ENVIRONMENTAL MANAGEMENT IN FORESTRY DEVELOPMENT PROJECT

DESIGNING AN OPTIMUM PROTECTED AREAS SYSTEM FOR SRI LANKA'S NATURAL FORESTS

Volume 1

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National Conservation Review teams

EXECUTIVE SUMMARY

Sri Lanka is a small but biologically diverse country that is recognized as a biodiversity hotspot of global importance for plants. Many plants and animals are endemic to the island, 26% in the case of flowering plants and from 45% to 76% for certain taxonomic groups of animals. Much of this diversity is found in the south-west wet zone which occupies one-third of the country. Closed canopy natural forest covers 24% of the country but it is least extensive in the wet zone where human population pressures are highest.

The over-riding objective of this National Conservation Review (NCR) of remaining natural forest in Sri Lanka is to define a national system of conservation forests in which watersheds important for soil conservation and hydrology are protected, forest biodiversity is fully represented and cultural, economic and social needs are met.

The NCR focused on assessing the importance of forests for soil, water and biodiversity conservation. All natural forests of 200 ha or more were included in the NCR, except those in the north and east of the island which were politically inaccessible. The biodiversity assessment was restricted to woody plants, vertebrates, molluscs and butterflies. Despite such limitations, **the NCR is among the most detailed, comprehensive and innovative evaluations of its kind carried out in any tropical country.** Between April 1991 and September 1996, a total of 1,725 plots (100 m x 5 m) were inventoried along 310 gradient-directed transects in 204 forests. Analyses are based on approximately 69,400 records of 1,153 woody plant species and 24,000 records of 410 species of selected animal groups. A total of 281 forests were evaluated with respect to their importance for soil and water conservation.

Sri Lanka has an extensive system of protected areas covering over 14% of total land area. However, this system is least extensive in the wet zone, where watershed protection is of paramount importance and biodiversity is highest. The results from the NCR show that many of the most important forests for soil and water conservation are not protected. Furthermore, certain floristic regions and forest types are poorly represented within the existing protected areas system. It has also been shown by this study that up to 15% of species diversity may be absent from the present system.

It is reassuring to find that 46% of the highest category of wilderness lies within protected areas, indicating their integrity and the relative absence of infrastructural developments, such as settlements and roads. A further 20% of high quality wilderness is found in forest and proposed reserves.

Of the 281 forests assessed for watershed protection, 85 were identified as being extremely important for soil protection and flood control, or interception of fog in the case of those located above 1,500 m. In general, wet zone forests are a top priority for soil and water conservation, particularly the largest units of contiguous forest (Central Highlands, KDN, Knuckles and Sinharaja) which protect the headwaters of the country's major rivers.

Of the 204 forests assessed for biodiversity conservation, minimum sets of 108 and 49 were identified for representation of woody plant and endemic woody plant species, respectively. Woody plant and animal diversity is represented within a total of 133 forests, but it should be noted that some woody plant inventories were inadequate and that all animal inventories were incomplete. Some 80% or more of woody plant and animal species are represented within eight units of contiguous forest, namely: Bambarabotuwa, Central Highlands, Gilimale-Eratne, KDN, Knuckles/Wasgomuwa, Pedro, Ruhuna/Yala and Sinharaja.

There is considerable commonality between forests important for soil and water conservation and those rich in species. An integrated analysis shows that a minimum set of 104 of 224 units of contiguous forest are necessary to meet watershed protection and biodiversity conservation priorities. Such an optimum system of conservation forests covers 516,795 ha, or 7.8% of total land area. With the exception of a few small fragments, all forests within the wet zone are included in this optimum system, together with the extensive forests of Ruhuna/Yala in the south-east and several small units to the north. If one of the criteria is changed from representation of all species to endemic species only, the minimum set of contiguous forests falls to 70 but the system extends over almost as large an area (490,193 ha, or 7.4% of total land area).

Given that there is very little redundancy in the wet zone, forests being important for either biodiversity conservation or for protection of watersheds, the current ban on logging should be maintained for the foreseeable future. As it is unlikely that such measures will be adequate to safeguard the entire spectrum of forest biodiversity, it will be necessary to conserve biodiversity though other measures, including private stewardship of natural forests. In the meantime, much can be achieved by upgrading the conservation status of existing forest and proposed reserves in the wet zone.

The Forest Department, in collaboration with other sectors, is encouraged to consider pragmatic ways of addressing the conservation priorities emanating from this study, taking into proper account their cultural, economic and social implications. Importantly, its Environmental Management Division now has the necessary skills and tools to optimise this system of conservation forests further in response to socio-economic and other constraints that might arise during the planning process. The Environmental Information Management System, held by the Division, provides a powerful tool for generating optimum systems of conservation forest according to predefined criteria and quantifying their potential benefits and costs.

In order to further optimise the system of conservation forests, it will be necessary to carry out additional surveys of forests overlooked by the NCR, as well as those inadequately inventoried for species. Moreover, any plans to release forest lands for other forms of use should be preceded by more detailed biodiversity surveys in order to fully evaluate their potential impact. This should be considered mandatory for any forest either not surveyed or inadequately surveyed by the NCR, particularly if it lies in the wet zone.

Despite the wealth of data generated by the NCR, they are preliminary and provide a basis for systems planning. Much more detailed and wide-ranging surveys will be required to plan and monitor the management of individual conservation forests once they are established. Given the continual need to survey and monitor biodiversity, it should be noted that there are more rapid, less costly alternatives of inventorying plant taxa at the level of genera without significantly jeopardising representation of species within minimum forest systems.

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Chapter 1

INTRODUCTION

1.1 BACKGROUND TO THE NATIONAL CONSERVATION REVIEW

A major criticism of the first Forestry Master Plan for Sri Lanka (1986) was its failure to address the environmental aspects of forestry, particularly with respect to conserving the country's rapidly dwindling natural forests in the wet zone (FPU, 1995). As a result of this criticism and following the preparation of the Forestry Sector Development Project (FSDP) in 1986, IUCN-The World Conservation Union was invited by the Government of Sri Lanka in 1988 to assess the environmental implications of the FSDP and, subsequently, in April 1989 to formulate an Environmental Management Component to strengthen environmental safeguards within the FSDP. This formulation led to the present Environmental Management in Forestry Development Project (EMFDP), which has run from April 1991 to September 1996[1] (UNDP/FAO/GOSL, 1989).

A principle recommendation arising from the IUCN (1988) assessment was to introduce a moratorium on all logging within the wet zone, pending a conservation evaluation of the country's remaining rain forests. This ban was introduced in 1990 and awaits the outcome of the conservation evaluation, which has since been carried out as part of the EMFDP and is the subject of this report.

Commonly referred to as the National Conservation Review (NCR), this component of the EMFDP is concerned with evaluating all remaining natural forests (including mangrove) with respect to their importance for biodiversity, in terms of ecosystem and species diversity, and their value for soil and water conservation. Its over-riding objective is:

> ***to define a national system of conservation forests in which watersheds important for soil conservation and hydrology are protected, forest biodiversity is fully represented and cultural, economic and social needs are met.***

This objective nests within the wider framework of strengthening the institutional capabilities of the Environmental Management Division, set up within the Forest Department in 1990 to address forest conservation and management issues (UNDP/FAO/GOSL, 1989). The project has been implemented by the Forest Department, with technical assistance from IUCN-The World Conservation Union under contract to the Food and Agriculture Organization of the United Nations, and with funds from the United Nations Development Programme. In order to meet its objective, the project includes natural forests administered by the Forest Department and other government agencies, such as the Department of Wildlife Conservation.

The NCR follows on from an Accelerated Conservation Review (ACR) of 30 lowland rain forests, managed as 13 units and covering some 480 km^2 (TEAMS, 1991). Scientific

[1] This includes a six-month extension to the original schedule.

information on their conservation importance was urgently needed ahead of the NCR because these forests had been earmarked for logging.

During the course of the NCR, a new Forestry Sector Master Plan (FPU, 1995) has been formulated for the period 1995-2020 which is based on a new *National Forestry Policy*, 1995. Together, they mark the turning point from focusing on exploitation of natural forests to an over-riding priority for conservation of biodiversity and protection of watersheds. Also significant is the policy shift towards people's participation in the protection and management of natural forests through appropriate partnership and tenurial arrangements. The NCR has been fully incorporated within the new Forestry Sector Master Plan.

Another relevant initiative is the preparation of a Biodiversity Conservation Action Plan for Sri Lanka, which commenced in 1996 following a planning phase in 1995. The biodiversity component of the Forestry Sector Master Plan, hence the NCR, will fall within the framework of this Action Plan.

The NCR has run for the entire duration of the EMFDP. Field work commenced in earnest in September 1991 and continued until March 1996. During this time remaining natural forests were surveyed, with the exception of those inaccessible in the north and east due to ongoing activities of the LTTE, the Tamil separatist movement. Thereafter, time was spent identifying herbarium and museum specimens, validating field data entered into the Environmental Information Management System (EIMS), analysing and reviewing the results in consultation with other government agencies, scientific institutions and non-government organisations at workshops, and producing this report.

The purpose of this report is to provide a comprehensive account of the results of the NCR, particularly in so far as they can be used to design an optimum system of forests for soil, water and biodiversity conservation purposes.

The report comprises seven chapters. Chapter 1 and 2, respectively, focus on the importance of forests for watershed protection (i.e. soil and water conservation) and biodiversity conservation in general, and with specific reference to Sri Lanka. The methodology is outlined in Chapters 3 and 4 for watershed protection and biodiversity, respectively. A worked example of the assessment of the importance of forests for soil and water conservation is provided in Section 3.8. The results of the soil and water conservation and biodiversity assessments are presented in Chapters 5 and 6, respectively. Results from these two assessments are integrated in Chapter 7 in order to better define an optimum system of conservation forests. Chapter 7 concludes with a review of how the findings from this study can be translated into effective conservation action.

1.2 VALUE OF FORESTS FOR SOIL AND WATER CONSERVATION

Natural forests play an important role in the conservation of soil and water resources. They contribute to the stability of watersheds by protecting the soil surface from the direct impact of intensive tropical rain storms, by stabilizing ground water levels and stream flows, and by recycling some rainfall as part of the hydrological cycle.

Rainfall is intercepted by the forest canopy and the rest falls on the forest floor where additional protection from splash erosion is provided by the covering of leaf litter. Organic matter incorporated into the soil from the leaf litter improves the surface soil properties by increasing infiltration of rainfall, thereby reducing surface run-off and the effects of rill and gully erosion. Water rapidly percolates vertically into the subsoil and drains laterally into the streams.

The removal of forest cover exposes the soil to erosion and compaction. Reduced vegetation cover allows more water to reach the soil more rapidly. Less infiltration, caused by surface sealing and compaction, increases surface run-off and, hence, erosion. This quickly reduces the depth of the soil and its capacity to store water. For example, an average of 300 mm of soil has been lost from Sri Lanka's upper Mahaweli watershed during the last 100 years (Krishnarajah, 1982), thereby reducing the capacity of the soil profile to store water by about 60 mm. With increasing surface run-off, the ground water table is progressively lowered and processes of desertification set in. Steep hill sides become more prone to landslides as tree roots rot, perennial streams become intermittent, and floods more frequent with increased surface run-off and accumulating sediment in the river beds. Inevitably, the repercussions of increased sediment loads and higher flood peaks are experienced further downstream from the deforested headwaters. In the long term, sedimentation of reservoirs may substantially reduce their capacity to store water for hydropower and irrigation, jeopardizing the ago-industrial base of the economy.

1.2.1 Tropical forests and soil conservation

Deforestation is a major cause of soil erosion in many tropical countries. The popular view that trees check soil erosion, particularly when planted in stands, is scientifically proven. Besides erosion, deforestation can lead to various problems downstream, such as reservoir siltation, sedimentation of irrigation works, and higher flood peaks.

It is necessary to distinguish between surface erosion, gully erosion and landslides because the ability of forests to control these various types of erosion differs considerably. In a review of 80 studies of surface erosion in tropical forests and tree crop systems, Wiersum (1984) concluded that surface erosion is negligible in those systems where the soil surface is adequately protected from the impact of raindrops by a well-developed litter and herb layer. Erosion is slightly higher if the understorey is removed, but rises dramatically with the removal of the litter layer. Studies in India have shown by that sediment loads are about five times higher in deforested than forested catchments (Haigh *et al.*, 1990). In Kanneliya, which lies in Sri Lanka's wet zone, it has been shown Ponnadurai *et al.* (1977) that sediment loads are lower (0.15 t ha^{-1} yr^{-1}) for natural forest than selectively logged forest (0.27 t ha^{-1} yr^{-1}). Sediment loads for pines (0.49 t ha^{-1} yr^{-1}) and grasslands (3.3 t ha^{-1} yr^{-1}) are still higher (Gunawardena, 1989a), but nowhere near the high loads of 100 t ha^{-1} yr^{-1} recorded from formerly forested, badly managed agricultural land (Stocking, 1984).

Accelerated soil erosion on hill sides shortens the effective life span of reservoirs. A study of 17 major reservoirs in India, for example, shows that they are filling at about three times the expected rate because of the vast areas deforested (Tejwani, 1977). Similarly, high rates of siltation (13,500 m^3 km^{-2} yr^{-1}) have been recorded from deforestation in Tanzania (Kunkle and Dye, 1981). In Sri Lanka, serious concern was expressed in 1873 about soil erosion caused by indiscriminate conversion of forest for plantation agriculture. A recent study shows that 15 millions tons of sediment passed through the Peradeniya gauging station in the upper Mahaweli watershed during the period 1952-1982 (NEDECO, 1984). Almost 44% of the capacity of the Polgolla Barrage, sited about 4 km downstream from this station, was silted by 1988, only 13 years after its commissioning (Perera, 1989). There is every indication that the reservoirs built under the Accelerated Mahaweli Development Project are silting up at a much faster rate than predicted at the feasibility stage.

Hill roads cause many landslides and are a major source of sediment. It has been estimated that roads in the Central Himalaya produce 430-550 m^3 km^{-1} yr^{-1} of sediment (Haigh *et al.*, 1990). Similarly, studies carried out in Sri Lanka have identified landslides as a major source of sediment (Gunawardena, 1987).

1.2.2 Hydrological importance of tropical forests

The influence of forests on the hydrological cycle has been studied for a long time, but many contradictory views persist. While there is general agreement about the beneficial effect of forest on microclimate, air and water purification processes, and control of run-off and erosion, the influence of forest and forest reclamation on the water balance within a region remains the subject of much controversy. The way in which forest influences rainfall, water yield and flooding is discussed in the following three sub-sections.

Rainfall

Opinions differ regarding the effect of forest on rainfall. Some authorities maintain that forest has a marginal effect on rainfall, while others consider that the removal of forest results in desertification. The consensus among hydrologists is that changes in land use have no effect on rainfall, except in extensive areas such as the tropical watersheds of the Congo and Amazon (Bruijnzeel, 1986; Meher-Homji, 1988; Pereira, 1989).

Although the impact of deforestation on rainfall is contentious and difficult to quantify at present, there is rather more agreement about its repercussions on storm intensity and associated soil erosion (Meher-Homji, 1988). Dickenson (1980) reviewed a number of studies and concluded that deforestation could increase the intensity and reduce the duration of tropical rainfall, enhancing run-off without necessarily changing the total amount of rain falling during a given period. Long-term observations of private rubber plantations in Malaysia provide circumstantial evidence of profound and lasting changes arising from forest clearance (Unesco, 1978). Total rainfall remained unchanged following large-scale forest clearance: rainfall frequency decreased but its intensity increased. Similarly, Meher-Homji (1980) has shown that large-scale deforestation tends to reduce the number of rainy days rather than the total volume of the rainfall. The result is enhanced soil erosion and, consequently, a higher incidence of major disasters. If rainfall remains unchanged in total amount but becomes sporadic, with a higher incidence of torrential downpours, the consequences are more flooding and greater siltation of river beds and reservoirs. Greater erosion reduces the capacity of soils to store water, with the result that streams dry up more quickly if drought conditions persist.

Water yield

A common misconception is that the complex of forest soils, roots and litter behaves like a sponge, soaking up water during rainy spells and releasing it gradually during dry periods. Although forest soils generally have higher infiltration and storage capacities than soils with less organic matter, most of this water sustains the forest rather than stream flow. Moreover, appreciable quantities of rainfall (20%) are intercepted by the canopies of tropical forests, 30% in the case of wet zone forests in Sri Lanka (Ponnadurai *et al.*, 1977), and released back into the atmosphere.

Hibbert (1967) was the first to review the effect of forest clearance on water yield. On the basis of 39 studies, he concluded that:

- reduction of forest cover increases water yield,
- establishment of forest cover on sparsely vegetated land decreases water yield, and
- response to treatment is highly variable and, for the most part, unpredictable.

Subsequent work by Bosch and Hewlett (1982), however, has shown that water yield can be predicted. They examined 94 case studies, including those reviewed by Hibbert, and concluded that coniferous forest, deciduous hardwood forest, brush and grass cover, in that order, have decreasingly less influence on water yield from the source area compared to bare ground which has none. Other work by Hamilton and King (1983) and by Oyabande (1988) supports these findings.

Such findings, however, do not necessarily apply in the tropics where intense rainfall is experienced over short intervals. For example, about 75% of the annual rainfall occurs during two weeks in some parts of Sri lanka's dry zone. Most of this water travels rapidly through the river basin system if the land is devoid of dense forest. Such forest may hold much of this rain water, increasing the opportunity for infiltration and thereby diverting more water to the reservoir of ground water than would be the case in the absence of forest. This replenishment of ground water may increase water yield during the dry season. As yet, there have been no experimental studies to support this theory.

The only undisputed case of forests having a positive influence on water yield is along coastal belts and at high elevations where the incidence of cloud or fog is high. Such *cloud* forests, which comprise almost 5% of the total area of closed moist tropical forest (Bruijzneel, 1986), intercept significant quantities of *horizontal precipitation* from cloud or fog. Typically, in the humid tropics, this represents from 7-18% of normal, *vertical precipitation* recorded during rainy seasons to over 100% during dry seasons. Preliminary studies conducted at 2100 m in Sri Lanka have shown that cloud forests contribute an additional 17% of normal precipitation (Mowjood and Gunawardena, 1992). Thus, conversion of cloud forest to agricultural land in the humid tropics will cause a marked and usually irreversible reduction in stream flow and ground water storage. This, and the fact that they often constitute unique ecosystems, provides a strong case for their conservation.

Flooding

Forest clearance in tropical uplands has often been considered to be the major cause of severe flooding, particularly in Asian countries such as northern India, China and the Philippines (Bruijzeel, 1986), and it is widely believed that upland afforestation provides the solution to this pressing problem. On the other hand, Bosch and Hewlett (1982) concluded from their review of mainly North American research that deforestation does not significantly increase the volume of water flowing in large streams, although significant increases in stream flow usually occur in small streams and these are related to the proportion of the catchment area that is cleared.

It has been shown that the presence or absence of forest has little effect on the magnitude of flooding, which is mainly the result of too much rain in too short a period. The degree of flooding is also a function of basin and channel geometry.

Recent studies in the tropics still suggest, however, that afforestation greatly reduces flood peaks by reducing surface flow. Studies conducted at Kanneliya, in Sri Lanka's low-country wet zone, show that the ratio of run-off/rainfall was increased by 29% in a logged catchment (Ponnadurai *et al.*, 1977). Comparative studies conducted at Wewelthalawa in the mid-country wet zone show that pine plantations produce 48% less surface run-off compared to grasslands (Gunawardena, 1989b). Similarly, in India, deforestation may account for the increase in extent of flood prone land from 20 to 40 million ha in the ten years up to 1989 (Haigh *et al.*, 1988).

