4a-b). The mother trees, growing along the tops of ridges produce vast quantities of seeds, which, with their helicopter-like wings disperse far and wide and germinate rampantly along slopes, surviving well, given they have no natural enemies and can grow in a wide range of light conditions. Dense groups of seedlings and young trees, often dozens in a square metre, can be seen. Whereas other invasive trees such as Hard Milkwood (*Alstonia macrophylla*) tend to sprout as pioneers in cleared and disturbed areas such as gaps where trees have fallen down, and where there is more light, young Peru Balm trees grow everywhere, even in quite shady areas with old, established native trees and shrubs. They grow quickest though in light areas. The tree was introduced to Sri Lanka in 1861 and first planted in the Governor's Garden adjoining the Udawattakele. In 1922 it was already observed that this tree "*grows and seeds prolifically in and near Kandy.*" (Dassanayaka I 432–34)

There are four main areas or pockets where the Peru Balm has become invasive in the Udawattakele. The largest area is a strip between the Temple of the Tooth and the Lewella Housing Estate; the second is on the ridge north of the Royal Pond and above the Na tree grove; the third area is on and around the abandoned road below the Na Tree grove; and the fourth pocket is surrounding the Range Forest Department office on the Thapovana Vihara Road. Although most young trees are found in the vicinity of the mother trees, some can be found as far as a hundred fifty meters away from them.

The danger this species poses to the Udawattakele and Sri Lankan nature has been well documented. As scientists H. P. Wedathanthri and H. M. G. S. B. Hitinayake of Peradeniya University state in a scientific article published almost 15 years ago: "*… Myroxylon has dominated the understory [in Udawattakele] even when a few mother plants are available in the overstory. This could be attributed to prolific seed production capacity, its ability to germinate under wide range of light conditions, favourable microclimatic conditions presenting in the understory and absence of any seed pest or pathogen. … Myroxylon invasion has resulted in the decline of species diversity of the forest. If no control measures are applied, … this species could invade the other parts of the forest … Therefore necessary action must be taken immediately to control Myroxylon balsamum.*" (Hitinayake et al 1999). This has been followed by articles (Pushpakumara et al 2000, De Costa et al 2001) with detailed scientific analyses that reinforce the issue. As Pushpakumara et al (2000) state: "*The presence of M. balsamum appears to significantly damage the composition, structures and functions of Udawattekele forest.*"

The Forest Department acknowledges the problem on its website: "When considering floristic composition of Udawattakele it is dominated by *Swietenia macrophylla* (mahogany), *Michelia champaca* (gini-sapu), *Mesua ferrea* (na) and *Myroxylon balsamum* (katta kumanchal). *Myroxylon balsamum* is an introduced exotic tree species which has later become invasive and is threatening the biodiversity in this forest."[10]

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[8] Also called *Scindapsus aureus.* On the "tortuous nomenclatural history" of this species, its long obscure origins, as well as the confusion with *Epipremnum pinnatum;* see Boyce 2004. Cf. "Epipremnum aureum (Linden & André) G.S. Bunting" at The Exotic Rainforest website at www.exoticrainforest.com.

[9] "*Myroxylon balsamum*," AgroForestryTree Database, www.worldagroforestrycentre.org. See also "*Myroxylon balsamum*," Center for Wood Anatomy Research, USDA Forest Service at , www.fpl.fs.fed.us.

[10] "Biosphere Reserves and Conservation Forests" at www.forestdept.gov.lk.

Despite the scientific recognition of the danger posed by the Peru Balm, young trees were until recently still sold at the plant sales outlet of the Peradeniya Botanical Gardens[11] and were planted around the Kandy Lake.

The Devil's Ivy, also called Golden Pothos is the second major threat. This member of the *Araceae* family is from the island of Moorea in French Polynesia (see Boyce 2004:208). It is an attractive, yellow green, epiphytic creeper popularly cultivated in gardens and as a houseplant. Despite its charms, however, this poisonous creeper is an obnoxious invasive in Sri Lankan forests such as the Udawattakele. Around the Royal Pond and from there west and north to the Presidential Palace and the Temple of the Tooth respectively, the creepers completely cover several hectares of the forest floor and tree trunks, leaving no space for other vegetation and young trees. They climb high up tree trunks and then, with their leaves becoming increasingly larger the higher they grow, block the light for young trees and other plants underneath (Fig. 5a-b). By overgrowing their host trees they stunt their growth and sometimes kill them. The creepers are gradually spreading further to other areas. Some years ago they were even planted along the western part of Lady Horton's Drive to prevent soil erosion from road banks. It reproduces vegetatively. It is also invasive in Singapore, Florida and Pacific islands such as Hawaii.[12]

The Mahogany, is a stately timber tree from forests in the tropical Americas. In large parts of its native range it has become rare or extinct due to over-exploitation and deforestation.[13] Just as the Rubber Tree (*Hevea brasiliensis*) cannot be grown in monospecific plantations due to a leaf blight disease, neither can Mahogany trees be grown in plantations in South America due to attacks by shoot boring moths.[14] In the Udawattakele, however, Mahogany grows quite rapidly[15] in the absence of insects and diseases that retard its growth and has become quite invasive. Dassanayake (*Flora of Ceylon*, p. 233) notes: "*Introduced to Ceylon in 1888 for ornament and timber production, it is the major tree in Udawattakele Forest Reserve…*" Indeed, along with the invasive Hard Alstonia it is the most common tree. In several areas, such as around the King's Pond and wherever else they were planted in the 1920s and 1930s, it has formed dense, shady monospecific stands. It has spread to all parts of the forest (Fig. 6a-b). It especially sprouts in disturbed areas such as along tracks and in gaps in the forest where trees have fallen down, but also sprouts in undisturbed forest, gradually crowding away native tree and shrub species. Like the Peru Balm, the Mahogany produces large quantities of seeds with helicopter-like wings, which are also carried afar by the wind. Mahogany trees shed all of their leaves once a year and thus cause a thick layer of tannin rich leaves in which native trees cannot sprout.[16] In the nearby Gannoruwa Forest Reserve, where it was planted in the 1920s, it is also invasive in native forest areas.

Ecuador Laurel or Salmwood is from the tropical Americas, where it has a very wide distribution and is grown for its high quality wood called "Laurel Blanco." It is also grown as an ornamental due to its copious bunches of white flowers. In its natural habitat *Cordia alliodora* is a pioneer species that grows in light places such as forest edges and gaps in the forest in a wide variety of ecological conditions, varying from very wet to seasonally dry and from sea level to as high as 2,000 meters.[17] The trees can start flowering and producing seed within 4 to 5 years.[18] Outside of its native range, it has become a problematic invasive in Tanzania and various Pacific islands such as Hawaii. It is said that: "*One tree may produce about one million seeds per year. … The tree invades land adjacent to cultivation. It produces many seeds and regenerates easily aggressively colonising disturbed forest and often forming monotypic stands. It is a major weed of plantation forests.*"[19] and that "*Control is very difficult as plants sprout readily from cut stems.*" [20] The seeds are dispersed by the wind. In the Udawattakele, it has invaded a 500 meter long strip of forest in the extreme north-eastern corner of the sanctuary right along Dharmasoka Mawatha, where the trees can be seen overhanging the road. Many

[11] Botanical gardens such as Peradeniya are a major source for invasive species in the tropics, see Binggeli 1998: 19–20.
[12] "Epipremnum pinnatum cv. Aureum" at Pacific Island Ecosystems at Risk (PIER), at www.hear.org.
[13] See Scott Wallace, "Mahogany's Last Stand," *National Geographic* website, ngm.nationalgeographic.com.
[14] See "Big-Leaf Mahogany in Brazil & South America" website at www.swietking.org/index.html.
[15] In contrast, in Mexico it takes, on average 122 years for a tree to reach a diameter of 55 cms, growing 0.38 – 1.09 cm a year; see "Big-Leaf Mahogany in Brazil & South America," at www.swietking.org/adults.html.
[16] Baguinon et al 2005.
[17] "Cordia alliodora" at Pacific Island Ecosystems at Risk (PIER), at www.hear.org.
[18] See Liegel L. H. and Stead, J. W. 1990.
[19] "Cordia alliodora" at Pacific Island Ecosystems at Risk (PIER) at www.hear.org, and "Cordia alliodora" at www.tropical-biology.org.
[20] "Cordia alliodora (Salmwood" at BioNet-EAFRINET, at keys.lucidcentral.org.

seedlings and young trees are growing along the boundary fence and in light places in the adjoining forest. Although in its native habitat the tree can grow to 35 meters tall, the trees in the Udawattakele are yet not larger than 5–6 meters, but nevertheless flower abundantly. Except for a few trees at the entrance of the Range Forest Department office, it is fortunately not yet found elsewhere in the forest. Given that this is a pioneer species that naturally grows in a wide range of conditions, it certainly will become a problematic invasive in the Udawattakele and elsewhere in Sri Lanka too. It could be spread by gardeners attracted by the flowers. It is therefore important that this tree is eradicated soon.

Besides these main invasive species, there are also others that are invasive. Hard Milkwood or *Alstonia macrophylla* (Havari nuga) is the most common tree in the forest along with the Mahogany. It is a pioneer species and its seeds only sprout in sunny, disturbed areas such as gaps in the forest (see Binggeli 1998:23). Although they are not as large a threat as the other invasive tree species, they are problematic in so far that they crowd away ecologically important native pioneer species such as Kenda (*Macaranga peltata*). Panama Rubber (*Castilla elastica*), from Central America, is a quick growing, large softwood tree. Young trees and seedlings are found around the large mother trees that grow in various places in the forest. It is an invasive in Polynesia, Australia, and Singapore.[21] Coffee shrubs (*Coffea canephora* or hybrid) from Africa are invasive, forming dense thickets especially in valleys, just they are doing in the nearby Gannoruwa Forest Reserve and at Hantana mountain range, and in the Western Ghats in India, Hawaii, Australia, etc.[22] The Glow Vine (*Saritaea magnifica*), an ornamental vine from Brazil, covers several large trees near the Maitri cave and is steadily spreading. Another large ornamental creeper called the Bengal Trumpet (*Thunbergia grandiflora*) overgrows trees near the main entrance. A yet unidentified invasive vine of the legume family (probably a *Derris* or *Millettia*) is completely smothering a large area near the lookout above the Temple of the Tooth. The Star Apple tree (*Chrysophyllum cainito*) from the West Indies and invasive elsewhere in the world also is invasive in a few areas. African Tulip trees (*Spathodea campanulata*) grow scattered throughout the forest, mostly in previously disturbed areas. Rusty Pittosporum (*Pittosporum ferrugineum*), from Southeast Asia, is also found here and there in the forest. The Philippine evergreen (*Aglaoneama communatum*), introduced as a decorative garden ground cover plant, is also invasive. According to Ranil et al (2008), the invasive Glossy Maidenhair Fern (*Adiantum pulverulentum*) from South America, along with the Peru Balm, crowds away native fern species, some of which are rare and not recorded elsewhere from Sri Lanka.

The forest areas that are most severely degraded due to invasive species are situated in the western side of the forest between the Temple of the Tooth, the President's Palace, the Range Forest Department Office, the valley surrounding the Royal Pond and the ridge and slopes north-west of it (Fig. 7). Patches of relatively unspoiled forest, with mostly native species of trees and shrubs, remain on the northern and eastern slopes and ridges of the forest. These patches of unspoiled forest, however, are becoming smaller and smaller due to the uncontrolled encroachment by invasive tree and creeper species.