1.3 VALUE OF FORESTS FOR BIODIVERSITY CONSERVATION

1.3.1 What is biodiversity?

Biodiversity, a contraction of the term *biological diversity*, is most commonly used to refer to the number, variety and variability of living organisms. In its widest sense, biodiversity is synonymous with *life on Earth*, being the product of millions of years of evolution and thousands of years of cultivation of plants and domestication of animals.

It has become customary to define biodiversity in terms of genes, species and ecosystems, corresponding to three fundamental and hierarchically-related levels of biological organisation (WCMC, 1992):

- **genetic diversity** is about the range of genetic material in the world's living organisms. It is a concept concerning the variability within a species, upon which depend the breeding programmes necessary to protect and improve cultivated plants and domesticated animals as well as much scientific advance and innovation. It is measured by the variation in genes, the chemical units of hereditary information that may be passed from one generation to the next.

- **species diversity** is about the variety of living organisms on Earth (Box 1.1). It is measured by the total number of species within a given area under study. The species level is generally regarded as the most natural one at which to consider whole-organism diversity, being the primary focus of evolutionary mechanisms.

- **ecosystem diversity** is about the variety of ecological complexes (habitats) within which species occur. Their health and conservation are crucial for the well-being and survival of the species which they support, as well as for human welfare. Quantitative evaluation of ecosystem diversity is problematic. While genes and species define themselves through replication, and communities may be defined and classified relatively unambiguously, ecosystems tend not to exist as discrete units, but represent parts of a highly variable natural continuum within which any perception of change is heavily scale-dependent. Moreover, unlike genes and species, ecosystems explicitly include abiotic components, being partly determined by soil parent material and climate.

The number of species present in a given area, species richness, is the most straightforward and in many ways the most useful measure of biodiversity. Species richness tends to vary geographically according to a series of general rules, of which the most important are:

- warmer areas support more species than colder ones;
- wetter areas support more species than drier ones;
- less seasonal areas support more species than seasonal ones;
- areas with varied topography and climate support more species than uniform ones; and
- larger areas support more species than smaller ones.

Box 1.1 **How many species are there?**

A species is a group of actually or potentially interbreeding living organisms reproductively isolated from other such groups (Mayr, 1969).

The number of species on Earth is very high but not known to within even an order of magnitude because the majority are thought to remain undescribed. An estimated 1.7 million species have been described to date, of which some 250,000 are flowering plants, over 1 million are invertebrates (insects are the largest group with 950,000 species) and about 45,000 are vertebrates (WCMC, 1992). Estimates of the total number of species that might exist in the world range from five million to nearly 100 million, with insects and micro-organisms constituting most of the species thought to exist but not yet discovered and described.

Thus, most species are concentrated in the tropics where conditions are hot and wet. Lowland tropical terrestrial ecosystems tend to have the highest diversity, with diversity declining with precipitation and latitude (or altitude). Similar generalisations apply to aquatic ecosystems. Coral reefs, lakes and wetlands in the tropics exhibit a higher diversity than temperate systems. Apart from precipitation and temperature gradients, species richness is also governed by nutrient and salinity levels in terrestrial and aquatic ecosystems, respectively (McNeely, 1988; WCMC, 1992; OECD, 1996).

Despite its usefulness, species richness is an incomplete measure of diversity and has particular limitations when comparing the diversity of two different areas. One factor is *species endemism* - i.e. whether or not a species is restricted (endemic) to an area under consideration. Any given area contributes to global diversity in terms of its complement of species and the proportion which are unique to that area. For example, islands, such as Sri Lanka, typically have fewer species than equivalent-sized continental areas but a higher proportion which are found nowhere else. In other words, they have lower species diversity and higher species endemism.

Another important factor is *taxonomic diversity*. Species that are very different from each other, by virtue of being distantly related, contribute more to overall diversity that closely related species. Thus, there is a case for measuring diversity at taxonomic levels higher than species (e.g. genera or families), given that an area with ten species in the same genus, for example, is less diverse than an area with ten species from ten different genera.

While species diversity may be strongly correlated with ecosystem diversity, it is usually not possible to maximise both species diversity and genetic diversity. Genetic diversity increases with the size of a population, but a population increase in some species may lead to a decline in genetic diversity in others, or even to a reduction in species diversity. Thus, strategies to conserve biodiversity must be directed towards maintaining the diversity of species and their associated habitats, while ensuring that no species falls below the minimum population level at which its future viability is severely at risk due to the loss of genetic diversity. Thus, from a management perspective, it is essential to identify objectives precisely in order to plan appropriate biodiversity conservation strategies.

1.3.2 Why conserve biodiversity?

Biodiversity has been slowly and naturally evolving since the beginning of life. Human activities also shape biodiversity. Pressures on biodiversity from increasing human populations and associated environmentally-unsound development have risen dramatically in the last century or more, resulting in the loss of much diversity, particularly at genetic and species levels. While the rate at which species are becoming extinct is uncertain, because so many species are unknown (Box 1.1), it has been estimated for various taxonomic groups of species in tropical forests that from 2% to 25% of species might become extinct over the next 25 years (UNEP, 1995). This represents 1,000-10,000 times the historic rate of extinction.

The loss of the world's biodiversity, and its ecological and economic consequences, is now widely recognised as a matter of urgent global concern. The increasing importance given to conserving biodiversity is evident from the rapid ratification of the Convention on Biological Diversity, one of three international environmental treaties signed by 157 countries at the United Nations Conference on Environment and Development, or *Earth Summit*, in 1992. Its principle objectives are the conservation of biodiversity, the sustainable use of its components, and the equitable sharing of the benefits arising from the use of genetic resources. The Convention entered into force in December 1993 and has now been ratified by over 130 countries, including Sri Lanka in 1994.

It is important to interpret the word *conservation* in terms of the management of human use of the Earth's resources so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations (IUCN, 1980). Thus, conservation is not focused solely on preservation, rather the emphasis is on wise use, thereby contributing to sustainable development. Sustainability is the basic principle of all social and economic development, optimizing the social and economic benefits available in the present without jeopardising the likely potential for similar benefits in the future (McNeely *et al.*, 1990).

Preserving biodiversity ensures that present and future options for its wise use are maintained, and that the planet is kept in a state supportive of human life (WCMC, 1992). Among the many reasons why biodiversity is important to human society are the following principle values:

- biodiversity facilitates ecosystem functions that are vital for continued habitability of the planet (e.g. carbon exchange, watershed flows of surface and ground water, protection and enrichment of soils, regulation of surface temperature and local climate);
- biodiversity offers aesthetic, scientific, cultural and other values which are intangible and non-monetary but are nonetheless almost universally recognised;
- biodiversity is the source of most of the world's products, including foodstuffs, fibres, pharmaceuticals and chemicals, and it provides the basis of biotechnology;

- biodiversity forms the basis for breeding new and improved varieties of crops and livestock; and
- the uniqueness and beauty of diverse ecological systems has value for ecotourism and a wide range of recreational uses (OECD, 1996).

These and other values can be classified in terms of their direct and indirect benefits, as shown in Box 1.2. Indirect benefits are seldom accounted for in cost-benefit analyses, but they may far outweigh direct benefits. Values are perceived in different ways according to needs. At the local level, for example, consumptive use value is often the most relevant, while national governments tend to be most interested in productive use value, often in terms of revenue from foreign exchange earnings. Although many products of biodiversity are traded internationally, the world community is also likely to be interested in non-consumptive use and existence values, particularly as it grapples with global issues such as climate change and rising sea level.

Assessing the values of biodiversity is an essential first step towards sound, sustainable development, enabling planners and resource managers to address conservation needs. The second step is to develop optimum strategies to conserve biodiversity.

Box 1.2 **Values of biodiversity**

Direct Values

- **Consumptive use value** is the non-market value of natural products, such as firewood, game and fodder, that are consumed directly, without passing through a market.
- **Productive use value** is the value of natural products harvested commercially, such as fish, medicinal plants and timber.

Indirect Values

- **Non-consumptive use value** is concerned primarily with nature's services rather than her goods through the proper functioning of ecosystems, such as watershed protection, photosynthetic fixation of solar energy, regulation of climate and soil production. It also includes recreational, aesthetic, spiritual, cultural, scientific and educational values.
- **Option value** is concerned with maintaining as many gene pools as possible, particularly for those wild species which are economically important or potentially so, in anticipation of unpredictable biological and socio-economic events. It is the value of keeping options open for the future.
- **Existence value** is the value of ethical feelings towards the very existence of wildlife.

(Source: McNeely, 1988)

Box 1.3 **Some values of forest**

WATER

The importance of forests in the hydrological cycle is well known, although far from properly understood (see Section 1.2.2). Both agriculture and industry depend on good quality water provided by forested watersheds. In relation to biodiversity, tropical forests provide spawning and feeding grounds for freshwater fishes during times of flood.

CLIMATE

Forests are closely linked to climate change, notably in their capacity to mitigate global warming through their role as carbon sinks. They sequester 90% of the world's terrestrial carbon, storing 20-100 times more carbon than agricultural land.

AMENITY

Tourism is the world's leading industry (worth US $350 billion per year), much of it being based on nature. Forests attract increasing numbers of national and foreign visitors.

TIMBER

The international trade in timber amounts to some US $103 billion per year, most of which comes from temperate forests. In the tropics, 80% of the estimated 1 billion cubic metres removed annually is used for fuel, providing a significant proportion of energy in rural areas.

MEDICINES

Forests are the source of many medicinal plants, one estimate suggesting that 28% of all plants have been used for medicinal purposes.

NON-WOOD FOREST PRODUCTS

Other than medicinal plants, this category includes products such as game, fish, nuts, fruits, mushrooms, resins and honey. Studies have shown that such products may be worth more than the timber within the same area.

AESTHETICS

Many people benefit from forests indirectly through a variety of media, without ever visiting them. This is particularly true of the biodiversity within forests. Documentary films on wildlife, for example, feature increasingly during prime viewing times, providing benefits worth millions of dollars.

RESEARCH

Many scientists are involved in forest-based research, indicating the value of forests and their associated species for elucidating a wide range of issues of importance to society.

EDUCATION

Forests provide an educational resource for students to learn about ecology, forest management, anthropology, philosophy, aesthetics and other subjects.

(Source: McNeely, 1996)

1.3.3 Why are forests important for biodiversity?

Forests cover 27% of the Earth's terrestrial surface (FAO, 1995). They are the major source of living, three-dimensional structural complexity on land, providing a rich and diverse source of habitats, from their canopies to root systems, for other species. In the words of Fernside (1990):

> *forests are the great biotic flywheel that keeps the biosphere functioning more or less predictably. They are the major biotic component of the global carbon cycle, contain about three times as much carbon as the atmosphere, and their destruction contributes directly to the warming of the earth over large areas, energy balance, water balance, nutrient fluxes, and air and water flows. They are, moreover, the major reservoir of biotic diversity on land: there is no habitat richer in species, none more promising as a source of succour for a swelling, grasping human population uncertain as to where its great hopes lie.*

In so far as biodiversity is concerned, forests are the main home of the Earth's species. Rain forests are particularly rich in species: covering less than 6% of the Earth's land surface, they contain at least 50% of the world's species (Collins, 1990). This reservoir of genetic resources is vital for human welfare, as a source of raw material for drugs, biological control of crop pests, and improving cultivated plants and domesticated animals through breeding or genetic engineering. Forest diversity also provides for the vast array of timber and non-wood forest used commercially and by local or indigenous communities. Forests provide many other benefits, although not all of these are necessarily a direct function of their diversity (Box 1.3).

1.4 FOREST CONSERVATION

1.4.1 Protected areas

One of the best-known and most effective ways of conserving biodiversity in order to better meet the material and cultural needs of mankind now and in the future is through the establishment and management of protected areas (MacKinnon *et al.*, 1986; McNeely, 1988). Such views are echoed by The World Bank in a strategy paper for conserving biodiversity in the Asia-Pacific region: "setting up comprehensive and well-managed protected area systems is likely to be the most practical way to preserve the greatest amount of the world's biological diversity and the ecological processes that define and mould it" (Braatz, 1992).

As defined at the IV World Congress on National Parks and Protected Areas, Caracas, 10-22 February 1992,

> ***a protected area is an area of land (and/or sea) especially dedicated to the protection and maintenance of biological diversity, and of natural and cultural resources, and managed through legal or other effective means*** (IUCN, 1994a).

In practice, protected areas are managed for a wide variety of purposes which may include:

- scientific research,
- wilderness protection,

- preservation of species and ecosystems,
- maintenance of environmental services,
- protection of specific natural and cultural features,
- tourism and recreation,
- education,
- sustainable use of resources from natural ecosystems, and
- maintenance of cultural and traditional attributes.

Six distinct categories of protected area are recognized by IUCN, definitions of which are provided in Box 1.4. One or more of the above management objectives may be encompassed to a greater or lesser extent within a particular category. Very often it is necessary to zone a protected area to provide for a range of management objectives and multiplicity of uses. Zonation can also be used to buffer ecologically sensitive core areas from external pressures.

Such integration of strict protection with sustainable use forms the basis of the biosphere reserve concept, first launched in 1971 under the UNESCO Man and the Biosphere Programme and now being widely applied to resolve the often conflicting interests of conservation and development. The concept concerns the zonation of a biosphere reserve into areas of different use, with a strictly protected core area of high biological value buffered by concentric zones under progressively more intensive but sustainable forms of development towards its periphery (Batisse, 1986). It has been applied widely to other types of protected area.

The maintenance of biodiversity on land outside protected areas is also essential, particularly in South Asia and Mainland South-East Asia where protected areas cover only 3.6% of these regions ((Green *et al.*, 1996). Some of the more innovative and cross-sectoral approaches to conserving biodiversity are reviewed by McNeely *et al.* (1990).

1.4.2 Criteria for selecting protected areas to conserve biodiversity

To ensure that protected areas function with maximum effect, they should be selected in accordance with principles of conservation biology. The following criteria provide a basis for the selection of protected areas.

Size

Protected areas should be as large as possible in order to (a) minimise risks of species' extinctions and (b) maximise representation of ecological communities and their constituent species.

(a) Given that protected areas are effectively islands of natural or near-natural habitat in a sea of humanity, they should be as large as possible to maximise the degree to which their contents retain their integrity and to minimise extinction rates. The larger a protected area is, the better it is buffered from outside pressures (Soule, 1983).

While many of the human pressures on species and their habitats can be reduced or removed through more effective management, chance demographic and genetic events are more difficult to overcome. Since genetic variability is rapidly lost in small populations due to genetic drift (random changes in gene frequencies) and

Box 1.4 **Definitions of the IUCN protected area management categories**

CATEGORY I	**Strict Nature Reserve / Wilderness Area: protected area managed mainly for science or wilderness protection**
CATEGORY Ia	**Strict Nature Reserve: protected area managed mainly for science**
Definition:	Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.
CATEGORY Ib	**Wilderness Area: protected area managed mainly for wilderness protection**
Definition:	Large area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.
CATEGORY II	**National Park: protected area managed mainly for ecosystem protection and recreation**
Definition:	Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.
CATEGORY III	**Natural Monument: protected area managed mainly for conservation of specific natural features**
Definition:	Area containing one, or more, specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance.
CATEGORY IV	**Habitat/Species Management Area: protected area managed mainly for conservation through management intervention**
Definition:	Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.
CATEGORY V	**Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation**
Definition:	Area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.
CATEGORY VI	**Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems**
Definition:	Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

(Source: IUCN, 1994a)

inbreeding (breeding among close relatives), populations should be maintained as large and diverse as possible (Wilcox, 1984).

Thus, protected areas need to be large enough to support minimum viable populations of key species. Good candidates are umbrella species, whose conservation will provide a protective umbrella for other associated species, and ecologically significant species which occupy central positions in the food webs of communities (Wilcox, 1984). Populations of key species should consist of at least 500 genetically effective individuals, or a total population of about 1,000 individuals including juveniles and other non-breeders, in order to maintain sufficient variability for adaptation to long-term changing environmental conditions (Frankel, 1983; Soule, 1987)[2].

(b) Protected areas should encompass as wide a contiguous range of ecological communities as possible because few species are confined to a single community and few communities are independent from those adjacent to them (MacKinnon *et al.*, 1986). The more communities represented, the greater the number of species and the greater the complexity of ecological interactions. Maximum representation of communities is best achieved by ensuring that the entire range of an environmental gradient, such as altitude or soil type, is included.

There is a relationship between the number of species within a relatively uniform area and the size of that area. As a general rule, for every 10-fold decrease in the size of an area, 30% fewer species are present (Wilcox, 1984). The relationship has been described by a variety of equations (see Nicholls, 1991), of which the most usually used are: species richness (S) as a power function of area (A),

$$S = kA^z(1+e)$$

and its logarithmic transformation,

$$\ln(S) = \ln(k) + z\ln(A) + \ln(1+e)$$

where k and z are constants (or parameters) and e is the stochastic or random component of the model.

Shape

Protected areas should be of a compact shape in order to minimise 'edge effects', and their boundaries should be biogeographically meaningful.

Edge effects, such as colonisation by invasive species from adjacent disturbed habitats or human encroachment, can be minimised by selecting compact shapes, preferably circular. Boundaries should follow natural topographic features, but watersheds are preferable to rivers because the latter often bisect essential terrestrial habitats of a range of species (MacKinnon *et al.*, 1986).

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[2] For short-term survival of serious inbreeding and its deleterious effects, the minimum viable population is estimated to be 50 breeding individuals (Soule and Wilcox, 1980).

Corridors and clusters

Protected areas should be linked to each other by corridors of natural or semi-natural habitat or located in clusters to prevent them from becoming completely isolated from each other.

Corridors and clustering of protected areas enable animals to move between adjacent sites, thereby maximising the exchange of genetic material between neighbouring populations. They also increase the effective size of protected areas.

Representativeness

The full complement of biodiversity within a region should be represented within a system of protected areas.

Given that it is seldom possible to protect entire geopolitical units in their natural state, systems of geographically scattered protected areas need to be established which are representative of every ecological community within a region.

Systems should be optimal in terms of the amount and uniqueness of biodiversity protected per unit area to make most efficient use of scarce land resources for conservation. This is best achieved by giving priority to centres of high species diversity.

Pragmatism

Pragmatic considerations should be incorporated in the selection and design of protected areas.

For example, an area should only be protected for conservation purposes if there is a good chance of its ecological integrity being maintained. Thus, protected areas should only be established in areas where they can be afforded adequate protection (MacKinnon *et al.*, 1986).

Other important considerations are the desirability to locate protected areas in areas where they can provide a variety of goods (e.g. firewood, minor forest products) and services (e.g. research, tourism, watershed protection), and to avoid establishing them in areas of high timber or agricultural production potential unless there are no suitable alternatives (Howard, 1991).

Chapter 2

SRI LANKA'S FORESTS

2.1 GEOGRAPHICAL SETTING

Sri Lanka is an island, 65,610 km^2 in area, lying off the south-eastern corner of the Indian subcontinent from which it has been separated since the late Miocene. Originally part of Gondwanaland in the distant geological past, it was never fully submerged by the sea, with the result that sedimentary deposits of Miocene limestone are confined to the north-west, including the Jaffna Peninsula. The rest of the island, nearly 90%, comprises pre-Cambrian crystalline rocks.