Management Essential

Despite repeated warnings of scientists regarding the threat the exotic invasive trees and creepers pose to the Udawattakele forest, and this issue being widely reported in scientific literature, in articles in newspapers and on the internet, no action has been taken so far to curb their spread and protect the precious biodiversity of the Udawattakele.[23]

To control the spread of invasive species a systematic long-term management plan needs to be instigated and implemented that ensures that the sanctuary is freed from invasive plant species and kept that way continuously. Regular check-ups would need to be done to ensure that seedlings and young trees earlier overlooked are removed and that no new invasive species take a hold. It is better to prevent than to have to remove massive invasions that have been ignored for many years. As the Udawattakele Reserve is surrounded by Kandy town and its suburbs, it is quite vulnerable to new introductions of invasive species from surrounding gardens. The invasive coffee shrubs and Star Apple fruit trees that are both spread by monkeys from surrounding gardens are an example of this. Binggeli (1998:24): "*Susceptibility of natural areas*

[21] "*Castilla elastica*," at Pacific Island Ecosystems at Risk (PIER), www.hear.org.

[22] "Coffee *Coffea arabica*" at Weeds of Australia websites at keyserver.lucidcentral.org and Joshi et al 2009.

[23] See Marambe et al 2001: "Actual management of invasive alien species is rare in Sri Lanka". Cf. Binggeli 1998:29.

to invasions is higher if a large seed source is available around it. The smaller the area of natural vegetation the more likely it is to be invaded."

Although fortunately not present yet, the highly invasive Purple Plague (*Miconia calvescens*) tree, one of the world's most dreaded invasive species, that would overgrow the entire forest under-story,[24] could spread from nearby gardens. The Pitch Apple (*Clusia major*) tree that strangles other trees, could be carried here by birds. It has already reached a rock outcrop at Aylapperuma near Dharmaraja College, close to the Udawattakele. Koster's Curse (*Clidemia hirta*) could also become problematic.

In the case of the highly problematic Peru Balm tree and Ecuador Laurel, the removal needs to be drastic and rapid, including any trees whether young or mature. To prevent the further spread of seeds, mature trees should be removed first.[25] In the case of other less aggressive 'invasives' such as the Mahogany tree, removal can be more gradual, starting with seedlings and young trees in areas which are not yet heavily invaded and where native vegetation is predominant. Methods employed to remove invasive tree species are cutting down large trees and applying herbicides on the stumps to prevent regeneration, girdling/ring-barking, injecting herbicides, and uprooting seedlings and young trees.[26] Uprooting of seedlings and small trees by hand is preferable as it spares native vegetation and wildlife. When too large to be uprooted manually, young trees could be uprooted with a pulling tool,[27] or cut down, after which a herbicide such as Roundup[28] is to be applied immediately to the stumps to prevent regeneration since Peru Balm trees rapidly regenerate when cut. Applying herbicide with a paintbrush on freshly cut stumps is much more efficient and environmentally friendly than spraying, which due to drifting away harms insects, frogs, etc. and damages native vegetation. Injection of herbicides into the trunks of large trees or, probably easier, ring barking and then applying herbicides on the cuts, is to be done in areas where native trees and lianas are to be spared. The Ecuador Laurel, which also has a taproot, is to be removed in a similar manner as the Peru Balm. Young Alstonia trees can easily be pulled out by hand. The removal of the Devil's Ivy could also be done manually: "*Physical removal is very difficult but can be effective if done repeatedly for a longer period. All pieces must be properly disposed of or they will resprout.*"[29]

Areas of native forest with a wide variety of native plant species that have not yet been heavily invaded by 'invasives' should be given priority in being freed from them, so that no 'invasives' can get a firm hold and crowd away the native vegetation, as has already happened in heavily infested areas (see Goodland et al 1998: Chapter 5). Replanting with a wide variety of locally native trees and shrubs should be done in areas that have become denuded after the removal of the 'invasives'. The sale of the valuable timber of Peru Balm, Mahogany and Alstonia trees would easily cover the costs of the removal project.

Modern nature reserve management includes the removal of exotic species and gradual replacing of old plantations with non-native species with local, native species. In the Netherlands, exotic pine plantations in nature reserves are gradually being replaced with native tree and shrub species. In England management schemes undertaken by volunteers have eliminated the highly invasive *Rhododendron ponticum* shrubs in some areas. Volunteers could also help to remove invasives in the Udawattakele.

Management plan templates and tutorials as used in the USA and Australia for the control of invasive weeds are available from invasive plant management websites.[30] A management plan simply requires dedication, minimal training, and workers and volunteers. The Dambulla Arboretum's canopy of native timber trees was encouraged by actively managing and clearing undesirable thorn scrub, that suppressed saplings (see Popham 1993). A UNDP funded program was carried out by a NGO in the Bundala National Park adjoining Bundala village, where the highly invasive Prickly Pear cactuses and Mesquite trees (*Prosopis juliflora*) were manually removed some small areas (Nizam 2010). Unfortunately, this kind of

[24] See Lowe S., et al 2004:8.
[25] Fortunately the seeds of Peru Balm and Mahogany remain viable only for a few months, unlike, for example, Miconia seeds which can remain viable for 12 years or longer; see Gunasekera 2009:104.
[26] On methods to remove invasive trees and shrubs, see Goodland et al 1998, section 6. See also "Eradicating Eucalyptus, Acacia, and Other Invasive Trees," at www.wildwork.org; and "How to remove invasive plants," at invasives.org.za.
[27] There are special shrub-pulling tools, such as the Weed Wrench and Tree Popper, for pulling out invasive shrubs and trees.
[28] See Goodland et al 1998:6.4: "It is particularly important not to damage the ability of native vegetation to re-colonise a site after the removal of all alien woody plants using herbicides. Glyphosate-based herbicides such as Roundup are often claimed to be relatively non-persistent and benign on the environment."
[29] "Epipremnum pinnatum cv. Aureum" at Pacific Island Ecosystems at Risk (PIER), at www.hear.org.
[30] E.g. www.invasive.org; see also Goodland et al 1998.

management is only done on a small scale: "*Sri Lanka has no policy-level initiative to control introduced alien species. Part of the problem is lack of knowledge on consequences of the presence of invasive aliens on ecosystems*." (Marambe et al, 2001:140:)

Currently Forest Department workers in the Udawattakele do not remove any invasive plants and trees because they are not encouraged to do so and, perhaps, because the Forest Department's rules for managing forest reserves do not permit this. To prevent invasive species from destroying the reserve, the Forest Department staff will need to be taught to recognise invasive species and should be trained and encouraged to remove them. The expertise gained in removing invasive plants in the Udawattakele will be of use in the removal of invasive plants elsewhere in Sri Lanka. Binggeli (1998:29): "*The problem of invasive plants is more likely to become more severe rather than recede in the coming decades. At the same time resources available to deal with the problem of invasive plants are unlikely to increase significantly. Only by using resources, not just financial but also intellectual, more efficiently will be there be more progress*."

Given the increasing threat that invasive species pose to Sri Lankan nature and agriculture, the Forestry, Wildlife and Agriculture Departments should appoint special officers who only deal with the identification, removal of, and prevention of spread of invasive species and also have the legal backing to do so. In Australia, South Africa and other countries landowners are legally obliged to remove several invasive plant species from their properties and are fined if they fail to do so.[31] Similar legislation could be implemented in Sri Lanka to prevent further problems. Ideally, a government department specialising in the eradication of invasive species should be formed. An effectively functioning department for the eradication and prevention of invasive species would prevent huge ecological and economical damage, and would far outweigh the costs of such a body.

It is also important to educate forest department staff, agricultural department staff, farmers, plantation owners, and the general public about the threats posed by invasive species to nature and agriculture in Sri Lanka. Education campaigns about the threat of invasive species could be held at schools and community centres. Many people continue to spread invasive species such as Purple Plague and Devil's Ivy by taking seeds and cuttings of these attractive looking plants to their gardens. Moreover, some ignorant people who are not knowledgeable about trees and natural forest ecosystems would oppose the removal of any trees and creepers despite them being a great ecological hazard.[32]

The areas with mainly native vegetation on the northern and eastern side of the Udawattakele show that the forest has a great capacity to regenerate after having been extensively cut down in the past. The gradual and continuous removal and elimination of invasive trees and creepers in infested parts will lead to a natural revival of native tree and shrub species. A diversity of habitats within a nature reserve, with both sparsely and densely forested areas, would make the reserve ideal for a wider variety of native plant and animal species to flourish and prosper.

Neglecting the management of Udawattakele as a forest reserve and wildlife sanctuary will eventually leave behind a "invasive weed sanctuary," an impoverished, green shell of a few species of exotic vegetation and no wildlife in what instead could flourish as a unique example of an urban tropical rainforest with a great diversity of plants and animals. Only active management in the forest will ensure the preservation of this green jewel in the heart of Kandy.

[31] "Legal obligations regarding invasive alien plants in South Africa" at www.arc.agric.za and "Catchment and Land Protection Act 1994" at www.dpi.vic.gov.au. See also Weeds Australia Database at www.weeds.org.au.
[32] See Marambe et al, 2001:140–41; and also Goodland et al 1998, section 3.2 and 8.

Illustrations

Fig. 1 Udawattekele

Fig. 2 Indian Muntjac deer (*Muntiacus muntjak*) and Sri Lankan Ornamental Tarantula


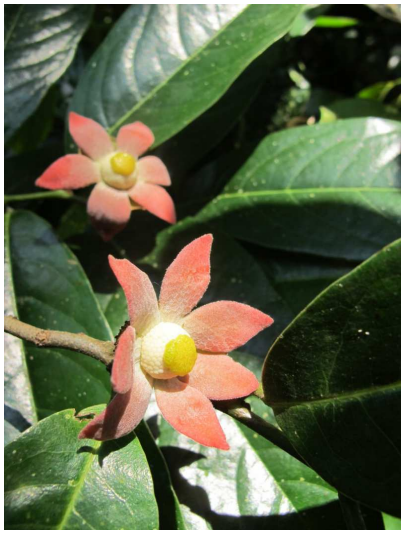

Fig. 3 Puswel (*Entada zeylanica*) and another liana.


Fig. 4a-b – Peru Balm seedlings and young trees (*Myroxylon balsamum*)


Fig. 5a-b – Devils Ivy (*Epipremnum aureum*)

Fig. 6a-b – Mahogany (*Swietenia macrophylla*), young and mature trees.

More pictures of wildlife in the Udawattakele Forest are available at:
https://picasaweb.google.com/113447755795718581160/UdawattaKele?authkey=Gv1sRgCJH5isPAnpHvlAE
and the invasive weeds at:
https://picasaweb.google.com/113447755795718581160/WeedsUdawattakele?authkey=Gv1sRgCPKspfKsu__kYQ