Approximately 75% of the island is coastal plain, sometimes referred to as the first peneplain. It is most extensive in the north and east where the landscape features isolated hills, remnants of erosion, that rise up 600 m or more. Here also occur many hundreds of reservoirs, legacies from the 12th century or earlier of the highly advanced irrigation systems built by the Rajarata civilization to water vast areas of paddy (Baldwin, 1991).

Inland from the first peneplain, a second peneplain rises to about 500 m. Further inland is a third peneplain comprising a south-central massif which rises to just over 2,500 m. The massif is a compact physiographic unit, somewhat anchor-shaped, with the Central Highlands bounded by a high mountain wall to the south and the Knuckles Range forming the extremity of the northern arm. The headwaters of all major rivers originate from this massif.

2.1.1 Influence of climate

The south-central massif has a major influence on the climate, intercepting the moisture-laden winds of the south-west monsoon from May to September when high rainfall is experienced in the south-western lowlands and windward slopes of the Central Highlands. During this Yala season the rest of the country in the north, east and south-east remains dry, experiencing the south-west monsoon as a dry, desiccating wind. The northern, eastern and southern parts of the country are much drier, averaging 1000-2000 mm per year as compared to 2000-5000 mm in the south-west, and receive most rainfall from the north-east monsoon during the Maha season (October-January).

On the basis of this climatic regime, the island is conventionally divided into *wet*, *intermediate* and *dry* zones (Figure 2.1). It should be appreciated, however, that the boundaries of these zones are imprecise and subject to academic debate. For example, the intermediate zone is not always distinguished and sometimes a fourth, *arid* zone is recognised for the north-west and south-east coastal areas, which receive less than 1250 mm of rainfall per year.

Climate is main determinant of natural forest distribution. As described more fully in Section 2.2.1, tropical rain forest is the climax vegetation of the south-west wet zone, with wet evergreen montane forest present at higher altitudes. The intermediate zone of the seasonally dry northern and eastern plains has tropical semi-evergreen forest, which gives

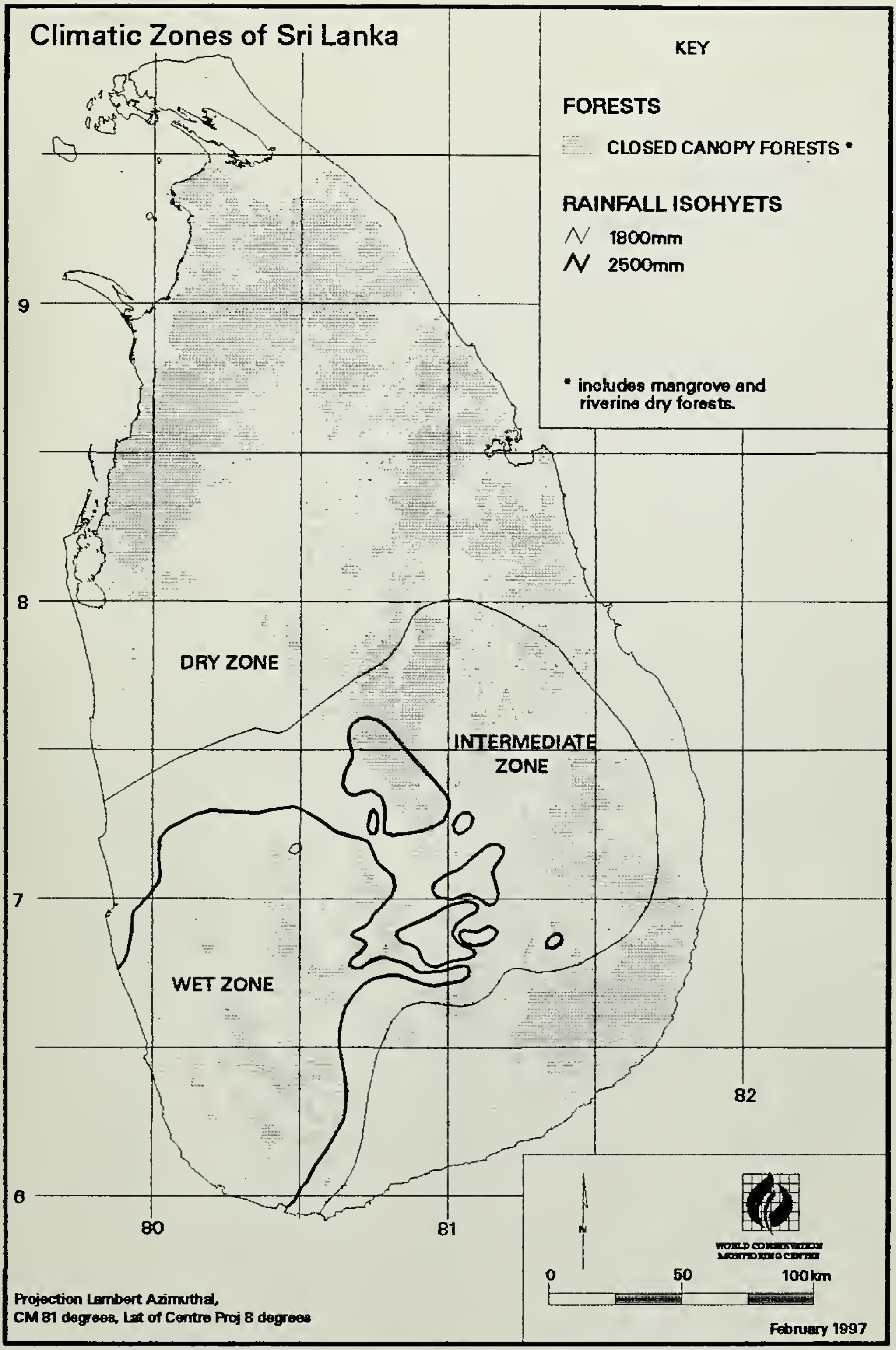

Figure 2.1 Rainfall isohyets and climatic zones of Sri Lanka superimposed on the distribution of closed canopy forest in 1992, based on the 1:50,000-scale forest map of Sri Lanka (Legg and Jewell, 1995)

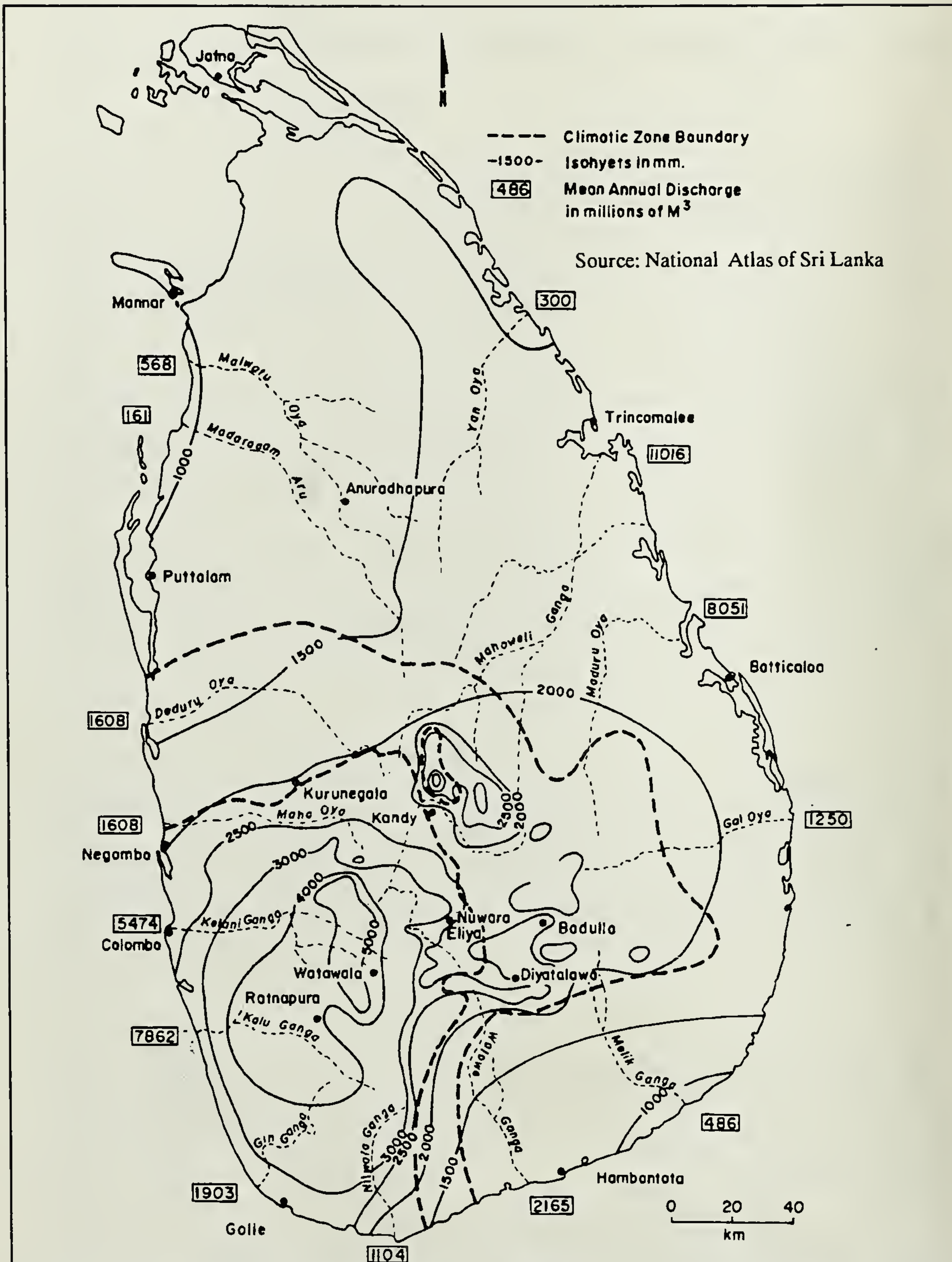

Figure 2.2 Discharge from Sri Lanka's main rivers (Source: National Atlas of Sri Lanka)

way to tropical dry mixed evergreen forest in the dry zone. The arid zone of the north-western and south-eastern extremities of the island are covered with tropical thorn forest (Baldwin, 1991).

2.1.2 River basin system

Surface water, which is essentially the surplus run-off from rainfall after evaporation and infiltration have occurred, drains radially from the high watersheds in the central hills. There are 103 natural river basins which cover 90% of the island. The remaining 94 coastal basins are small, contributing little to water resources. River basins in the wetter parts of the hill country are perennial, while many of those in the dry zone are seasonal. Only a few river basins carry water from the wet to the dry zone, such as the Mahaweli Ganga which drains 16% of the island. The relative importance of the main rivers is shown in Figure 2.2 in terms of their mean annual discharge.

The south-western part of the central hills comprises the critical upper catchments of the country's largest rivers. Over 65% of wet zone catchment rainfall is discharged into rivers, with the Kalu Ganga having the maximum discharge of 77%. Rivers rising in the drier eastern half of the hill country discharge 20-40% of rainfall.

2.1.3 Water resources

The surface water potential is summarised for each district in Figure 2.3. Values exceed 2.4 m for Colombo, Galle, Kalutara, Kegalle and Ratnapura districts, while most districts in the Dry Zone have less than 0.03 m water depth. Hence, the most luxuriant vegetation (rain forest) occurs in the wet zone, while the thorn forest characteristic of the dry zone reflects the high water deficit. However, surface water levels provide only an indirect indication of the availability of water for vegetation, the critical limiting factor being its monthly distribution.

2.2 BIODIVERSITY

Sri Lanka is one of the smallest but biologically most diverse countries in Asia. It is recognized as a *biodiversity hotspot* of global importance, being one of 250 sites of prime importance for the conservation of the world's floristic diversity (Davis and Heywood, 1994). Its diverse topography and varied tropical climate have given rise to extremely high levels of species diversity, higher than in most other tropical Asian countries when measured per unit area. Much of this diversity is endemic, a reflection of the island's separation from the Indian subcontinent since the late Miocene.

The various types of ecosystems have been relatively well studied and defined, but species diversity in many taxonomic groups remains poorly recorded and little is known about the genetic diversity within species. Recent reviews of Sri Lanka's biodiversity can be found in Baldwin (1991) and Wijesinghe *et al.* (1993).

Much of this diversity is found in Sri Lanka's forests, particularly those in the wet and intermediate zones of the south-west of the island where conditions are wettest and temperature (dependent on altitude) most varied. Diversity tends to be lower in the seasonally dry plains of the dry zone to the north and east.

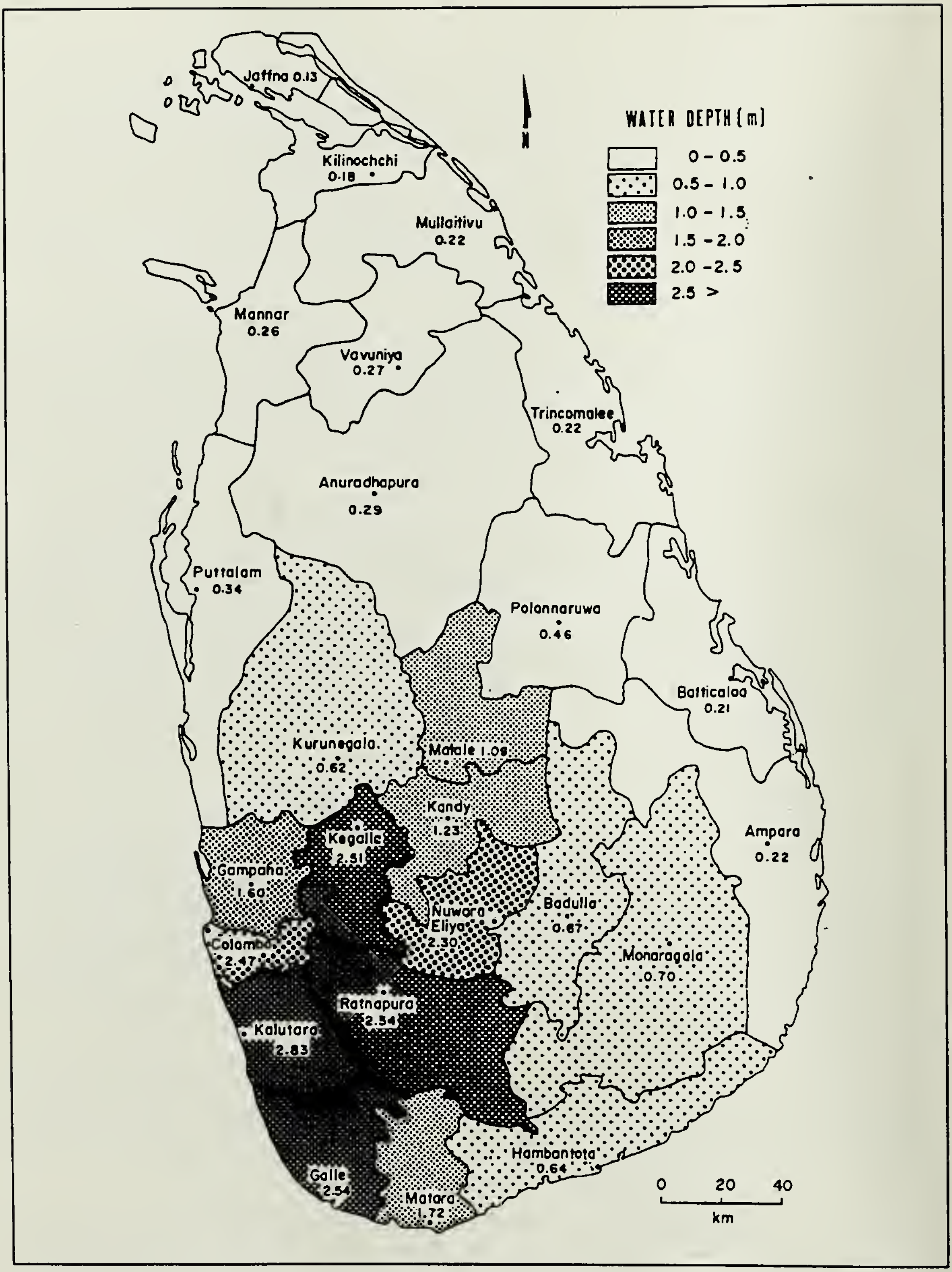

Figure 2.3 Surface water potential of districts in Sri Lanka

2.2.1 Forest cover and diversity

Closed-canopy forest covers nearly 24% of the island and open canopy a further 7% (Table 2.1). Its distribution, based on interpretation of 1992 Landsat imagery by Legg and Jewell (1995), is shown in Figure 2.1. An estimated 4,055 ha of degraded natural forests have been enriched with mahogany (Legg and Jewell, 1995). Most remaining forest is of the dry monsoon type, which is most extensive in the north and south-east of the island. Only fragments of tropical rain forest, few larger than 10,000 ha, remain in the south-west wet zone, where species diversity is highest. Although the total area of mangrove forest is very small, its importance as an ecosystem is considerable. It stabilizes the shoreline of estuaries and lagoons, and provides essential spawning and nursery grounds for many species of fish, as well as habitat for a variety of crustaceans and other marine life.

Table 2.1 Extent of remaining natural forest in 1992 (Source: Legg and Jewell, 1995)

Zone	Total area (ha)	% total land area*
Closed-canopy:		
Montane	3,108	0.05
Sub-montane	68,838	1.04
Lowland	141,549	2.14
Moist monsoon	243,877	3.69
Dry monsoon	1,094,287	16.54
Riverine	22,411	0.34
Mangrove	8,687	0.13
Sub-total	**1,582,757**	**23.92**
Open canopy:		
Sparse	463,842	7.01
TOTAL	**2,046,599**	**30.93**

* Percentages are based on a total land area of 6,616,628 ha.

Table 2.2 Main types of natural forest, their dominant communities or species and their bio-climatic distribution (Source: Wijesinghe *et al.*, 1993)

Forest type	Dominant communities or species	Bio-climatic zone
Wet evergreen forest (tropical rain forest)	*Dipterocarpus* (low/mid altitudes) *Mesua-Doona-Shorea* (mid altitudes) *Campnosperma zeylanica* (Adam's Peak range) *Vitex-Wormia-Chaetocarpus-Anisophyllea* (low altitudes)	Low/mid-country wet
Tropical montane forest	*Syzygium-Calophyllum-Gordonia-Michelia* (widespread) *Stemonoporus* (Adam's Peak range)	Montane wet
Intermediate evergreen forest	Intermediate between wet evergreen and dry mixed evergreen forest	Low/mid-country intermediate Montane intermediate
Dry mixed evergreen forest	*Manilkara-Drypetes-Chloroxylon* (widespread) *Alseodaphne-Berrya-Diospyros* (more humid conditions)	Dry
Semi-evergreen thorn forest	*Manilkara hexandra, Salvadora persica, Dichrostachys cinerea, Acacia* spp.	Arid

The major types of natural forest ecosystem and their distribution are shown in Table 2.2. In general, tropical rain forest occurs in the lowlands of the wet zone up to about 900 m. Its dominant trees form a closed canopy at 25-30 m, with emergents rising to 45 m. The undergrowth is relatively sparse but rich in epiphytes and lianas. Lower montane (900-1350) and upper montane (> 1350 m) forests have a lower canopy and denser undergrowth. The intermediate evergreen forest of the transition zone, between the wet and dry zones, has its own characteristic species e.g. Lunumidella (*Melia dubia*), Pihimbiya (*Filicium decipiens*), Katu imbul (*Bombax ceiba*), and Murutha (*Lagerstroemia speciosa*) as well as some in common with the adjacent zones. The dry mixed evergreen forests of the dry zone are often without a closed canopy and seldom exceed 20 m in height. In the extreme north-west and south-east of the island, which have very long dry seasons, they give way to semi-evergreen thorn forest of lower stature and with an undergrowth of thorny shrubs.

2.2.2 Species diversity

Much of Sri Lanka's flora and fauna has been collected and described since the early nineteenth century, although lower forms of plants and animals remain poorly known. Even among the vertebrates and flowering plants, however, it appears that many species remain undiscovered. Intensive surveys in recent years in Hiniduma, Ritigala and Sinharaja have led to the discovery of many new species. It is likely that more species await discovery in biologically diverse places such as the Knuckles, Horton Plains and Peak Wilderness, which have yet to be systematically inventoried.

The number of species of vascular plants, vertebrates, and some invertebrate groups described to date is summarised in Table 2.3, together with their status. Many of these species are endemic to Sri Lanka, for example 26% of flowering plants, 76% of land snails, 60% of amphibians, and 49% of reptiles. Prior to the NCR, little was known about the distribution and status of many of these species. Based on such information as does exist, numerous species are threatened with extinction according to either national or international criteria[3].

2.2.3 Genetic diversity

Genetic diversity is the least well studied component of biodiversity. Most of the research on it has been related to economically important crops. For example, germ plasm from some native spices of commercial importance has been collected from the wild, such as cinnamon (*Cinnamomum verum*), cardamom (*Elettaria cardamomum*), betel (*Piper betle*), and pepper (*Piper nigrum*). A large number of wild fruits that are consumed mostly by villagers have yet to be studied and their genetic diversity preserved. Likewise the gene pool of many medicinal plants and wild relatives of cultivated plants is still found only in the wild, where it is threatened by continuing deforestation and unsustainable exploitation.

Regarding the fauna, there have recently been a few studies of large vertebrates, notably elephant and leopard, which indicate a decrease in genetic diversity as a consequence of geographic isolation from the Indian subcontinent. However, there has been no further study

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[3] It should be noted that many endemic species are listed in Table 2.3 as threatened at national but not global level. In principle, any endemic which the host country considers to be threatened should be classified as threatened by IUCN by virtue of it endemicity. In practice, criteria need to be applied more consistently at national and international levels to avoid such anomalies.

to assess whether or not this diversity has been further eroded as a result of the decline of populations due to habitat fragmentation.

Table 2.3 Numbers of species of vascular plants, vertebrates and selected invertebrate groups and levels of endemism and threat, based on Bandaranaike and Sultanbawa (1991) for angiosperms, Ratnapala and Arudpragasam (n.d.) for land snails, Kotagama (n.d.) for vertebrates and WCMC (1994) for other plant and animal groups. National threatened status is based on Wijesinghe *et al.* (1993), and global threatened status on the *1994 IUCN Red List of Threatened Animals* and the WCMC Plants Database (23 December 1994).

Group	Species			Endemic species		
	Number	Threatened		Number	Threatened	
		National criteria	Global criteria		National criteria	Global criteria
Pteridophytes	314	90 (29%)	36 (11%)	57 (18%)	30 (53%)	35 (61%)
Gymnosperms	1	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Angiosperms	3368	487 (14%)	413 (12%)	879 (26%)	227 (26%)	399 (45%)
Butterflies	>242	81 (33%)	3 (1%)	14 (6%)	11 (79%)	3 (21%)
Spiders	>400	14 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Land molluscs	266	152 (57%)	0 (0%)	201 (76%)	152 (76%)	0 (0%)
Freshwater fishes	65	30 (46%)	19 (29%)	29 (45%)	28 (97%)	19 (66%)
Amphibians	*48	29 (60%)	0 (0%)	29 (60%)	29 (100%)	0 (0%)
Reptiles	162	113 (70%)	9 (6%)	79 (49%)	78 (99%)	1 (1%)
Birds	419	56 (13%)	8 (2%)	24 (6%)	17 (71%)	6 (25%)
Mammals	89	39 (44%)	9 (10%)	12 (13%)	11 (92%)	0(0%)

* Excludes the newly described toad *Bufo kotagami* (Fernando *et al.*, 1994).

2.2.4 Loss of biodiversity

Sri Lanka has one of the densest human populations in Asia, with the result that much of its original forest has been cleared for settlement, cultivation, and production of timber. Changes in land-use practices began with the onset of the colonial period. Until the early 19th century, most of the hill country and low country dry zone were forested; large tracts of forest remained in the north, east, and south-east; only the extreme south and south-west were generally cultivated, paddy fields and coconut plantations being common (Holdsworth, 1872). From 1830, vast tracts of forest at middle altitudes were cleared for coffee, to be replaced by tea from 1850 after the coffee plantations were devastated by a leaf-blight. Forest clearance in the dry zone began around 1869, accelerating towards the turn of the century with the introduction of large colonization schemes. Shifting cultivation or *chena* also became more widely practised, contributing significantly to the destruction of forest cover (Perera, 1977).

The emphasis on timber production continued long after independence in 1948. The result of this policy, combined with the demands of an increasing human population, has been the rapid reduction of forest cover. The human population has risen from 0.9 million in 1822 (the first census) to nearly 18 million inhabitants in 1994; the forest cover has declined from about 84% of the total land area in 1881, to 23.9% in 1992 (Figure 2.4). Loss of natural forest cover has been most pronounced in the wet zone, where it has become extremely fragmented (Figure 1.1) due to the much higher human population density. Here, in approximately one-third of the island, reside 55% of the human population.

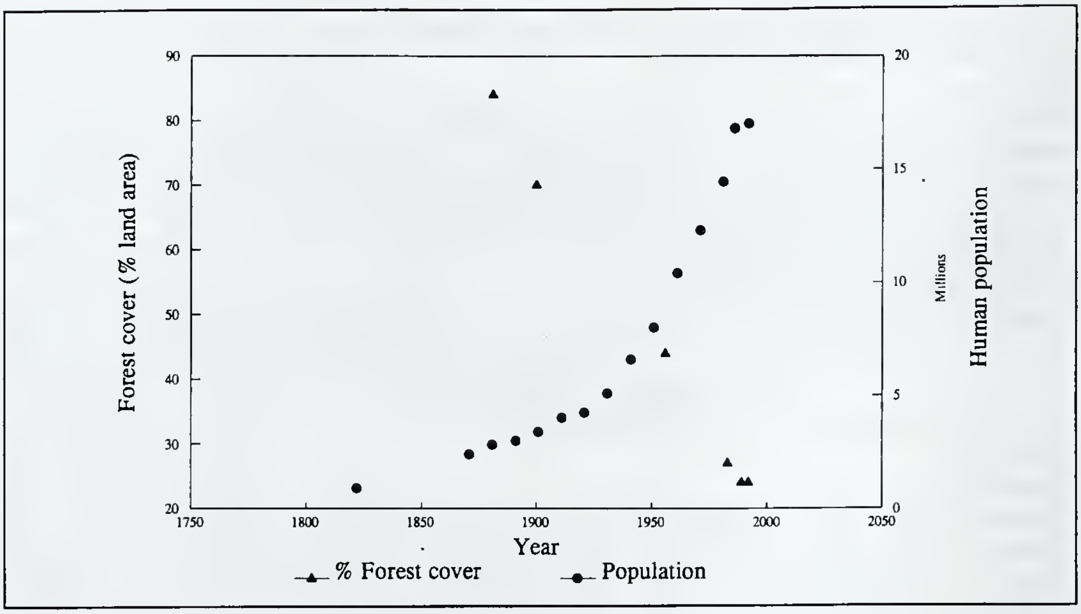

Figure 2.4 Relationship between increasing human population and declining forest cover (Source: FPU, 1995)

In general, however, the impact of loss of forest on species diversity cannot be quantified because of the lack of historical baseline information. There is evidence to suggest that some forest species may already have become extinct. Of the 58 dipterocarps, for example, all of which are endemic and 11 of which have been described during only the last 25 years, one species is thought to have become extinct.[4] There are many more documented examples of forest species that have become rare, very often because of over-exploitation. Satinwood (*Chloroxylon swietenia*), ebony (*Diospyros ebenum*), calamander (*Diospyros quaesita*), and nedum (*Pericopsis mooniana*) are now rare, having been selectively removed for their valuable timber. Madara (*Cleistanthus collinus*) seems to have been exploited to extinction[5]. Medicinal and ornamental species, such as orchids, are also at risk from exploitation. Of the 170 species of orchid found mostly in forest, 13 species are thought likely to become extinct. They include *Dendrobium maccarthiae, D. heterocarpum, Ipsea speciosa*, and *Rhynchostylis retusa*. Further details of plant species in decline can be found in Sumithraarachchi (1986), Baldwin (1991) and IUCN Wijesinghe *et al.* (1994).

Among forest vertebrates, the elephant has declined from more than 10,000 at the beginning of this century to 2500-3000 in 1993 due to hunting and destruction of habitat, particularly wet montane forests. This decline may have been confined to the British colonial period, when the population is reported to have decreased from 10,000 to 2,000 elephants, but there is a paucity of post-independence census data (Santiapillai and de Silva, 1994). The remaining population is now restricted to the dry zone, but even here its natural habitat has become increasingly fragmented and isolated, disrupting movements and dispersal patterns. In the case of reptiles, 14 species of endemic snakes have not been recorded since 1950 or

[4] This information is based on a 1994 review of the herbarium collection at the Royal Botanic Gardens, Peradeniya (A.H.M. Jayasuriya, pers. comm.).

[5] The absence of any records of this species from the NCR provides further evidence of its extreme rarity or possible extinction.

earlier, 13 of which are forest inhabitants, albeit mostly rather inconspicuous due to their burrowing habits (G.P.B. Karunaratne, pers. comm., 1994).[6]

The full impact of this reduction in forest cover on biodiversity, in terms of loss of species, will never be known, but threats to the future survival of species will rise as their habitats diminish. Currently, threats are greatest in the more densely populated wet zone, where levels of species richness and endemism are highest.

2.3 PROTECTION OF FORESTS

2.3.1 Early history

Sri Lanka has a strong tradition in nature protection Sri Lanka which dates back to the introduction of Buddhism in 246 BC. Prior to that, it is likely that hunting was enjoyed by at least the elite of society, but this practice changed under the Buddhist philosophy of reverence for all forms of life - killing was forbidden. One of the world's first wildlife sanctuaries was established by King Devenampiyatissa in the 3rd century BC. Succeeding kings continued to uphold Buddhist precepts: forests were protected by royal edicts, tree felling and collection of forest products were controlled and the fragile ecosystem of the wet zone forests were left practically undisturbed. Kings appointed *kele koralas* (forest officers), whose duties included prevention of poaching and protection of royal trees. In the 12th century AD, King Kirti-Nissanka-Mala proclaimed that no animals should be killed within a radius of seven gav (35.7 km) of the city of Anuradhapura (Abeywickrema, 1987; IUCN, 1990).

2.3.2 Evolving conservation policies and legislation

Forest policy and legislation

Evolving policies and legislation concerned with forest and biodiversity conservation are summarised in Table 2.4. Forestry legislation was introduced principally to protect national and community interests in forest resources through reservation of state lands as reserved forests and village forests, respectively. The *Forest Ordinance*, with its emphasis on timber production, has become *greener* through various amendments. For example, activities such as bark stripping, tapping, quarrying, burning lime or charcoal, collecting forest produce and pasturing cattle were added to the list of activities prohibited within reserved forests under the *Amendment Act No. 13 of 1966*. The Ordinance, last amended by Act No.84 of 1988, is presently undergoing further revision to strengthen its provisions for conservation, as well as to improve enforcement measures and raise penalties for forest offenses. Provision is made in the draft amendment for the establishment of conservation forests.

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[6] The 14 species of snake, known only from their type specimens in the case of the endemic species, are as follows: *Typhlops lankaensis* Taylor 1947, *T. violaceus* Taylor 1947, *T. malcomi* Taylor 1947, *T. tenebrarum* Taylor 1947 and *T. veddae* Taylor 1947, all five of which are thought by some authorities to be conspecific with a living species (*Ramphotyphlops braminus*), *T. ceylonicus* Smith 1943, *Uropeltis rubunae* Deraniyagala 1954, *Rhinophis tricolorata* Deraniyagala 1975, *R. punctata* Muller 1832, *R. porrectus* Wall 1921, *R. dorsimaculatus* Deraniyagala 1941, *Colubes fasciolatus* Shaw 1802, *Dendrelaphis oliveri* Taylor 1950 and *Gerarda prevostiana* Eydoux & Gervais 1832-1837.

Table 2.4 Chronology of key policies and laws concerning conservation of forests and associated biodiversity

Year	Policy/law [Competent authority]	Provisions for biodiversity conservation
1848	Timber Ordinance No.24	Reservation of forests, largely for timber production.
1873		Hooker advocates protection of natural forests above 5,000 ft as climatic reserves.
1885	Forest Ordinance No.10 [Conservator of Forests]	Protection of forests and their products within reserved forests (including stream reservations) and village forests, primarily for sustained production. Also, protection of wildlife in sanctuaries.
1907	Forest Ordinance No.16 [Conservator of Forests]	Protection of forests and their products within reserved forests and village forests, primarily to provide for controlled exploitation of timber.
1929	First authoritative Forest Policy	Preservation of indigenous flora and fauna
1938	○ Amended	○ Clearing of forests prohibited above 5,000 ft. Plantations to be converted to indigenous species.
1937	Fauna and Flora Protection Ordinance No.2 [Director of Wildlife]	Protection of wildlife in national reserves (i.e. strict natural reserves, national parks, and intermediate zones embodying only crown land) and sanctuaries (comprising both crown and private land) and outside such protected areas. Total protection afforded to wildlife in national reserves and sanctuaries, but in sanctuaries habitat protected only on state land while traditional human activities may continue on privately-owned land.
1964	○ Amendment Act No.44	○ Nature reserve and jungle corridor incorporated as categories of national reserve.
1970	○ Amendment Act No.1	○ Intermediate zone, envisaged as a buffer zone to provide for controlled hunting, removed from Ordinance.
1993	○ Amendment Act No.49	○ Refuge, marine reserve and buffer zone incorporated as categories of national reserve.
1953	National Forest Policy ○ Re-stated in 1972 and 1980	Emphasis on conserving forests to preserve and ameliorate the environment, and to protect flora and fauna for aesthetic, scientific, historical and socio-economic reasons.
1969 1975	Unesco Biological Programme Unesco Man and Biosphere Programme	Arboreta, representative of the main bio-climatic zones, demarcated within forest and proposed reserves.
1982	Mahaweli Environment Project	Network of protected areas established to mitigate impact of Mahaweli Development Project on wildlife and to protect catchments in upper reaches of Mahaweli Ganga.
1988	National Heritage Wilderness Areas Act No.3 [Conservator of Forests]	Protection of state land having unique ecosystems, genetic resources or outstanding natural features within national heritage wilderness areas.
1990	National Policy for Wildlife Conservation (approved by Cabinet)	Objectives include the maintenance of ecological processes and preservation of genetic diversity. *Ex situ* conservation is recognized as important for threatened species.
1990	Forestry Sector Development Programme: Environmental Management in Forestry Development Project	Logging of natural forests banned in wet zone, pending review of their watershed protection and biodiversity conservation values.
1995	National Forestry Policy (approved by Cabinet)	Over-riding priority given to conservation of biodiversity and protection of watersheds.

Concern about the complete denudation of forests for coffee and tea plantations was expressed in 1873 by the eminent botanists Hooker and Thwaites, and by Gregory, the then Governor of Ceylon. That same year Joseph Hooker warned against the replacement of natural forests with plantations in view of its serious impact on the climate, and advocated the complete protection of all natural forests above 5,000 ft (about 1,500 m) as climatic reserves (Jansen, 1989). This was eventually incorporated within an amendment to the Forest Policy in 1938.

Preservation of native flora and fauna has featured consistently in forest policy, beginning with the country's first Forest Policy introduced in 1929 by the British Governor, Sir Herbert Stanley, and including the subsequent National Forest Policy of 1953. The National Forest Policy was reformulated in 1980 to give more emphasis to preserving the environment and to include a new objective, specifically to involve local people in forestry activities through a programme of social forestry. However, this policy was not officially adopted, having never been approved by the Cabinet, and has since been superseded by the new National Forestry Policy of 1995.

A turning point was reached in 1972 when public outcry against tree felling in Sinharaja Forest Reserve prompted the Cabinet to appoint a Sub-Committee to examine the problem. Then in the mid-1980s, during the formulation of the first Forestry Master Plan of 1986, it was recognized, after intense lobbying by the NGO community, that provisions for forest conservation were totally inadequate, particularly in the wet zone. An environmental impact assessment of the Forestry Master Plan was carried out by IUCN-The World Conservation Union, to which the Government responded positively by:

- introducing a moratorium on logging in the wet zone until the conservation value of remaining natural forests had been assessed; and
- incorporating an environmental component within the Forestry Sector Development Programme.

In order to overcome the weaknesses inherent in the *Forest Ordinance*, the *National Heritage Wilderness Areas Act No.3* was passed in 1988 to provide for the protection of unique or outstanding natural areas. Entry is by permit and activities are restricted to scientific research and observation of flora and fauna. Other conditions include the over-riding of anything contradictory in the provisions of any other written law apart from the Constitution. The Act was introduced principally to safeguard biodiversity within Sinharaja, the largest tract of rain forest remaining in the country which had been nominated the previous year for inscription on the World Heritage List as a natural property. Sinharaja was declared a national heritage wilderness area in 1988 and that same year it was also designated a World Heritage site.

The new National Forestry Policy gives overriding priority to the conservation of biodiversity and protection of watersheds within forest ecosystems (Box 2.1). Among the various strategies identified for implementing this policy are a number that relate to the establishment of a permanent forest estate for conservation. These are cited in Box 2.2.

Adoption of many of the new forestry policies will need to be reinforced by changes to the existing legislation, notably the *Forest Ordinance* which is presently under revision. The *Forest Ordinance* will need to give priority to the conservation of biodiversity within forests and make adequate provisions for its protection, particularly in conservation forests. Boundary demarcation and notification of the many reserves proposed over several decades is also an outstanding priority. This will need to be rationalized as part of a review of the protected areas system in the forestry subsector (FPU, 1995).

Box 2.1 **National Forestry Policy of 1995**

Parts of the National Forestry Policy which focus specifically on forest and biodiversity conservation are as follows:

1 National Forestry Policy objectives

1.1 To conserve forests for posterity, with particular regard to biodiversity, soils, water, and historical, cultural, religious and aesthetic values.

2 Policy on management of state forest resources

2.1 All state forest resources will be brought under sustainable management both in terms of continued existence of important ecosystems and flow of forest products and services.

2.3 The natural forests will be allocated firstly for conservation, and secondly for regulated multiple-use production forestry.

2.4 For the management and protection of the natural forests and forest plantations, the state will, where appropriate, form partnerships with local people, rural communities and other stakeholders, and introduce appropriate tenurial arrangements.

2.7 Planned conversion of forests into other land uses can take place only in accordance with procedures defined in legislation and with accepted conservation and scientific norms.

3 Policy on management of private forest and tree resources

3.3 The state will promote tree growing by local people, rural communities, NGOs and other non-state sector bodies for the protection of environmentally sensitive areas.