Areas Invaded

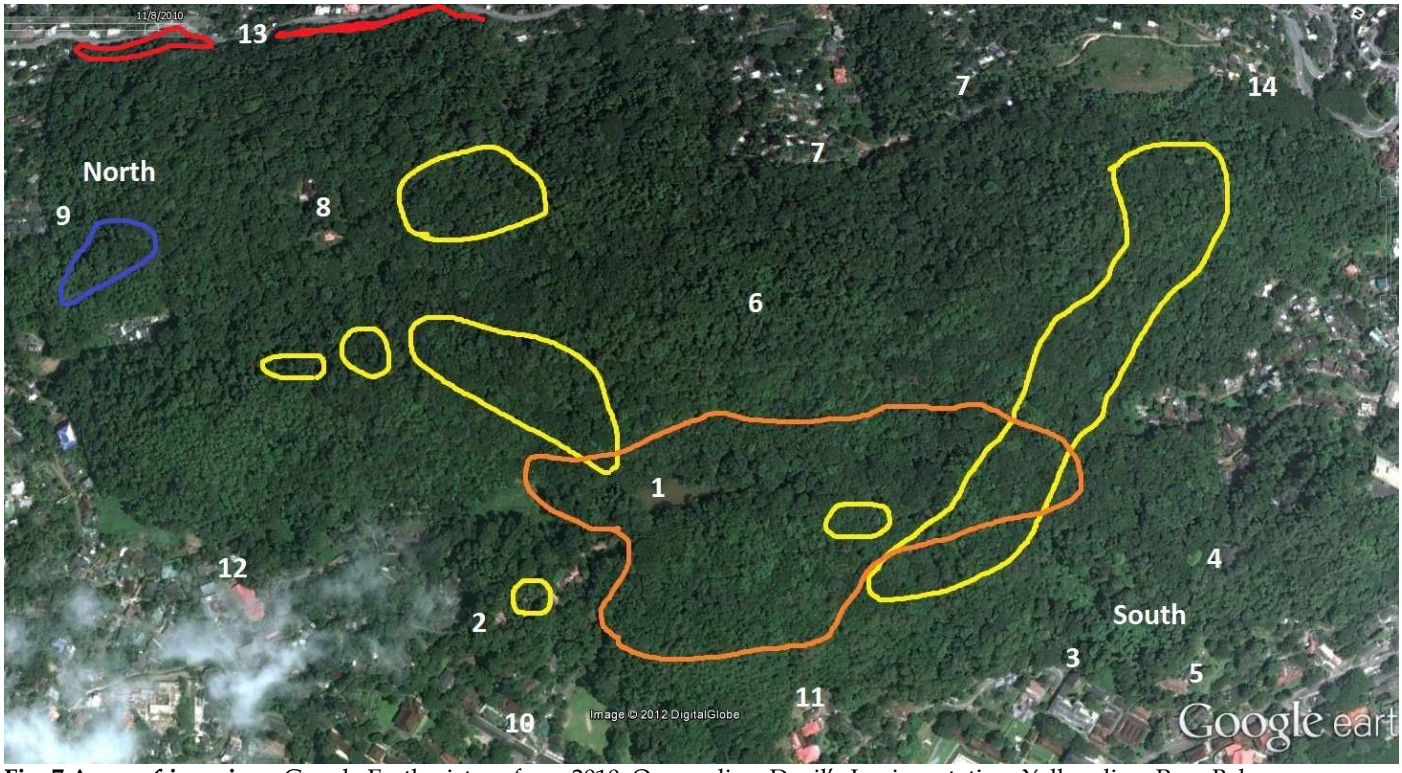

Fig. 7 Areas of invasives, Google Earth picture from 2010. Orange line: Devil's Ivy investation. Yellow line: Peru Balsam investation (Mature trees and seedlings at greatest density). Red line: Equador Laurel. Blue line: Pine plantation. 1. Royal Pond. 2. District Forest Office. 3. Temple of the Tooth. 4. Range Forest Office. 5. Garrison Cemetery. 6. Highest point. 7. Lewella housing estate. 8. Forest Hermitage & Senanayakaramaya. 9. Uplands housing estate. 10. Trinity College. 11. Governor's Residence. 12. Sudharmarama Temple. 13. Dharmasoka Mawatha. 14. Aylaperuma Mawatha.

APPENDIX: List of animals and plants in the Udawattekele in 2014

This list is tentative as the survey of plant species is still ongoing, some species still have to be determined, and taxonomic status may have changed). The lists were compiled by Nyanatusita. Plant species were determined by Nyanatusita and Dr. J. de Vlas. (No grasses and ferns were surveyed.) The list of birds is limited to birds often seen. The list of plant species in Karunaratna (Appendix XIII) contains a lot of garden species such as the Coconut tree and Durian that would have been observed in the cultivated gardens adjoining the forest, while this list confines itself to wild areas in the sanctuary itself. The list of exotic species only contains those species that are common and multiply themselves within the Udawattakele. Although the Na tree *Mesua ferrea* is not locally native and in the Udawattakele only grows in a grove that was planted during a reforestation program, it is nevertheless included in the section of native trees. Likewise White Teak or *Gmelina arborea* is not locally native and was planted in the 1920s. (**Endemic species are given in bold**.)

Mammals

1) Asian Palm Civet (*Paradoxurus hermaphroditus*)
2) **Dusky striped squirrel (*Funacaambulus obscurus*)**
3) **Golden Palm Civet (*Paradoxurus zeylonesis*)**
4) Greater Bandicoot Rat (*Bandicota indica*)
5) Greater False Vampire Bat (*Megaderma lyra*)
6) Indian Brown mongoose (*Herpestes fuscus*)
7) Indian Flying-fox (*Pteropus giganteus*)
8) Indian Giant Flying Squirrel (*Petaurista philippensis*)
9) Indian Muntjac (*Cervus muntjak*)
10) Indian Pangolin (*Manis crassicaudata*)
11) Indian wild boar (*Sus scrofa cristatus*)
12) **Pale-fronted Toque Macaque (*Macaca sinica aurifrons*)**
13) Porcupine (*Hystrix indica*)
14) Ruddy Mongoose (*Herpesthes smithii*)
15) Schneider's leaf-nosed bat *Hipposideros speoris*
16) **Slender Loris' (*Loris tardigradus grandis*)**
17) Small Indian Civet (*Viverricula indica*)
18) Sri Lankan spotted chevrotain (*Moschiola meminna*)