4 Policy on wood and non-wood forest products, industries and marketing

4.4 Effective measures to protect the forests and prevent illegal trade in wood, non-wood forest products and in endangered species of flora and fauna will be instituted.

5 Policy on institutional support for forestry development

5.2 Legislation will be amended or revised, as necessary, to support implementation of the policy.

5.3 The state will provide full support to the various resource managers for sustainable forestry development, and its institutions will be reoriented and strengthened to enable them to accomplish their role.

6 Policy on intersectoral linkages

6.3 Nature-based tourism will be promoted to the extent that it does not damage the ecosystems and insofar as it provides benefits to the local population.

6.5 The general public and industries will be educated about the importance of forestry, and of conserving biodiversity and protecting watersheds.

Box 2.2 **Strategies for National Forestry Policy Implementation**

The following strategies identified in the National Forestry Policy of 1995 are directly concerned with the allocation of state forest land for conservation and protection purposes:

1 Strategies to promote sustainable land use for forestry

Allocation and zoning of state forest land for conservation, agroforestry and forest plantation development, in order to establish a Permanent Forest Estate.

1.1 All forests will be brought under management by allowing for combinations of managers, including state agencies, and managers outside the state sector such as local people, user groups, rural communities, NGOs, the estate sector, and local industries. However, natural forests should be managed only by the state agencies together with the local people and communities, possibly assisted by NGOs. Various partnership approaches to forest management and conservation will be developed, including joint forest management and leasehold forestry. The new approaches have to be adopted first on a pilot basis before any comprehensive schemes are implemented.

1.2 State forest land will be allocated for management in the following categories:

(i) *Class I forests.* These forests should be strictly conserved or preserved to protect biodiversity, soils, and water, and historical, cultural, religious and aesthetic values. Research is allowed in these areas.

(ii) *Class II forests.* Non-extractive uses (such as scientific research, protection of watersheds and habitats of wildlife, and regulated nature-based tourism) should be allowed, as well as controlled collection of NWFPs and dead fuelwood by local people living adjacent to the forest. All the activities have to be in accordance with the management plans that are to be developed jointly with the rural communities. This category would include all other protected areas not in Class I. Zoning of such forests should be adopted, wherever feasible, to assign different parts of the forest for protection, collection of traditional forest products, conserving religious and cultural values, etc. The broad management objectives would be the same as in Class I.

State forest land for conservation

1.10 The existing Protected Area System (PAS) will be rationalized and consolidated into an integrated PAS (Class I and II forests), covering biodiversity related to both flora and fauna, critical watersheds, and forests with special cultural, religious, historic, and aesthetic values. The ministries responsible will take measures to ensure that the protected areas will be of a size necessary to conserve biodiversity.

1.11 The PAS will be demarcated on the basis of biodiversity surveys, other scientific studies and approved criteria.

- Macro-level criteria will be developed for establishing a protected area system whose boundaries will be established on maps and in a Geographic Information System.
- At the operational level, the implementing agencies, with the participation of the local people and NGOs, will develop criteria and demarcate the areas to be managed as protected areas.

1.12 The PAS will be managed by the state, in co-operation with local people and NGOs.

- *Strict conservation areas* (Class I) will be zoned and managed by authorized officers only for conservation and research. *Other protected areas* will be zoned and managed jointly by the state and local people, with assistance from NGOs, as multiple-use conservation forests, where only those activities that are defined in the management plans are allowed.

Wildlife policy and legislation

Various legislation was introduced from 1890 onwards to control the reckless slaughter of wildlife, all of which was subsequently integrated under the Act No.1 of 1908. Proponents of the new restrictions formed the Game Protection Society in 1894 - today the Wildlife and Nature Protection Society - and employed watchers to protect areas reserved for game hunting. Similar initiatives were taken by the then Conservator of Forests and two vast, uninhabited forests were declared as sanctuaries for the protection of wildlife under the *Forest Ordinance No. 10 of 1885*, namely Yala (Block II) in 1900 and Wilpattu in 1905 (Kotagama, 1992).

In 1930 administration of forests was placed under the Ministry of Agriculture and Lands. One of its first initiatives was to set up a Fauna and Flora Protection Committee to advise on the reservation of additional areas for the protection of flora and fauna. The Committee's recommendations were accepted in 1935, and provided the basis to the *Fauna and Flora Protection Ordinance* enacted in 1937 (Kotagama, 1992). This legislation has since been amended on several occasions. A significant provision in *Amendment Act No.1 of 1970* is the recognition of indigenous rights (i.e. rights acquired prior to the establishment of a national reserve or sanctuary), but such rights are deemed to have lapsed if not exercised for a continuous period of two years. The most recent *Amendment Act No.49 of 1993* provides for the establishment of several new categories of reserve (Table 2.4) and raises penalties for infringements of the Ordinance which had become grossly inadequate.

The need for a wildlife conservation policy was long recognized as a high priority but only relatively recently adopted in the form of a *National Policy for Wildlife Conservation*, following its approval by the Cabinet of Ministers in June 1990. The policy was formulated in response to the Sri Lanka National Conservation Strategy (CEA, 1988), approved by Parliament in 1988, and its objectives are based on those of the World Conservation Strategy (IUCN/UNEP/WWF, 1980). Salient features of the policy are summarised in Box 2.3.

Box 2.3 **National Policy for Wildlife Conservation, 1990**

The fundamental objectives of the *National Policy for Wildlife Conservation in Sri Lanka* are:

- to maintain ecological processes ...
- to preserve genetic diversity, especially the biodiversity and endemic biota.
- to ensure the sustainable utilization of species and ecosystems ... which are of immediate and potential importance to support the people.

In the introduction to the *National Policy for Wildlife Conservation*, attention is drawn to the crucial importance of the wet zone for biodiversity and endemism and the urgent need to redress the drastic imbalance of protected areas, most of which are located in the dry zone. Although implicit in the objectives, none of the policy statements makes specific reference to biodiversity conservation, other than one concerning the importance of *ex situ* conservation in protecting threatened species. Rather more attention is given to clearly defining management objectives specific to each protected area designation, and to providing for a multiplicity of sustainable uses for the benefit of local people and visitors. The policy also advocates a decentralized administration to enhance the flow of benefits from protected areas to those living in their vicinity. Very little of this policy has been implemented as yet (FPU, 1995).

2.3.3 National context

The strong conservation tradition and affinity of Sri Lankan culture towards nature is enshrined within the second Republican Constitution (1978) which includes the following clauses:

- *The State shall protect, preserve and improve the environment for the benefit of the community.* [Article 27.14]
- *The exercise and enjoyment of rights and freedom is inseparable from the performance of duties and obligations, and accordingly it is the duty of every person in Sri Lanka to protect nature and conserve its riches.* [Article 28F]

This has provided the foundation of a series of cross-sectoral conservation initiatives to address the ever-increasing demands on and threats to Sri Lanka's natural resources. The first attempt to address environmental conservation issues in a coherent, holistic manner was the preparation of a National Conservation Strategy by the Central Environmental Authority (1988), closely followed by an Action Plan in which specific activities were identified. The Strategy includes directions for the establishment of a comprehensive system of protected areas and, in the forestry subsector, for the identification of forests for legal protection.

This initiative was followed by a review of Sri Lanka's natural resources (Baldwin, 1991) funded by USAID, and the preparation of a National Report to UNCED. With support from the World Bank, the newly established Ministry of Environment and Parliamentary Affairs prepared a National Environmental Action Plan for 1992-1996. This 1994 update of the Action Plan includes a chapter on *Forests and Bio-diversity*, in which the prerequisites to effectively conserving what remains in Sri Lanka's forests are identified as:

- high-level political commitment to establish an appropriate legal, institutional and policy framework; and
- improved political and public understanding of the economic and environmental benefits (MEPA, 1994).

The 1994 update emphasizes the urgent need for fundamental policy and institutional reforms within the forestry and wildlife subsectors, but any attempt to propose specific policy reforms is considered premature in view of the ongoing Forestry Master Plan.

Within the forestry subsector, the release of the first Forestry Master Plan, 1985-2020 (Jaakko Poyry International Oy, 1986) marked the turning point of forest policy from one of exploitation to conservation of natural forests. While much forest has since been secured for conservation, and more will be allocated, the need to effectively manage protected areas and ensure that the benefits of doing so flow to local communities is emerging as the overriding priority for this and the next decade. These and other issues are addressed in the present Forestry Sector Master Plan (FPU, 1995), the biodiversity chapter of which will be incorporated as the forestry sector component of the *Biodiversity Action Plan for Sri Lanka*. This plan is now in the process of being prepared, following the formulation of a strategy to guide its preparation (MTEWA, 1994).

2.3.4 International context

Sri Lanka has entered into a number of international agreements relating to the conservation of biodiversity, details of which are summarized in Table 2.5. The MAB Programme, Ramsar Convention and World Heritage Convention are concerned specifically with protecting internationally important properties for conservation, but also include more general measures for the wise use of all wetlands (Ramsar Convention) or protection of all cultural and natural heritage (World Heritage Convention). The Convention on Biological Diversity provides *inter alia* for the conservation of biodiversity both within and outside protected areas, and the maintenance of viable populations of species within their natural surroundings. Under the Forest Principles, which are not legally binding, the importance of forests as storehouses of biodiversity is recognized and the State is encouraged to protect ecologically viable representative or unique examples of its forests.

2.3.5 Protected areas system

Growth

The growth in Sri Lanka's protected areas system is shown in Figure 2.5. Within the forestry subsector, forest reserves were gazetted from 1850 onwards, but none was demarcated until 1885 and none notified with boundaries until 1890. The bulk of the forest reserves network was established in the 1920s, although a large number of smaller reserves were notified in the subsequent two decades. Many more reserves were proposed during this period but never actually notified.

Table 2.5 Obligations under international biodiversity conservation agreements to which Sri Lanka is party

Entry	International agreements	Obligations
1970	UNESCO Man and Biosphere Programme	Objective of programme is to establish a global system of biosphere reserves representative of natural ecosystems to conserve genetic diversity and to promote conservation activities such as monitoring, research and training. Emphasis is on: o restoration of degraded ecosystems o integration of traditional land use practices within a conservation framework o involvement of local people in conservation planning
1979	Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 (CITES)	The Convention aims to protect wildlife from over-exploitation and to prevent international trade from threatening species with extinction. Trade in species listed under Appendix I is prohibited. Appendix II species may be traded in accordance with a permit system, provided export is not detrimental to the survival of the species.
1980	Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972 (World Heritage Convention)	The Convention provides for the protection of cultural and natural properties deemed to be of outstanding universal value. Obligations of State parties include: o identify sites of outstanding universal value and nominate them for inscription on the World Heritage List o protect all cultural and natural heritage (not just World Heritage sites)

Entry	International agreements	Obligations
1990	Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1971 (Ramsar Wetland Convention)	The Convention aims to stem the loss of wetlands and ensure their conservation for fauna and flora and for ecological processes. Obligations of State parties include: ○ designate one or more wetlands for inclusion in the *List of Wetlands of International Importance* ○ promote wise use of all wetlands (includes marine waters to a depth of 10 m - hence mangroves) ○ promote the conservation of wetlands through the establishment of nature reserves on wetlands, irrespective of their inclusion or not in the *List of Wetlands of International Importance*, and manage wetlands for the benefit of waterfowl. ○ promote training in the fields of wetland research, management and wardening. ○ consult with other Contracting Parties about implementation of the Convention, especially with regard to transfrontier wetlands, shared water systems, shared species and development aid for wetland projects.
1992	Non-legally binding authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests, UNCED 1992 (Forest Principles)	The guiding objective of these Principles is to contribute to the management, conservation and sustainable development of forests and to provide for their multiple and complementary functions and uses. Principles to be pursued by each State include: ○ recognize the role of forests ... as rich storehouses of biodiversity ○ protect ecologically viable representative or unique examples of forests ○ carry out EIAs where actions are likely to have significant adverse impacts of important forest resources ○ control pollutants that are harmful to the health of forest ecosystems
1994	Convention on Biological Diversity, 1992	Objectives of the Convention are conservation of biodiversity, sustainable use of its components and equitable sharing of benefits arising from utilization of genetic resources. Obligations of State parties include: ○ develop national plans for the conservation of biodiversity ○ identify and monitor components of biodiversity important for its conservation ○ establish a system of protected areas for biodiversity conservation ○ conserve biodiversity within and outside protected areas ○ promote the protection of ecosystems, natural habitats and maintenance of viable populations of species in natural surroundings ○ promote environmentally sound and sustainable development in areas adjacent to protected areas ○ restore degraded ecosystems, promote recovery of threatened species and control alien species ○ adopt measures for *ex situ* conservation of biodiversity to complement *in situ* measures ○ protect and encourage customary use of biological resources in accordance with traditional practices that are compatible with conservation requirements ○ adopt economically and socially sound incentives for biodiversity conservation ○ introduce EIA procedures for proposed projects likely to adversely affect biodiversity, with provision for public participation

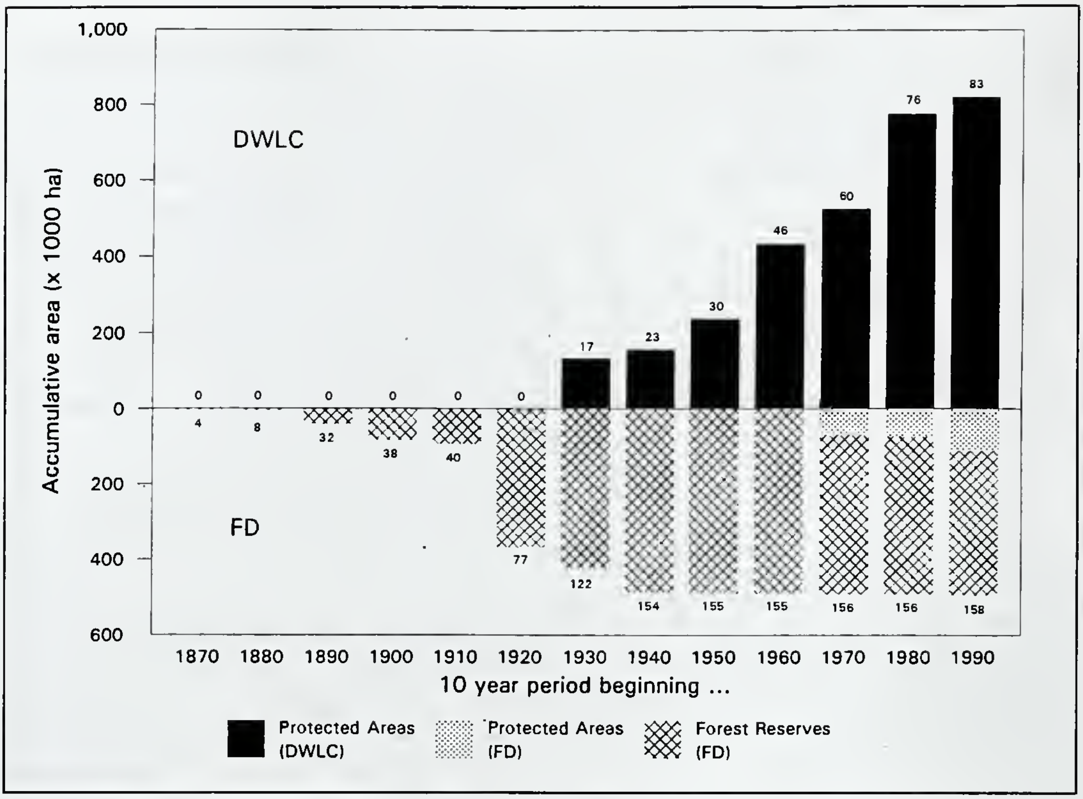

Figure 2.5 Growth of protected areas system in forestry and wildlife subsectors

While there has been no appreciative growth in the forest reserve network since the 1950s, there has been a significant shift in the function of forest and proposed reserves from production to conservation. This began in the mid-70s with establishment of a network of 36 Man and Biosphere reserves within which timber extraction was not permitted.[7] In the last few years the network of forest protected areas has expanded considerably, with the addition of 31 conservation forests in the wet zone and the Knuckles Conservation Forest in the intermediate Zone (Figure 2.5).

Within the wildlife subsector, the network of protected areas has grown progressively since the enactment of the *Fauna and Flora Protection Ordinance* (Figure 2.5). The beginnings of this network are masked by the fact that game sanctuaries established from 1900 onwards were subsequently abolished under the new Ordinance and declared as national reserves or sanctuaries. The network expanded considerably during the 1980s, mostly in the basin and adjacent areas of the Mahaweli Ganga to protect water catchments and to provide refuge to animals displaced by the Accelerated Mahaweli Development Programme.

A complete list of nationally designated areas is provided in Annex 1, together with maps showing their boundaries. It should be noted that many of these areas designated under national legislation or, as in the case of *proposed reserves*, intended for notification are not protected areas *sensu* IUCN (see Box 1.4).

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[7] The original network of 36 Man and Biosphere reserves covered 298,317 acres, or 120,724.8 ha (Bharathie, 1979). It included Hurulu and Sinharaja, which were designated international biosphere reserves in 1977 and 1978, respectively. The present network appears to be less extensive but further checking of existing records is necessary in order to clarify its precise extent.

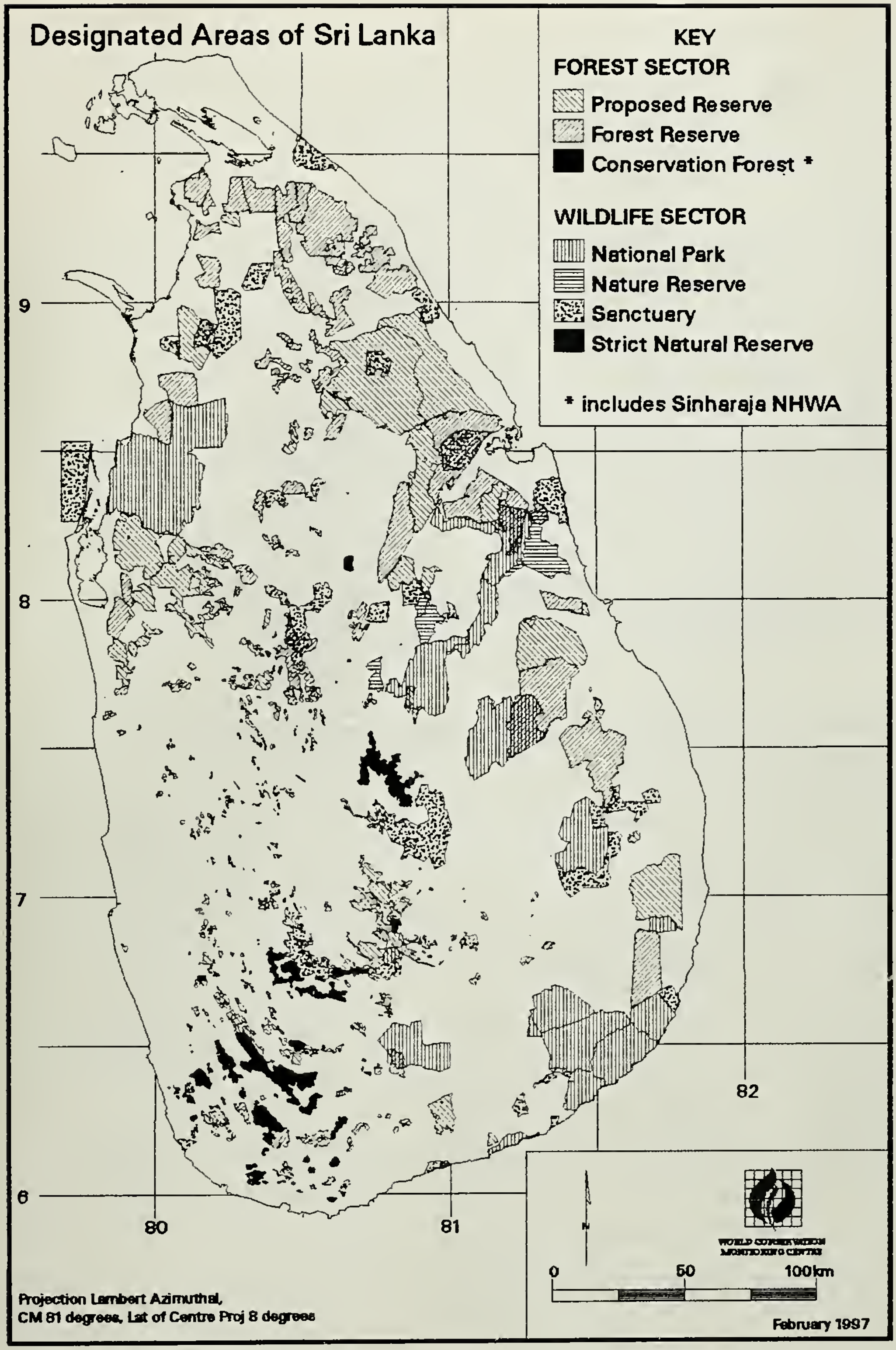

Figure 2.6 Map of designated areas administered by the Forest Department and Department of Wildlife Conservation

Subsector comparisons

Designated areas administered by the Forest Department tend to be small and confined mostly to the wet zone, whereas those under the authority of the Department of Wildlife Conservation tend to be larger and occur mainly in the dry zone. This is shown clearly by the distribution map of designated areas in Figure 2.6.

Over 28% of the total land area of Sri Lanka[8] is reserved and administered by either the Forest Department or Department of Wildlife Conservation: 16.1% and 12.4%, respectively, after correction for land released by the Forest Department subsequent to being reserved (Table 2.6). This is an overestimate, however, because Forest Department records do not account for reserves transferred to the Department of Wildlife Conservation and designated as national reserves or sanctuaries. Correction for this double counting, using statistics generated from the National Forest Geographic Information System (Table 2.7), produces an estimate of 15.1% of total land area under the Forest Department. However, the actual percentage of total land area under the Forest Department is between 15.1% and 16.1% for reasons given in the footnote to Table 2.7.

Table 2.6 Extent of designated areas administered by Forest Department and Department of Wildlife Conservation.

National designation	No.	Area			
		Declared		Present*	
		ha	%	ha	%
Forest Department					
Forest Reserve	177	518,199	7.8	466,335	7.1
Proposed Reserve	217	621,147	9.4	589,388	8.9
National Heritage Wilderness Area	1	11,187	0.2	11,187	0.2
Subtotal	395	1,150,533	17.4	1,066,910	16.1
Department of Wildlife Conservation					
Jungle Corridor	1	10,360	0.2	10,360	0.2
National Park	12	462,448	7.0	462,448	7.0
Nature Reserve	3	33372	0.5	33,372	0.5
Sanctuary	52	284,117	4.3	284,117	4.3
Strict Natural Reserve	3	31,574	0.5	31,574	0.5
Subtotal	71	821,871	12.4	821,871	12.4

* Corrected, in the case of Forest Department, for land released subsequent to being reserved or proposed for reservation.

[8] A figure of 6,616,618 ha for the total land area in Sri Lanka is used for statistical analyses throughout this report, this being consistent with that used by Legg and Jewell (1995) to estimate forest cover.

Table 2.7 Overlap of forest and proposed reserves with protected areas administered by the Department of Wildlife Conservation.[1]

Department of Wildlife Conservation		Overlap with Forest Department	
Designation	**Total Area (ha)**	**FRs (ha)**	**PRs (ha)**
Jungle corridors	not mapped	?	?
National parks	506,012	11,230	6,204
Nature reserves	40,115	2,651	786
Sanctuaries	281,142	27,470	18,771
Strict natural reserves	2,720	1,134	5
Total	829,989	42,485	25,766

[1] Statistics were generated from the National Forest GIS maintained by the Forest Department. Reserves managed by the Department of Wildlife Conservation and Forest Department were overlaid to calculate the extent of overlap between respective categories of reserve. The two GIS datasets are not completely comprehensive. For example, maps of forest and proposed reserves under the Forest Department do not take into account changes in boundary due to lands released subsequent to the designation of these reserves. Such mapped information is not readily available. Thus, total overlap may overestimate double counting by including some released lands.

Currently, the Forest Department manages 148,512 ha for conservation or 2.2% of total land area (Table 2.8). Thus, the national system of protected areas covers over 14% of total land area, which is higher than in many other South and South-East Asian countries (McNeely *et al.*, 1994).

Table 2.8 Extent of protected areas administered by the Forest Department

Description **- Name**	**No.**	**Area (ha)**
International biosphere reserves - Hurulu Forest Reserve - Sinharaja Forest Reserve/Proposed Reserve[1]	 1 1	 512 8,864
National biosphere reserves[2]	39	63,384
Conservation forests (wet zone) - Knuckles Conservation Forest - Sinharaja National Heritage Wilderness Area - other conservation forests	 1 1 31	 16,000 11,187 60,525
Total	74	160,472
Total - corrected[3]	**72**	**148,512**

[1] Sinharaja Forest Reserve and Proposed Reserve were included within Sinharaja National Heritage Wilderness Area, subsequent to their designation as an international biosphere reserve.

[2] Statistics for the total number and area of national biosphere reserves are conflicting. According to the Environmental Information System maintained by the Forest Department, there are 40 national biosphere reserves covering a total area of 93,222 ha, plus an additional two international biosphere reserves (Hurulu and Sinharaja) with a combined area of 9,376 ha. These records are based on the Forest Department Register and UNESCO, respectively. However, records on file in the Forest Department indicate a total of 41 biosphere reserves, including the two internationally designated biosphere reserves, covering an area of 72,760 ha. It is quite likely that neither dataset is entirely accurate (up-to-date) as there are statistical discrepancies between a number of individual sites. The latter dataset is used in this study because it provides a more conservative estimate of the protected areas system. Sinharaja is also a World Heritage site, but the area of this property is included within the statistics for international and national biosphere reserves.

[3] Corrected for seven national biosphere reserves (Diyadawa, Gilimale-Eratne, Haycock, Kaneliya, Kombala-Kottawa, Oliyagankele and Rammalakanda), with a total area of 1,477 ha, which are located within wet zone conservation forests, Dotalugala national biosphere reserve (1,619 ha) in the Knuckles Conservation Forest and Sinharaja Biosphere Reserve which lies within Sinharaja National Heritage Wilderness Area.

However, many of Sri Lanka's protected areas are small and isolated, reflecting the fragmented nature of much of the remaining natural habitat. As shown in Figure 2.7, 30% of protected areas are less than 100 ha and 54% are less than 1,000 ha in size. Whereas most protected areas of the Forest Department are less than 1,000 ha, most of those of the Department of Wildlife Conservation are larger than 1,000 ha. However, many of the Forest Department's small protected areas are biosphere reserves (61% are less than 100 ha), which are core areas of much larger forest or proposed reserves. Nevertheless, opportunities to protect large blocks of forest are becoming fewer. For example, approximately half of the 31 *other* conservation forests in the wet zone (Table 2.8) are less than 1,000 ha.

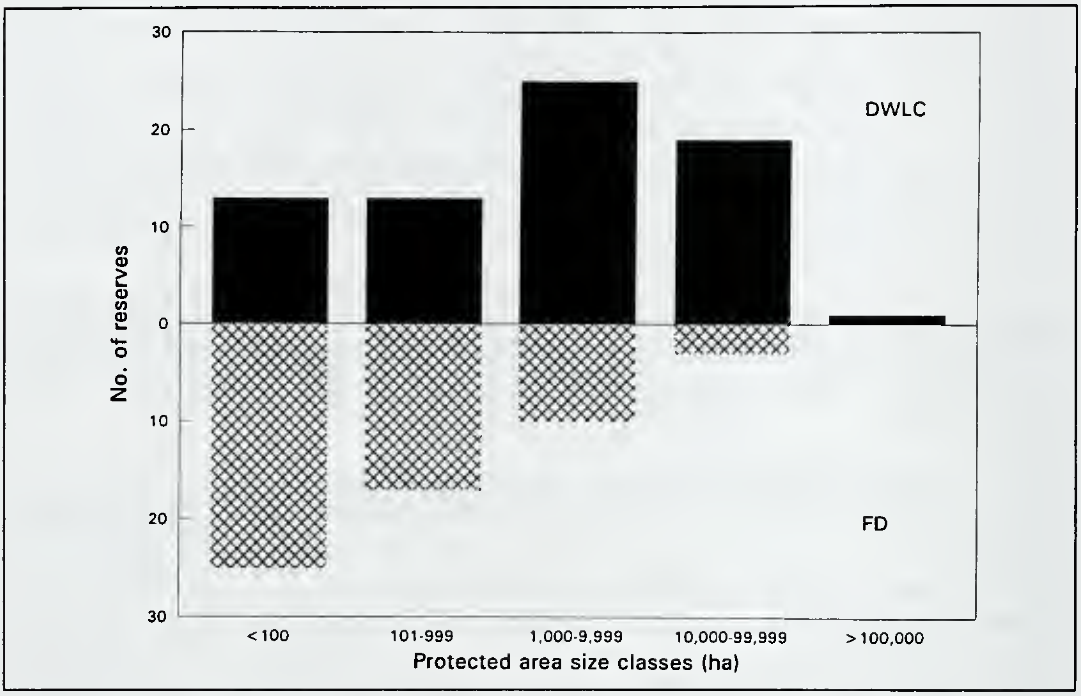

Figure 2.7 Distribution of size of protected areas administered by Forest Department and Department of Wildlife Conservation

The single largest protected area is Wilpattu National Park (133,571.4 ha) in the north-west arid zone. Slightly larger is the 144,512.8 ha complex of contiguous protected areas in the south-east, dry zone, comprising Ruhuna National Park, Yala East National Park and Yala Strict Natural Reserve. Protected areas tend to be smaller in the intermediate and wet zones, much more of the original forest having been converted to other forms of land use. Here, the largest and most important protected areas are Peak Wilderness Sanctuary and adjacent Horton Plains National Park (with a combined area of 25,539 ha), Knuckles Conservation Forest (16,000 ha) and Sinharaja National Heritage Wilderness Area (11,187 ha).

Internationally designated protected areas

Sri Lanka participates in all three international initiations concerned with protected areas (see Table 2.5), and has sites listed under each of them (Table 2.9). Arguably the most important site for biodiversity conservation is Sinharaja, the country's largest remnant of rain forest which has been declared a biosphere reserve under the UNESCO MAB Programme and subsequently inscribed on the World Heritage List of Natural Properties.

Table 2.9 Natural sites designated for conservation under international initiatives

International initiative	Protected area	Year	Area (ha)
Ramsar Wetland Convention	Bundala S	1990	6,216
UNESCO MAB Programme	Hurulu FR	1977	524
	Sinharaja FR/PR	1978	8,864
World Heritage Convention	Sinharaja NHWA	1988	11,187

Chapter 3

METHODS - SOIL AND WATER CONSERVATION ASSESSMENT

3.1 INTRODUCTION

The importance of forests for soil and water conservation is assessed on the basis of the following four criteria, as reviewed in Section 1.2:

- Soil Conservation
  - soil erosion
- Water Conservation
  - flood hazard
  - protection of headwaters
  - fog interception

Similar criteria have been identified by MacKinnon *et al.* (1986) for the selection of areas in need of protection for their hydrological functions.

Whereas forest is entirely beneficial for the prevention of erosion, its presence has both positive and negative impacts on the hydrological cycle as discussed in Section 1.3.2. Thus, the importance of forest for soil conservation is given priority weighting over its water conservation value in the methodology.

The methodology is described below and a worked example is provided in Section 3.8.

3.2 SOIL EROSION

Two approaches to assess erosion at the reconnaissance level have been identified by Morgan (1980). The first is based on regional variations of various erosion indices, such as gully density and drainage density. The second uses rainfall to calculate an erosivity index based on kinetic energy. The latter, physically-based method has been universally accepted as a standard technique. It was used in a case study to assess the erosion risk of Peninsular Malaysia (Morgan, 1980). A similar procedure has been adopted in the present study to determine rainfall erosivity. In addition, some of the parameters usually considered in more detailed erosion assessment procedures are also incorporated in the methodology.

3.2.1 Assessment of the importance of forests for soil conservation

Soil erosion by water is influenced most by the amount of rainfall. In regions of very low mean annual rainfall, little erosion is caused by the rain running off the land because most of it is absorbed by the soil and vegetation. In other regions of very high rainfall (> 1000 mm yr^{-1}), as in Sri Lanka, dense forest typically develops which protects the soil from erosion by water. Removal of this natural forest cover usually results in severe erosion.

However, it is not only the amount of rainfall that affects soil erosion but also its intensity. The intense downpours characteristic of the tropics have a very much greater impact than the gentler rains of temperate climates. The zone of intensive or 'destructive' rain lies between approximately 40^0 North and 40^0 South, within which Sri Lanka is situated.

The severity of soil erosion also depends on the susceptibility of a given soil to erosion. This attribute of soil is influenced mostly by its physical characteristics, such as texture, structure, infiltration capacity and permeability. Soil structure is largely determined by the organic matter content of the soil: the higher the level of organic matter, the less susceptible the soil is to erosion.

Thus, the amount of erosion depends upon a combination of the power of the rain to cause erosion and the ability of the soil to withstand erosion (Hudson, 1981). In mathematical terms, soil erosion is a function of the erosivity of the rain and the erodibility of the soil, or

$$\text{Erosion} = f(\text{Erosivity})(\text{Erodibility}).$$

This relationship is expressed by the Universal Soil Loss Equation (USLE), developed by Wischmeier and Smith (1965) and widely accepted as a predictive equation to estimate the mean annual soil erosion. In its basic form, USLE is:

$$A = E.K. \tag{1}$$

where A = mean annual soil loss (t ha^{-1} yr^{-1}),
E = erosivity, and
K = erodibility.

Erosivity can be defined as the potential ability of the rain to cause erosion. For given soil conditions, one storm can be compared quantitatively with another based on a numerical scale of values of erosivity. Erodibility is defined as the vulnerability of the soil to erosion and, for given rainfall conditions, one soil condition can be compared quantitatively with another, based on a numerical scale of values of erodibility.

Erodibility has three components: first the fundamental or inherent characteristics of the soil, such as texture, structure and organic matter content, which can be measured in the laboratory; secondly, topographic features, especially the slope of the land; and thirdly, the way in which the soil is treated or managed. In the present study, the third factor is assumed to be a constant because the only type of land use under consideration is natural forest. Thus, the following equation is used to predict soil loss from natural forest:

$$A = E.K.S. \tag{2}$$

where S = slope factor.

Estimating rainfall erosivity

Rainfall erosivity is a function of the size and velocity of the rain drops. It can be predicted from its proven relationship with rainstorm intensity (Wischmeier and Smith, 1958; Hudson, 1981; Lal, 1976; Morgan *et al.*, 1982). But rainfall intensity data are not available in many countries, including Sri Lanka, due to a lack of recording rain gauge stations[9]. This problem

[9] A recording rain gauge automatically records the amount of rainfall with time.

can be overcome by developing models to predict rainfall erosivity from meteorological parameters, such as total annual rainfall and the Fournier Index, which are commonly available from non-recording rain gauge stations (Arnoldus, 1980).

A similar approach has been used in Sri Lanka (Premalal, 1986). Ten meteorological stations with recording rain gauges were selected to sample the mid- and up-country zone (i.e. above 300 m) and 12 for the low-country zone (i.e. below 300 m). An erosivity index was calculated using the procedure described by Hudson (1981). A regression equation was derived for the mid- and up-country to predict erosivity from mean annual rainfall, modified Fournier Index and altitude. For the low-country, it was found that mean annual rainfall alone is strongly correlated with erosivity.

However, these two equations for the mid/up-country and low-country zones can only be used to estimate erosivity for a given forest if it has a single value for altitude and lies within one zone. Consequently, the original data for mid-, up- and low-country were pooled and a multiple step-wise regression performed on erosivity with a variety of independent variables, including mean annual rainfall, modified Fournier Index and altitude. This showed that mean annual rainfall alone accounts for about 75% of the variation. The resultant regression equation is given below:

$$E = 972.75 + 9.95\ MAR,\ (R^2 = 0.75) \tag{3}$$

where E = Erosivity ($J\ m^{-2}\ Yr^{-1}$), and
MAR = Mean annual rainfall (mm).

Two hundred and twenty *station-years* of rainfall data were used to derive the above equation. This is a considered to be an adequate sample size, being very much larger than the 11 *station-years* of data used to derive a similar erosivity index for Peninsular Malaysia (Morgan, 1980). It should be emphasized that the above Equation (3) is valid only for Sri Lanka.

An estimate of mean annual rainfall is a prerequisite to calculating erosivity for a given forest using Equation (3). The isohyetal method (Linsley *et al.*, 1982) was used to estimate mean annual rainfall (Section 3.8.1) in preference to Theissen's polygon method of weighting, which is not suitable, particularly in the case of smaller forests.

Estimating soil erodibility

The erodibility of the major soil types in Sri Lanka is given by Joshuwa (1977). Erodibility values are obtained from the soil map which is superimposed on the forest map in order to assign the respective erodibility value to each forest. This is necessarily crude because more detailed soil maps are not available.

The alternative of surveying soils within individual forests to obtain a more detailed information on soil type was not warranted in view of the time involved in obtaining adequate sample sizes. Furthermore, since there is only a twofold difference between the highest and lowest erodibility values of the major soils in Sri Lanka, more precise estimates would not make a significant difference to the overall assessment of the hydrological value of forests.

Determining slope factor

The mean slope is determined using the procedure described by Fleming (1975). Each forest is located on the 1:63,360 series of topographic maps and overlaid by a grid, effectively dividing it into smaller units. The perpendicular distance is measured from the contour at each grid point to the nearest stream (or paddy field when there is no stream in the vicinity). This value is divided by the altitudinal difference to derive the slope from which an arithmetic mean is obtained. The procedure, described in Section 3.8.1, is modified in the case of dry zone forests where stream density is lower due to the reduced rainfall and to the terrain being less steep. In such cases, slope is estimated by dividing the difference in altitude between two points by the distance for a range of different aspects and calculating a mean value.

The slope factor in Equation (2) has a value of 1.0 when the slope is 9%. Soil erosion increases exponentially with the slope. It has been widely accepted that in the tropics the exponential term for the slope is equal to 2 (Hudson, 1981). Thus, the slope factor in the USLE should be substituted by mean slope as follows:

$$S = (s/9)^2 \qquad (4)$$

where S = slope factor, and
s = mean percentage slope.

3.2.2 Ranking forests for soil erosion

Substitution of the erosivity, erodibility and slope factor into Equation (2) enables the mean annual soil loss to be estimated for a given forest under standard conditions, which are as follows:

- slope length is 22.6 m,
- land use is bare cultivated fallow, and
- land is ploughed up and down the slope.