Reptiles

1) Banded kukri (*Oligodon arnensis*)
2) **Boie's rough-sided snake (*Aspidura brachyorrhos*)**
3) Common hump-nosed pit viper (*Hypnale hypnale*)
4) Green Forest Lizard (*Calotes calotes*)
5) **Green pit viper (*Trimeresurus trigonocephalus*)**
6) Green vine snake (*Ahaetulla nasuta*)
7) **Humpnosed lizard (*Lyriocephalus scutatus*)**
8) Oriental Ratsnake (*Ptyas mucosus*)
9) **Peter's earth snake** (*Rhinophis philippinus*)
10) Rock Python (*Python molurus*)
11) Spectacled cobra (*Naja naja*)
12) Sri Lanka Cat Snake (*Boiga ceylonensis*)

13) **Sri Lanka Kangaroo-lizard (*Otocryptis wiegmanni*)**
14) **Sri Lanka wolf snake (*Cercaspis carinatus*)**
15) **Sri Lankan Krait (*Bungarus ceylonicus*)**
16) Toeless snakeskink (*Nessia monodactylus*)
17) Whistling lizard (*Calotes liolepis*)

Birds (Commonly seen species)

1) Black Bulbul (*Hypsipetes leucocephalus*)
2) Brown Fish Owl (Bubo zeylonensis)
3) **Brown-capped Babbler (*Pellorneum fuscocapillus*)**
4) Ceylon Shikra (*Accipiter badius badius*)
5) Common Tailorbird (*Orthomus sutorius sutorius*)
6) Crested Serpent Eagle (*Spilornis cheela spilogaster*)
7) Dull-blue flycatcher (*Eumyias sordida*)
8) Emerald Dove (*Chalcophaps indica*)
9) Forest Wagtail (*Dendronanthus indicus*)
10) Greater Goldenback (Chrysocolaptes stricklandi)
11) Hill Myna (*Gracula religiosa*)
12) **Layard's parakeet (*Psittacula calthropae*)**
13) Lesser Goldenback (*Dinopium benghalense psarodes*)
14) Sri Lanka Hanging Parrot (*Loriculus beryllinus*)
15) Sri Lanka Paradise Flycatcher (*Terpsiphone paradisi ceylonensis*)
16) White-rumped Munia (*Lonchura striata*).
17) White-rumped Shama (*Copsychus malabaricus leggei*)
18) Yellow-fronted Barbet (*Megalaima flavifrons*)

Indigenous Trees

1) Adenanthera pavonina, Red beadtree, Sinh: (Madatiya)
2) *Aleurites moluccana,* Candlenut, (Tel kekuna)
3) *Alstonia scholaris,* Blackboard tree, (*Rukattana*)
4) *Aphananthe cuspidata / Gironniera cuspidate,* (Wal-munamal)
5) ***Artocarpus nobilis*, Wild breadfruit, (Wal Del)**
6) *Artocarpus heterophyllus,* Jack, (Kos)
7) *Bombax ceiba,* Red silk-cotton, (Katu imbul)
8) *Broussonetia Zeylanica*, Ceylon Paper Mulberry, (Alandu)
9) ***Canarium zeylanicum*, (Kaekuna)**
10) *Carallia brachiata,* Freshwater Mangrove, (Dawata)
11) *Caryota urens,* Kitul Palm, (Kitul)
12) *Celtis cinnamomea,* (Gurenda)
13) *Celtis philippensis,* (Meditella)
14) *Chukrasia tabularis,* Indian mahogany, (Hulan-hik)
15) *Chrysophyllum roxburghii,* Indian star apple, (Lawulu)
16) *Cleidion spiciflorum,* (O-kuru)
17) *Cinnamomum verum,* Cinnamom Tree, (Kurundu Cinnamon)
18) *Cordia dichotoma,* Indian Cherry, (Lolu)
19) *Dillenia indica*, (Hondapara)
20) *Dimocarpus longan* Longan tree, (Mora)
21) *Diospyros ebenum,* Ebony, (Kaluwara)
22) *Elaeocarpus serratus,* Ceylon olive, (Weralu)

23) *Erythrina variegata,* Coral tree or Dadap, (Erabadu)
24) *Ficus nervosa,* (Kala maduwa)
25) *Ficus racemosa,* Cluster fig, (Attikka)
26) *Ficus tinctoria,* (Wal Ehetu)
27) *Ficus tsjahela,* (Kiri-pela)
28) *Filicium decipiens,* Fern Tree, (Pihimbiya)
29) *Garcinia cambogia,* Gambooge, (Goraka)
30) *Garcinia Morella,* (Gokatiya)
31) *Garcinia xanthochymus,* Sour mangosteen, (Kolon Rata Goraka)
32) **Glenniea unijuga, (Wal-mora**)
33) *Gmelina arborea,* White teak, (Ethdemata)
34) ***Gyrinops walla,* (Walla patta)**
35) *Harpulia arborea,* (Na imbul)
36) *Hydnocarpus venenata,* (Makulu)
37) *Lepisanthes tetraphylla,* Torchwood, (Dambu)
38) *Mangifera indica,* Mango, (Amba)
39) Meliosma simplicifolia, (Elbedda)
40) *Mesua ferrea,* Ceylon Iron-wood, (Na)
41) *Macaranga peltata,* (Kenda)
42) *Mallotus phillipensis,* Red Kamala, (Hamparilla)
43) *Mallotus tetracoccus,* (Bu-kenda)
44) *Mangifera Zeylanica,* Wild Mango, (Atamba)
45) *Myristica dactyloides,* Bitter Nutmeg, (*Malaboda*)
46) ***Neolitsea cassia,* Grey Bollywood, (Dawul Kurundu)**
47) *Pterospermum suberifolium,* Fishing Rod Tree, (Welan)
48) *Psydrax dicoccos,* Ceylon Boxwood, (also called *Canthium dicoccum* Sinh. Panderu)
49) *Sapindus emarginatus,* Notched Leaf Soapnut, (Penela)
50) *Semecarpus obscurus,* Marking-nut Tree, (Badulla)
51) *Spondias pinnata,* Hog Plum, (Wal Ambarella)
52) *Sterculia balanghas,* (Nawa)
53) *Stereospermum personatum,* Trumpet tree, (Palol)
54) *Syzygium gardneri,* (Damba)
55) *Terminalia bellirica,* Beleric, (Bulu)
56) *Tetrameles nudiflora,* False Hemp Tree, (Sinhala: Nigunu)
57) *Trema orientalis,* Charcoal tree, (Gedumba)
58) *Vitex altissima,* Peacock Chaste Tree, (Milla)