In other words, the value of the mean annual soil loss represents the worst-case scenario when the forest is removed and the land is badly managed. These erosion values can be reduced substantially by introducing conservation practices and covering the bare soil with vegetation. Forests with very high soil erosion rates are those most important for soil conservation; they rank high in priority for protection measures.

3.3 HEADWATERS PROTECTION

Policy within the Sri Lanka's Commission on Land Use demands that

- stream sources and headwaters of river systems,
- water divides, and
- stream reservations and riparian land

be protected for soil and water conservation purposes.

The importance of a forest for protecting stream sources is evaluated by counting the number of streamlets originating from within a forest using the 1:63,360 topographic series of maps. A second criterion used is the number of major river catchments protected by the forest, based on the standard system of river catchments defined by the Irrigation Department (Navaratne, 1985). Assessing the importance of a forest in terms of its proximity to the headwaters of a river and for protecting stream reservations and riparian land is based on the distance from the forest to the outlet of the river. Distance was selected as the criterion because water originating from a given forest will sustain flora and fauna throughout its course to the sea. It is measured from the headwaters stream closest to the centre of the forest, along its course to the outlet, using the 1:63,360 maps.

In summary, the assessment is based on:

- the number of streamlets originating from the forest,
- the number of river catchments protected by the forest, and
- the distance (km) from the headwaters stream nearest the centre of the forest to the outlet.

3.4 FLOOD HAZARD

In the absence of flow records for a forest, a preliminary estimate of the mean annual flood or other flood statistics may be obtained from the relationship between floods and catchment characteristics using maps (NERC, 1975). However, this indirect method is generally less reliable than any direct analysis of flood statistics. Research in the UK has provided a set of equations relating mean annual flood to catchment area alone, with provision for regional variations. Other investigations have taken into account climate and slope (NERC, 1975).

The use of multiple regression techniques to study the relationship between mean annual flood and its coefficient of variation and catchment characteristics is widely accepted. One reason why such techniques have been so useful in assessing flood hazard is the strong relationship between mean annual flood and other variables, such as slope and channel network (i.e. number of streams per unit area), which can be estimated easily from topographic maps.

3.4.1 Estimating flood hazard from catchment characteristics

In the absence of any previous research on estimating flood hazard from catchment characteristics for Sri Lankan conditions, a model developed in the UK has been adopted for the present study. This is justified because the behaviour of most of the variables concerned with the flooding component of the hydrological cycle appear to be the same. Details of the analysis and the flood prediction equations are given in a Flood Studies Report (NERC, 1975).

In the UK study, catchment characteristics were obtained from 1:63360 and 1:25000 topographic maps. Climatic variables were also used. Of these variables, only those which can be measured or estimated accurately were selected for this study, namely mean annual rainfall, catchment area (or forest area for the purposes of this study) and stream frequency. These three variables account for 86% of the variation of mean annual flood.

Most of the rainfall stations in Sri Lanka have more than 30 years of rainfall data from which mean annual rainfall can be calculated. Area can be measured using a planimeter. Stream frequency is measured by counting the number of channel junctions within a forest, using the 1:63,360 topographic series, and dividing by its area. A stream without any junctions is given a value of one, as if it had a single junction. It is best to work progressively up along each tributary; the running total is noted at each major junction. This value is then divided by the area and presented as stream junctions km^{-2} (adapted from NERC, 1975).

Stream frequency was selected in preference to drainage density, which cannot be reliably sampled by grid or other methods (NERC, 1975). It is simpler to measure and it is strongly correlated with drainage density (Melton, 1958). Moreover, 1:63,360 maps are sufficiently detailed for measuring stream frequency. In the UK study, there was a very high correlation (0.89) between stream frequency measurements from 1:63,360 and 1:25,000 maps for 55 catchments.

The predictive equation for mean annual flood is given below:

$$BESMAF = 4.53*10^{-5}\ AREA^{0.84}\ STMFRQ^{0.51}\ SAAR^{1.34} \qquad (5)$$

where BESMAF = mean annual flood ($m^3\ s^{-1}$),
AREA = area (km^2),
STMFRQ = stream frequency (stream junctions km^{-2}), and
SAAR = mean annual rainfall (mm)

It should be noted that the values estimated from the equation will not provide absolute values of mean annual flood since the regression equation was derived from a different set of data. However, the values indicate the *flood response* of each forest and should be used for ranking purposes only.

3.5 FOG INTERCEPTION AT HIGHER ALTITUDES

Altitude has been identified as a criterion for identifying forests for conservation in the past mainly because the headwaters of major rivers originate from higher elevations. However, the importance of forests for protecting stream sources and headwaters of river systems is assessed using measures other than altitude, as described in earlier in this chapter (3.3).

Recent research has shown that altitude has a direct effect on the hydrological cycle through the contribution of additional moisture from cloud forests (Juvik and Ekern, 1978; Gunawardena, 1991; Mowjood and Gunawardena 1992). Since a given forest may extend over a range of altitudes, altitude needs to be adjusted accordingly, using a procedure similar to the isohyetal method (Linsley *et al.*, 1982). Calculation of the mean altitude enables the percentage of additional moisture contributed through fog interception to be calculated using the following equation, which was derived from experimental studies conducted in Hawaii:

$$Y = -38.5 + 0.04\ X \qquad (6)$$

where Y = additional percentage moisture contributed by fog, and
X = altitude (m).

Mean annual rainfall for a given forest is multiplied by Y (Equation 6) to estimate the annual fog contribution (mm). This is converted to a volumetric value by multiplying by the area of the forest. Since fog interception increases with altitude, Y should be calculated at 500 ft (167 m) intervals and multiplied by the respective area. The equation is valid for forests above 1,500 m, there being no significant fog interception at lower altitudes.

Application of this equation, derived from fog studies in Hawaii, to conditions in Sri Lanka is justified elsewhere (Gunawardena, 1991). As described in the next section, similar studies are underway in Sri Lanka. Once completed, these will enable the coefficients in Equation (6) to be modified.

3.5.1 Field experiments in Sri Lanka

A field study to determine the significance of fog interception to the hydrology of catchment systems was begun at Horton Plains in 1993. An automatic weather station with a fog collector was installed at the top of a 20 m high tower, which stands 5 m above the forest canopy. The net rainfall beneath the forest canopy is also measured. A detailed description of the experiment is given elsewhere (Bastable and Gunawardena, 1994).

Preliminary results, based on two years of data, show that interception of horizontally driven fog by the forest canopy may account for over 50% increase in net rainfall for certain months, usually during the south-west monsoon (Figure 3.1). On average, such horizontal interception of fog accounts for 3.6% of annual rainfall (Gunawardena, 1996). Assuming that the vertical interception of fog is about 30% of annual rainfall, which is a reasonable value for tropical forest, the total contribution from fog to the hydrological cycle is about 33.6% of annual rainfall.

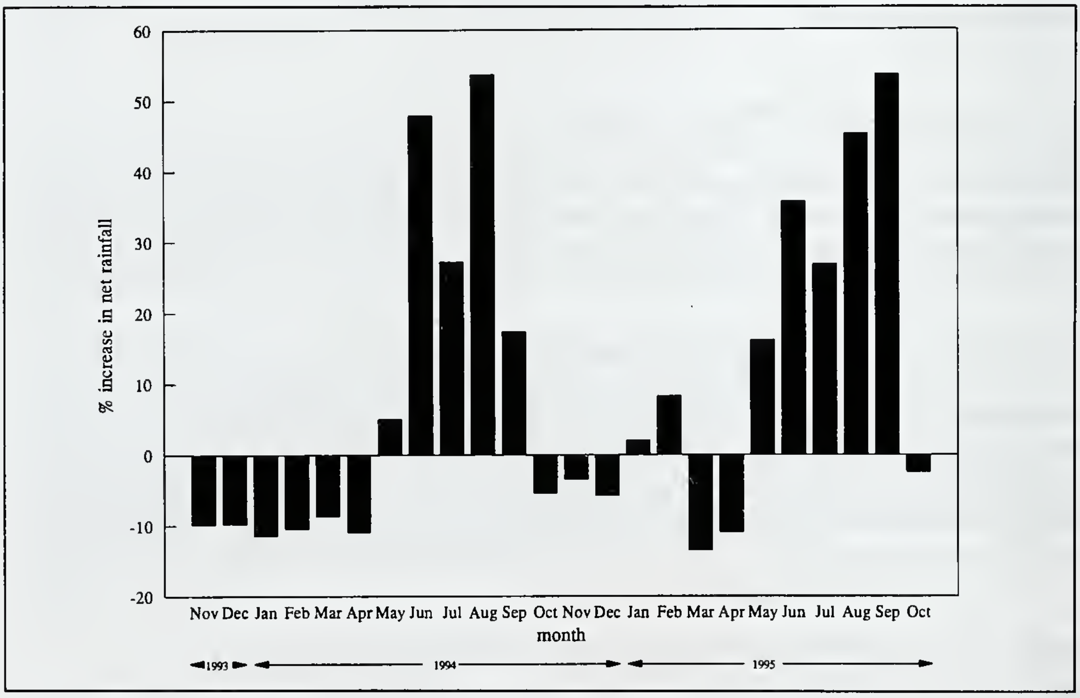

Figure 3.1 Increase in net rainfall from fog interception at Horton Plains between November 1993 and October 1995

It will be necessary to obtain several years of data from additional locations in order to determine the coefficients of Equation (6). Meanwhile, these preliminary results suggest that the value of Y (moisture contributed by fog) in Equation (6) is somewhat inflated. Such an overestimate does not directly affect the results of the present study because they are based on ranks rather than absolute values of the fog contribution.

3.6 EVALUATION

The following evaluation is applied to all natural forests except those which have already been designated for strict protection by the government because they lie in the immediate catchment of hydroelectric and water supply reservoirs.

3.6.1 Preliminary ranking

Forests are ranked according to four main criteria as a measure of their importance for soil and water conservation. The four criteria are:

i soil erosion,
ii importance as headwaters of rivers,
iii flood hazard, and
iv additional moisture from fog interception.

Soil erosion is measured for each forest as mean annual soil loss (t ha^{-1} yr^{-1}) using Equation (1) which treats erosivity, erodibility and slope as independent variables.

The **importance** of a forest **for protecting headwaters of rivers** is measured in terms of a) the number of streamlets originating from the forest, b) the number of river catchment areas protected by the forest, and c) the length along the river from the centre of the forest to the river outlet. Each forest is ranked in descending order for criterion a, b, and c, separately. The values of the three columns of ranks are added horizontally, and the lowest value is assigned the highest rank. If two values are equal, priority is given in the following order: a), b), c).

Mean annual flood, which is used as an index of flood hazard, is estimated for each forest by substituting mean annual rainfall, area and stream frequency in the predictive Equation (5).

Fog interception is measured as the additional moisture (mm yr^{-1}) contributed by a forest (above 1,500 m).

3.6.2 Final ranking

The four main criteria (Section 3.6.1) are classified into two groups, namely:

- soil conservation importance (criterion i), and
- hydrological importance (criteria ii, iii, and iv).

Importance for soil conservation is based on ranking soil erosion (criterion i). Hydrological importance is based on ranking the summation of the rank values of criteria ii, iii, and iv. The lowest value is ranked highest. If there are two equal values, priority is given in the following order: criteria ii, iii, iv. Ranks for soil conservation and hydrological importance are added and their values ranked,the lowest value being ranked highest. If two values are equal, priority is given to soil conservation.

3.6.3 Selection of forests for soil and water conservation

In order to prioritise forests for soil and water conservation, threshold values of 300 t ha^{-1} yr^{-1} for soil erosion and 10 m^3 s^{-1} for mean annual flood were identified on the basis of a preliminary analysis of results for the wet zone (Green and Gunawardena, 1993). Forests with values exceeding both these thresholds are considered to be of highest importance for conservation; those with values exceeding one or other threshold are considered important to conserve; and those with values below both thresholds are ranked as lowest importance.

In addition, any forest above 1,500 m was automatically considered to be a top priority for conservation because of its significant contribution to fog interception.

The importance of a forest for protecting headwaters of rivers was not used in this final selection procedure because it was derived from a series of ranking procedures, rather than being based on absolute values as for erosion and flood control, and fog interception.

3.7 CONSTRAINTS

The methodology developed for this study is adequate for a rapid assessment of the importance of forests for soil conservation and hydrology. Although some field checking was carried out to validate the results, subjectively interpreting them as necessary, more detailed, quantitative studies of soil and hydrological conditions in Sri Lanka are required in order to refine the methodology. Plans are underway to examine soil erosion and hydrology in the upper catchment areas of the country using a GIS. Once the relevant data have been digitised, they can be used to improve on the estimates derived from the present study.

Given that the headwaters of all major rivers in Sri Lanka lie in the wet and intermediate zones (Figure 2.2), not surprisingly none of the forests in the dry zone is shown to be important for soil or water conservation using the methodology developed for this study. The major hydrological role of forests in the dry zone concerns the recharge of the ground water reservoir during the north-east monsoon. Unfortunately, however, there has been very little study of the significance of this role of forests. Thus, caution must be exercised in evaluating dry zone forests until such time as this role can be measured quantitatively.

3.7.1 Soil erosion

Estimates of soil erosion potential are influenced principally by values for rainfall and slope, the erodibilty value having little effect. The most sensitive variable in determining soil erosion is slope because the slope factor increases exponentially with slope. Forests with rock outcrops and lower stream density tend to have higher values of slope. Thus, any inaccuracy in estimating slope will result in exaggerated soil erosion values.

Although not available for this study, GIS software can be used to measure slope much more accurately, resulting in more reliable estimates of soil erosion.

3.7.2 Headwaters protection

Importance for headwaters protection is based on summing the rank orders of forests for their number of streams, distance to river outlet and the number of catchments they encompass. Whereas there are several hundred rank values for the first two criteria, there are only five values for the number of catchments. Thus, catchment number has very little influence on the final rank.

3.7.3 Flood hazard

Determination of flood hazard is based on the assumption that the entire catchment area above the point at which mean annual flood is estimated is forested. This may not always be the case.

3.8 WORKED EXAMPLE

This section provides a worked example for nine forests selected from Galle and Matara districts. It is based on preliminary data obtained at the outset of the NCR (Green and Gunawardena, 1993).

3.8.1 Soil erosion

Estimating rainfall erosivity

Rainfall erosivity is estimated from the following equation:

$$E = 972.75 + 9.95\ \mathrm{MAR},\ (R^2 = 0.75) \qquad (1)$$

where E = Erosivity ($\mathrm{J\ m^{-2}\ Yr^{-1}}$), and
MAR = Mean annual rainfall (mm).

The isohyetal method is used to estimate mean annual rainfall. This is illustrated in Figure 3.2 for Dellawa using mean annual rainfall data from nearby rain gauge stations (Table 3.1).

Table 3.1 Data from rain gauge stations in the vicinity of Dellawa

Rain gauge station	Mean annual Rainfall (mm)	Location	
		Latitude	Longitude
1. Panilkanda Estate	3208	06-21-33N	80-37-38E
2. Tawalama	4731	06-20-28N	80-21-22E
3. Millawa Estate	3749	06-17-35N	80-27-41E
4. Morawaka	3386	06-15-25N	80-29-25E
5. Opatha	4080	06-16-05N	80-24-29E
6. Vedagala	3564	06-27-15N	80-25-32E
7. Dependene Group	3483	06-27-45N	80-32-56E
8. Lauderdale Group	3478	06-25-08N	80-36-23E

Data for each station are plotted on a 1:63,360 map, enabling contours of equal rainfall (isohyets) to be drawn. Mean annual rainfall is estimated for each area between adjacent isohyets, weighted by its percentage area. Summation of the mean values for each area provides an estimate of mean annual area for the entire forest, as follows:

$$MAR = \frac{A\,(R_A + R_B)/2 + B\,(R_B + R_C)/2 + C\,(R_C + R_D) + \ldots}{100} \tag{2}$$

where MAR = Mean annual rainfall,
R_A, R_B, R_C, and R_D are the rainfall isohyets, and
A, B, and C are the areas enclosed within isohyets R_A - R_B, R_B - R_C, and R_C - R_D, respectively.

Substituting values from Figure 3.2, the mean annual rainfall for Dellawa is calculated as follows:

$$MAR = \frac{3.1(4050) + 14.2(3950) + 20.8(3850) + 23.5(3750) + 34.8(3650) + 3.4(3550)}{100}$$

$$MAR = 3759 \text{ mm}$$

The value for mean annual rainfall is substituted in Equation (1) in order to calculate an erosivity value for Dellawa as follows:

$$E = 972.75 + (9.95 \times 3759)$$
$$E = 38375 \text{ J m}^{-2} \text{ yr}^{-1}$$

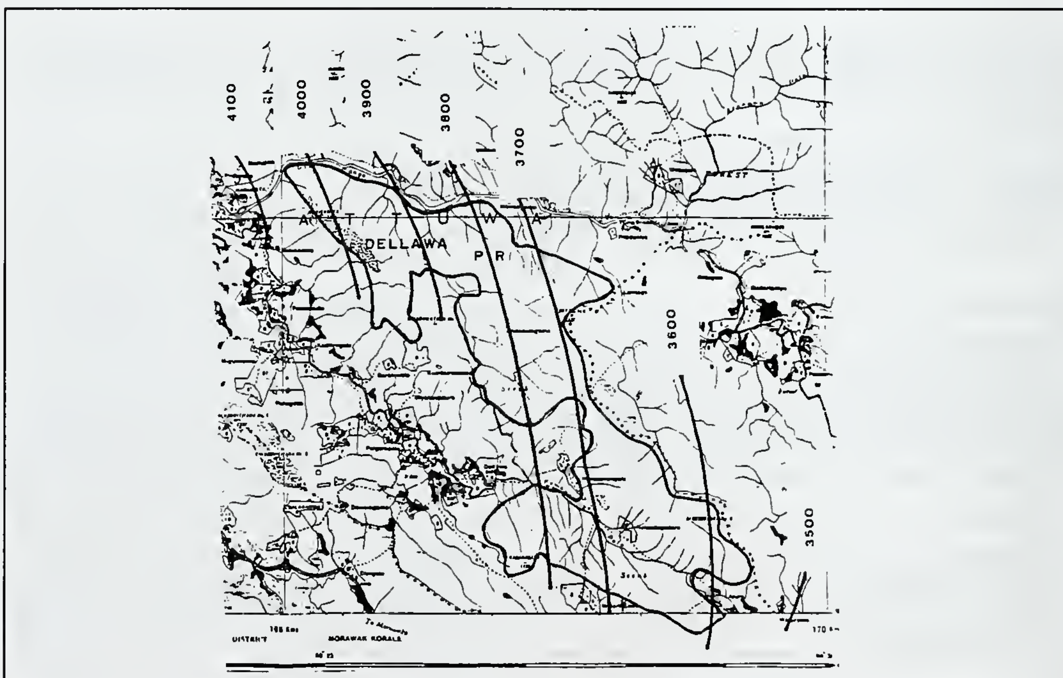

Figure 3.2 Mean annual rainfall isohyets for Dellawa

The erosivity index (383.75) is obtained by dividing the erosivity value by 100. It indicates the ability of the rainfall to cause soil erosion. Mean annual rainfall and the respective erosivity values are given in Table 3.2 for each forest.