Indigenous shrubs and small trees

1) *Acronychia pedunculata,* (Sinhala: Ankenda)
2) *Aglaia elaeagnoidea,* (Puwanga)
3) *Allophylus cobbe,* (Bu-kobbe)
4) **Allophylus zeylanicus,** (Wal Kobbe)
5) Antidesma bunius, (Karawala-kebella)
6) *Aporusa lindleyana,* (Kebella)
7) Ardisia gardneri,
8) *Ardisia missionis,*
9) *Ardisia moonii,*
10) ***Areca concinna,* Wild Betel nut palm, (Lenatheriya, Lenteri-puwak)**
11) *Atalantia ceylanica,* (Yakinaran)

12) *Breynia vitis-idaea,* (Gas kayila)
13) *Brucea javanica,* (Wal Papul)
14) *Chassalia curviflora,*
15) ***Chionanthus albidiflora,*** **(Embul korakaha)**
16) Cipadessa baccifera, (Kirikon)
17) *Clausena anisata,* Horse wood
18) *Clausena indica,* (Meegon)
19) *Clerodendrum infortunatum,* (Pinna)
20) Dichapetalum gelonioides, (Balu Nakuta)
21) Dysoxylum ficiforme, Orangeberry
22) Ficus hispida, Hairy fig, (Kota Dimbula)
23) *Glochidion moonii,* (Bu hunukirilla)
24) *Glochidion stellatum*
25) *Glycosmis mauritiana*
26) *Glycosmis pentaphylla,* (Dodan-pana)
27) *Glyptopetalum zeylanicum*
28) Gomphia serrata
29) ***Goniothalamus gardneri,*** **(Kalu kera)**
30) *Hunteria Zeylanica,* (Mediya)
31) *Isonandra lanceolata,* (*Kirihembiliya, Molpeda*)
32) Ixora thwaitesii
33) Lasianthus strigosus, (Wal kopi)
34) *Leea indica,* (Gurulla)
35) Lepisanthes erectum
36) *Litsea quinqueflora,* (Kosbada)
37) *Litsea deccanensis,* (Lena-ida)
38) **Litsea longifolia, (Rathkeliya)**
39) Mallotus resinosus, (Ma-enduru)
40) Mallotus tetracoccus, (Boo kenda)
41) *Melochia umbellate,* (Mal kenda)
42) *Micromelum minitum,* (Wal karapuncha)
43) *Miliusa indica,* (Kekili-messa)
44) *Murraya paniculata,* Orange Jessamine, (Etteriya)
45) *Mussaenda frondosa,* (Mussenda)
46) *Pagiantha dichotoma,* (Divi-kaduru)
47) Pandanus sp., (Weta keyiya)
48) *Nothapodytes nimmoniana,* (Ganda-pana)
49) *Nothopegia beddomei,* (Bala)
50) ***Pavetta blanda,*** (Pavetta)
51) *Phaleria capitata,*
52) *Polyalthia korinti,* (Mi-wenna Ul-kenda)
53) Psychotria nigra
54) Sauropsos androgynus, Star gooseberry, (Mella-dum-kola)
55) *Scolopia acuminate,* (Katu-kenda, Katu kurundu)
56) *Streblus asper,* Sandpaper tree, (Geta-nitul)
57) *Symplocos cochinchinensis*, (Bombu),
58) *Tarenna asiatica,* Asiatic Tarenna, (Tarana)
59) *Turpinia malabarica,* (Eta hiriya)
60) ***Walsura gardneri***

61) *Wendlandia bicuspidate,* (Rawan idala)

Indigenous Herbs:

1) *Amomum echinospermum,* Wild Cardamom
2) *Amomum graminifolium,* Wild Cardamom
3) *Cassia hirsuta* (Parangi-tora)
4) *Costus speciosus,* Crape ginger, (Thebu)
5) *Curculigo orchiodes,* (Heen-bin-tal)
6) Dendropthoe faclcata, (Pilla)
7) Dianella ensifolia, (Monara-petan)
8) *Dracaena thwaitesii,* Dragon tongue plant
9) *Epithema carnosum*
10) *Eranthemum capense*
11) *Geophilla repens*
12) *Lepidagathis hyaline* or *incurva*
13) *Ophiorrhiza mungos,* (Dat-ketiya)
14) *Pogostemon heyneanus,* (Gan-kollan-kola)
15) *Pseuderanthemum latifolium*
16) *Rhipsalis baccifera,* (*Wal-nawahandi*)
17) Runglia longifolia
18) Senna hirsuta
19) Indian stringbush, *Wikstroemia indica*.

Orchid species:

1) Aerangis hologlottis, One Piece Lip Aerangis
2) *Anoectochilus setaceus,* Bristly Anoectochilus, (Vana-raja)
3) *Cymbidium bicolour,* Two Coloured Cymbidium
4) *Dendrobium macrostachyum*
5) *Hetaeria oblongifolia*
6) Luisia tenuifolia
7) *Luisa teretifolia*
8) *Polystachya concreta*
9) *Thrixspermum pulchellum*
10) *Tropidia bambusifolia*
11) *Vanda testacea*
12) *Zeuxine regia,* (Iru raja)

Lianas, creepers and vines:

1) *Acacia caesia,* (Hinguru wel)
2) *Alangium salviifolium,* (Ruk-Anguna)
3) *Ampelocissus indica* (= *A. latifolia*), Wild Grape
4) *Anamirta cocculus,* (Titta-wel)
5) ***Argyreia populifolia,* (Giri-tilla)**
6) Aristolochia indica, (Sap-sanda)
7) *Artabotrys zeylanicus,* (Yakada-wel)
8) *Asparagus falcatus,* (Hatawariya)
9) Caesalpina bonduc or *major,* (Kumburu-wel)
10) *Calamus pseudotenuis*
11) *Calamus zeylanicus* or *ovoideus,* (We-wel)

12) *Cansjera rheedii,* (Eta-mura)
13) *Capparis roxburghii,* (Kalu-illan-gedi)
14) *Cayratia pedata,* (Gerandi-dul-wel, Mediya-wel)
15) *Chonemorpha fragrans,* Frangipani Vine, (Bulu-walanguna)
16) *Cissampelos pareira,* (Diya-mitta)
17) *Cissus gardneri*
18) *Cissus heyneana*
19) Cissus lonchiphylla
20) *Combretum albidum*,(Raengun vael)
21) *Cyclea peltata,* (Kehipiththan)
22) *Dalbergia pseudo-sissoo,* Hornet creeper, (Bambara-wel)
23) *Dichaetaria wrightii,* (a grass species)
24) *Diploclisia glaucescens,* Glaucous Diploclisia, (Ata Thiththa Wel)
25) ***Derris parviflora,* (Sudu-kala Wel)**
26) *Derris canarensis,* Kanara Derris, (Diya-kala Wel)
27) *Eleagnus latifolia,* Bastard oleaster, (Embilla)
28) *Entada zeylanica,* (Puswel)
29) Erycibe paniculata, (Etambiriya)
30) *Gloriosa superba,* Flame lily, (Niyangala)
31) *Gouania microcarpa*
32) *Grewia carpinifolia*
33) *Hibiscus furcatus,* (Napiritta)
34) *Hiptage bengalensis,* Hiptage, (Puwak-gediya-wel)
35) ***Hiptage parviflora***
36) *Hypserpa nitida,* (Niriwel)
37) *Jasminum flexile*
38) *Mallotus repandus*
39) *Morinda umbellate,* (Kiri-wel)
40) *Naravelia zeylanica,* (Naraveli)
41) *Olax imbricate,* South Asian Olax
42) *Paramignya monophylla,* (Wellangiriya)
43) *Piper zeylanicum,* Wild Pepper, (Wal Gammiris)
44) *Piper sylvestre,* Wild Pepper, (Wal Gammiris)
45) *Pothos scandens,* (Pota wel)
46) Reissantia indica
47) Rourea minor, (Goda-kirindi)
48) *Stenochlaena palustris*
49) *Schefflera stellata,* (Ittha)
50) *Smilax perfoliata,* (Maha-kabarassa)
51) Tetrastigma nilagiricum
52) *Tetrastigma sp.*
53) Uncaria elliptica, Cat's Claw or Hook Vine
54) Toddalia asiatica, (Kudu-miris)
55) Uvaria macropoda, (Attu-muddah)
56) *Ventilago maderspatana,* (Yakkada Vael)
57) *Ziziphus oenoplia,* Jackal Jujube, (Hin-eraminiya)
58) *Zizyphus rugosa,* Wild Jujube, (Maha-eraminiya)

Exotics Trees (invasive and non-invasive):

1) *Albizia saman* or *Samanea saman,* Saman or Rain Tree, (Para Mara, Nunga)
2) *Alstonia macrophylla,* Hard Milkwood or Hard Alstonia, (Havari nuga)
3) *Cananga odorata,* Ylang ylang, (Wana sapu)
4) *Castilla elastica,* Panama Rubber
5) *Chrysophyllum cainito,* Star apple, (Rata lawulu)
6) *Cordia alliodora,* Ecuador laurel or salmwood
7) *Couroupita guianensis,* Cannonball Tree, (Sal)
8) *Dieffenbachia seguine,* Dumb-cane
9) *Manilkara zapota,* Sapodila, (Rata-me Sapadila)
10) *Michelia champaca,* Champaka, (Sapu)
11) *Myroxylon balsamum,* Peru balsam, (Katukumunjara)
12) *Pinus caribaea,* Caribbean pine
13) *Pittosporum ferrugineum,* Rusty pittosporum
14) *Sapium glandulosum,* Gumtree
15) *Spathodea campanulata,* African Tulip Tree, (Kudella gaha)
16) *Swietenia macrophylla,* Mahogany

Shrubs:
1) *Brugmansia suavolens* (formerly *Datura suavolens*), Angel's Trumpet, Rata-attana)
2) *Chromolaena odorata,* Siam Weed
3) *Coffea robusta* and/or *Coffea arabica,* Coffee
4) *Pachystachys coccinea / Jacobinia coccinea,* Cardinal's Guard
5) *Thunbergia erecta,* King's Mantle
6) *Theobroma cacao,* Cocoa.

Lianas, vines & creepers
1) *Derris* or *Millettia* sp. (above Senkadagala Lena)
2) *Epipremnum aureum,* Devil's ivy
3) *Mikania micrantha,* Mile a minute
4) *Philodendron scandens,* Heart-leaved Philodendron
5) *Saritaea magnifica,* Glow Vine
6) *Thunbergia grandiflora,* Bengal Trumpet

Herbs
1) *Adiantum pulverulentum,* Glossy Maidenhair fern
2) *Aglaoneama communatum,* Philippine evergreen
3) *Angiopteris evecta,* Giant Fern
4) *Begonia humilis*
5) *Piper umbellatum, (*Maha-labu*)*
6) *Rivina humilis,* Pigeonberry