Table 3.2 Mean annual rainfall and erosivity index for selected forests in Galle and Matara districts

Forest	Mean annual rainfall (mm)	Erosivity index
1. Beraliya (Akuressa)	2671	275.49
2. Dellawa	3759	383.75
3. Diyadawa	3410	349.02
4. Kalubowitiyana	4189	426.53
5. Kanumuldeniya	2432	251.71
6. Kekanadura	1721	180.97
7. Masmullakele	2076	216.29
8. Oliyagankele	2465	254.99
9. Rammalakanda	2837	292.01

Estimating soil erodibility

The major soil type(s) within a forest can be determined by superimposing the forest boundary onto the soil map (published by the Survey Department of Sri Lanka). Erodibility values of the major soil types are given by Joshuwa (1977). If there is more than one type within a forest, the erodibility value should be weighted according to the area covered by the different soils.

All forests selected in this example have red yellow podzolic soils, for which the erodibility value is 0.22.

Determining slope factor

Forest boundaries are marked onto 1:63,360 maps and a 10 mm x 10 mm grid drawn over each forest, as shown in Figure 3.3 for Dellawa. The perpendicular distance is measured from the contour at each grid point to the nearest stream. This distance is divided by the altitudinal difference between the contours at the grid point and the stream in order to calculate the slope. Slope values are summed and divided by the number of grids in order to obtain a mean value.

The slope at each grid point is given in Table 3.3 for Dellawa. Summation of the slopes (14.38) and division by the total number of grid points (52) gives a mean value of 0.28, or 28%. The slope factor is calculated as follows:

$$S = (s/9)^2$$
$$S = (28/9)^2$$
$$S = 9.68$$

where S = slope factor, and
s = mean percentage slope.

Mean slope and the slope factor are given for each forest in Table 3.4.

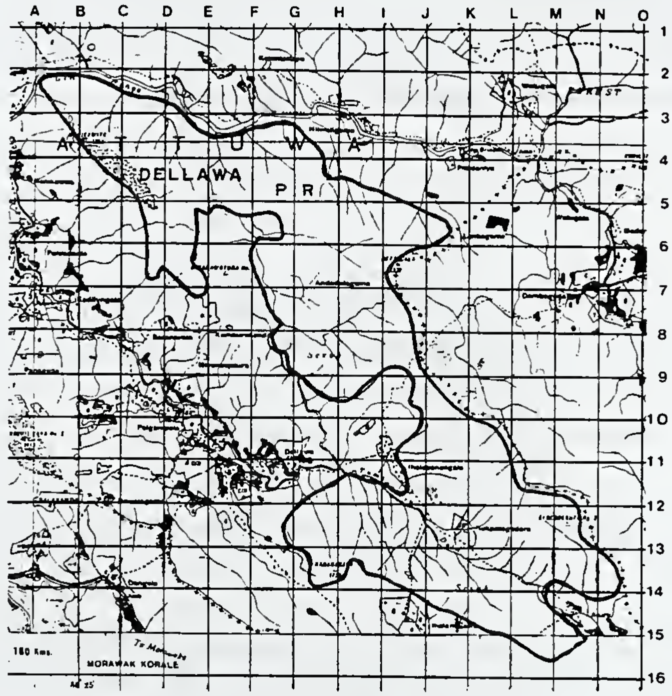

Figure 3.3 Overlaying a 10x10 mm grid onto a contour map to estimate mean slope in Dellawa

Table 3.3 Slopes at grid points in Dellawa

	B	C	D	E	F	G	H	I	J	K	L	M	N
3	0.38	0.41	0.47	-	-	-	-	-	-	-	-	-	-
4	-	0.12	0.34	0.47	0.47	0.37	-	-	-	-	-	-	-
5	-	-	0.39	0.0	0.32	0.3	0.47	0.3	-	-	-	-	-
6	-	-	0.34	-	-	0.24	0.12	0.41	0.47	-	-	-	-
7	-	-	-	-	-	0.24	0.0	0.32	-	-	-	-	-
8	-	-	-	-	-	0.30	0.24	0.36	-	-	-	-	-
9	-	-	-	-	-	-	0.47	-	0.0	-	-	-	-
10	-	-	-	-	-	-	-	-	0.0	0.28	-	-	-
11	-	-	-	-	-	-	-	-	0.47	0.36	0.24	-	-
12	-	-	-	-	-	-	0.32	0.09	0.63	0.0	0.47	0.0	-
13	-	-	-	-	-	0.39	0.47	0.12	0.16	0.47	0.59	0.42	0.32
14	-	-	-	-	-	-	-	-	0.06	0.32	0.24	-	0.0
15	-	-	-	-	-	-	-	-	-	-	0.09	0.24	-

Table 3.4 Mean slope and slope factor for selected forests in Galle and Matara districts

Forest	Mean slope (%)	Slope factor
1. Beraliya (Akuressa)	20	4.94
2. Dellawa	28	9.68
3. Diyadawa	33	13.44
4. Kalubowitiyana	48	28.44
5. Kanumuldeniya	14	2.42
6. Kekanadura	3	0.11
7. Masmullakele	12	1.78
8. Oliyagankele	14	2.42
9. Rammalakanda	23	6.53

Calculating soil erosion

The mean annual soil loss is calculated by substitution of the values of the erosivity index, erodibility, and slope factor into Equation (4).

$$A = E.K.S. \qquad (4)$$

where A = mean annual soil loss (t ha^{-1} yr^{-1}),
E = erosivity index,
K = erodibility, and
S = slope factor.

Substituting the respective values for Dellawa forest,

$$A = 383.75 \times 0.22 \times 9.68$$
$$A = 817.23 \text{ t ha}^{-1} \text{ yr}^{-1}$$

Values of the erosivity index, erodibility, slope factor and erosion hazard are given in Table 3.5 for each forest. These results show that Kalubowitiyana has the highest erosion hazard. This forest has the highest erosivity index as well as the highest slope factor, making it most prone to erosion.

Table 3.5 Erosion for selected forests in Galle and Matara districts, together with values of erosivity index, erodibility and slope factor

Forest	Erosivity index	Erodibility	Slope factor	Erosion t $ha^{-1}yr^{-1}$
1. Beraliya (Akuressa)	275.49	0.22	4.94	299.3
2. Dellawa	383.75	0.22	9.68	817.2
3. Diyadawa	349.02	0.22	13.44	1032.3
4. Kalubowitiyana	426.52	0.22	28.44	2669.1
5. Kanumuldeniya	251.71	0.22	2.42	134.0
6. Kekanadura	180.97	0.22	0.11	4.4
7. Masmullakele	216.29	0.22	1.78	84.6
8. Oliyagankele	254.99	0.22	2.42	135.8
9. Rammalakanda	292.01	0.22	6.53	419.6

3.8.2 Headwaters protection

Streamlets originating from a forest

The number of streamlets originating from a forest is counted, using the 1:63,360 series of maps. The value for Dellawa is 77.

Number of river catchments protected by a forest

Streamlets originating from a forest are traced to major rivers, identified as such by the Irrigation Department (see Chapter 3.3). The number of major rivers into which flow the streamlets of a forest is counted. Dellawa contributes water to two major rivers, namely Nilwala and Gin Ganga.

Distance from headwaters of centralmost stream to its outlet

The stream closest to the centre of a forest is selected and the distance measured from its headwaters to its mouth, using a thread laid along its course. If there are two river catchments, the values of the respective distances are summed. Values for Dellawa are as follows:

Distance along Nilwala River	=	58
Distance along Ginganga	=	87
Total distance	=	145 km

The number of streamlets and river catchments, and the total distance between headwaters and outlets are given in Table 3.6 for each forest.

Table 3.6 Distance of stream headwaters from river mouths for selected forests in Galle and Matara districts, together with the number of streamlets and major rivers

Forest	Streams	Major Rivers	Headwaters distance (km)*				
			Nil	Gin	Pol	Kir	Total
1. Beraliya (Akuressa)	37	2	37	-	27	-	64
2. Dellawa	77	2	58	87	-	-	145
3. Diyadawa	73	2	64	95	-	-	158
4. Kalubowitiyana	5	2	61	79	-	-	140
5. Kanumuldeniya	5	1	-	-	-	30	30
6. Kekanadura	0	-	-	-	-	-	-
7. Masmullakele	1	1	17	-	-	-	17
8. Oliyagankele	0	-	-	-	-	-	-
9. Rammalakanda	43	2	64	-	-	39	103

* Nil = Nilwala; Gin = Ginganga; Pol = Polwatta Ganga; Kir = Kirama Oya

3.8.3 Flood hazard

Mean annual flood for a given forest is used as an index of its response to floods, and hence provides a measure of its role in reducing flood hazard. It is estimated using the following predictive equation:

$$BESMAF = 4.53*10^{-5}\ AREA^{0.84}\ STMFRQ^{0.51}\ SAAR^{1.34} \qquad (5)$$

where
BESMAF = Mean annual flood ($m^3\ s^{-1}$),
AREA = Area (km^2),
STMFRQ = Steam frequency (stream junctions km^{-2}), and
SAAR = Mean annual rainfall (mm)

Area

This information is available for most forests that have been notified as forest reserves under the Forest Ordinance or as national reserves and sanctuaries under the Fauna and Flora Protection Ordinance. It is also available for proposed reserves. For other state forests, for which such information may not be available, the area is measured directly from 1:63,360 maps using a planimeter. The area of Dellawa is 22.36 km^2.

Stream frequency

Using 1:63360 maps on which forest boundaries have been marked, the number of stream junctions within each boundary is counted. Streams without any tributaries are considered as one junction. The total number of stream junctions within the 22.36 km^2 Dellawa is 65. Thus, its stream frequency is:

$$STRFRQ = 65/22.36$$
$$STRFRQ = 2.9$$

Mean annual rainfall

Determination of mean annual rainfall is described in Section 3.1.1. The mean annual rainfall (SAAR) for Dellawa is 3759 mm.

Calculating flood hazard

Substituting values of area, stream frequency and mean annual rainfall into Equation (5), the mean annual flood for Dellawa is:

$$BESMAF = 4.53*10^{-5}\ 22.37^{0.84}\ 2.9^{0.51}\ 3759^{1.34}$$
$$BESMAF = 65.47\ (m^3\ s^{-1})$$

If a forest does not have a stream originating from it, the mean annual flood is considered to be equal to zero. The values of area, stream frequency, mean annual rainfall and mean annual flood are given in Table 3.7.

Table 3.7 Flood hazard for selected forests in Galle and Matara districts, together with values of area, stream frequency and mean annual rainfall

Forest	Area km^2	Stream frequency km^{-2}	Mean Annual Rainfall	
			mm	t $ha^{-1}yr^{-1}$
1. Beraliya (Akuressa)	16.46	1.80	2671	25.11
2. Dellawa	22.36	2.90	3759	65.47
3. Diyadawa	24.48	2.52	3410	57.72
4. Kalubowitiyana	2.72	1.84	4189	10.23
5. Kanumuldeniya	6.79	0.64	2432	6.21
6. Kekanadura	3.80	0.00	1721	0.00
7. Masmullakele	6.18	0.14	2076	2.14
8. Oliyagankele	4.86	0.00	2465	0.00
9. Rammalakanda	14.07	2.22	2837	26.55

3.8.4 Fog interception

Assessment of fog interception applies only to forests above 1,500 m. All forests selected from Matara and Galle districts for purposes of this worked example lie below this altitude. Hence, the additional moisture contributed by fog interception is zero.

For illustrative purposes, the procedure for estimating fog interception for a selected forest, Hakgala, is given below using Equation (6).

$$Y = -38.5 + 0.04\ X \qquad (6)$$

where Y = additional percentage moisture contributed by fog, and
X = altitude (m).

The value of Y is multiplied by the mean annual rainfall to estimate the additional moisture contributed by fog in mm per annum. The volume is estimated by multiplying the depth of the additional moisture by the area of the forest. The procedure for estimating total fog interception for Hakgala is given below.

An estimated 26.6 ha of Hakgala forest lies within an altitudinal range of 5,000-5,500 ft (1,667-1,833 m). The mean altitude is 5,250 ft or 1,750 m. Substituting this mean altitude in Equation (6),

$$Y = -38.5 + (0.4 \times 1750)$$
$$Y = 31.5\%$$

The mean annual rainfall for Hakgala is 2176 mm. Thus,

depth of fog interception = 2176 x 31.5/100
depth of fog interception = 685.4 mm per annum

and volume of fog interception = $685.4{*}10^{-3} \times 26.6{*}10^{4}$ per annum.

The total volume of fog intercepted by the entire forest of Hakgala is shown in Table 3.8.

Table 3.8 Annual volume of fog intercepted by Hakgala forest

Altitude range (m)	Mean altitude (m)	Area (ha)	Fog interception (m^2*1000)
1,667-1,833	1,750	26.6	182.6
1,833-2,000	1,917	223.1	1,852.6
2,000-2,167	2,083	732.5	7,145.9
2,167-2,333	2,250	153.1	1,716.3
2,333-2,500	2,417	6.7	84.3
Total		1,142.0	10,981.7

3.8.5 Evaluation

Preliminary ranking

Forests are ranked according to a single criterion, soil erosion, as a measure of their importance for soil conservation, and according to three criteria for assessing their water conservation value, namely importance as headwaters of rivers, flood hazard and additional moisture contributed by fog interception.

The importance of a forest for protecting headwaters of rivers is assessed in terms of three sub-criteria: the number of streamlets originating from it, the number of river catchments protected by it, and the distance from the headwaters to the river mouth. Each of these sub-criteria is ranked separately and the values of the three columns of ranks are added horizontally to derive an overall headwaters value which is then ranked. If values are equal, priority is given in the order: streams, major rivers and distance. The results of this ranking procedure are given in Table 3.9.

Table 3.9 Selected forests in Matara and Galle districts ranked for their importance as headwaters catchments

Forest	**Streams Rank**	**Major Rivers rank**	**Distance rank**	**Headwaters total**	**Headwaters rank**
1. Beraliya (Akuressa)	4	1	5	10	5
2. Dellawa	1	1	2	4	1
3. Diyadawa	2	1	1	4	2
4. Kalubowitiyana	5	1	3	9	4
5. Kanumuldeniya	5	2	6	13	6
6. Kekanadura	7	3	8	18	8
7. Masmullakele	6	2	7	15	7
8. Oliyagankele	7	3	8	18	8
9. Rammalakanda	3	1	4	8	3

Hydrological importance is determined by adding the rank values of headwaters importance, flood hazard and fog interception and assigning the highest rank for the lowest total. If two or more values of the total are equal, priority is given to the value of the headwaters rank. The results of this ranking procedure are given in Table 3.10. It should be noted that rank values of forests for headwaters importance and flood hazard are very similar (see Section 3.8.3).

Table 3.10 Selected forests in Matara and Galle districts ranked for their hydrological importance

Forest	Headwaters rank	Flood hazard rank	Fog interception	Hydrology total	Hydrology rank
1. Beraliya (Akuressa)	5	4	-	9	4
2. Dellawa	1	1	-	2	1
3. Diyadawa	2	2	-	4	2
4. Kalubowitiyana	4	5	-	9	5
5. Kanumuldeniya	6	6	-	12	6
6. Kekanadura	8	8	-	16	8
7. Masmullakele	7	7	-	14	7
8. Oliyagankele	8	8	-	16	8
9. Rammalakanda	3	3	-	6	3

Final ranking

The rank values of erosion and hydrology are summed for each forest and the total ranked to obtain an overall ranking for soil and water conservation. If two or more totals are equal, priority is given to erosion hazard. The results of the final ranking are given in Table 3.11.

Table 3.11 Final ranking of selected forests in Galle and Matara districts for their importance in soil and water conservation

Forest	Erosion rank	Hydrology rank	Erosion + hydrology	
			Total	Rank
1. Beraliya (Akuressa)	5	4	9	5
2. Dellawa	3	1	4	2
3. Diyadawa	2	2	4	1
4. Kalubowitiyana	1	5	6	3
5. Kanumuldeniya	7	6	13	6
6. Kekanadura	9	8	17	9
7. Masmullakele	8	7	15	8
8. Oliyagankele	6	8	14	7
9. Rammalakanda	4	3	7	4

This worked example shows that Diyadawa is overall the most important of the selected forests for its role in conserving soil and maintaining the hydrological regime. Dellawa is hydrologically the most important forest, mainly due to its dense stream network. Kalubowitiyana ranks highest for soil conservation alone, a reflection of its high rainfall and steep terrain, but it is relatively less important for hydrology due to its small size. The extremely high erosion value, more than double that of any other forest (Table 3.5), was checked in the field and seen to be high, as evidenced by a recent landslide.

Selection of forests for soil and water conservation

Forests are prioritised according to their importance for soil and water conservation in Table 3.12, based on absolute measures of soil erosion and mean annual flood, respectively. The importance of forests for protecting the headwaters of rivers is not used in this final selection procedure because it closely mirrors mean annual flood (Table 3.10). In addition, any forest above 1,500 m is automatically considered to be a top priority for conservation because of its significant contribution to the hydrological cycle through fog interception. In the case of this particular example, none of the forests lies above 1,500 m.

Table 3.12 Importance of selected forests in Matara and Galle districts for soil and water conservation

HIGHEST IMPORTANCE FOR CONSERVATION	IMPORTANT FOR CONSERVATION		LOWEST IMPORTANCE FOR CONSERVATION
Soil erosion >300 t ha^{-1} yr^{-1} Mean annual flood >10 m^3 s^{-1}	Soil erosion >300 t ha^{-1} yr^{-1}	Mean annual flood >10 m^3 s^{-1}	Soil erosion <300 t ha^{-1} yr^{-1} Mean annual flood <10 m^3 s^{-1}
Diyadawa		Beriliya (Akuressa)	Kanumuldeniya
Dellawa			Oliyagankele
Kalubowityana			Masmullakele
Rammalakanda			Kekanadura

Chapter 4

METHODS - BIODIVERSITY ASSESSMENT

4.1 INTRODUCTION

Biodiversity surveys are necessary for rational land use planning and decision-making, and they are required to resolve land use conflicts. Much of the conflict between logging and forest conservation, for example, is concerned with which species and how many are present in a particular area. If that information is present the issue can be simplified. The conflict remains but it can be resolved on the basis of facts, not guesses or unsound extrapolations. Very often, however, the information is not available and the first step towards resolving the conflict is to conduct a biodiversity survey to determine what species are present, where they are and how many. This is the prevailing situation in Sri Lanka, as already outlined in Section 2.2.2.

Financial resources for surveying biota are diminishing relative to planning needs, hence it is essential that surveys are cost-effective (Burbidge, 1991). To help ensure that costs are kept to a minimum, only relevant data should be collected and they should be available for re-use as required.

It is necessary, therefore, to develop a method of surveying biodiversity that is both comprehensive and cost-effective (i.e. rapid) in order to meet one of the objectives of the NCR component of the Environmental Management in Forestry Development Project, namely:

> ***to assess the conservation value of Sri Lanka's remaining natural forests, including mangroves.***

This will enable decisions concerning future uses of these natural resources to be based on sound, scientific principles.

4.1.1 Survey design

The most widely used scientific criteria for assessing conservation value are diversity, rarity, naturalness, size and representativeness (Margules and Usher, 1981; Usher, 1986; Margules *et al.*, 1988). Indeed, these criteria are used to identify natural properties under the World Heritage Convention. All refer, either wholly or in part, to a common underlying theme: the maintenance of biodiversity in perpetuity.

Conservation planning in the past has usually be focused on ensuring adequate representation of communities or habitats, but many species cannot necessarily be perpetuated by the reservation of communities because of their dependence on disturbance, their ranging behaviour or their occurrence in community interfaces. Thus, the best conservation planning should encompass both species and communities, with priority, if any, being given to species (Kirkpatrick and Brown, 1991). In practice, the number of species has become the simplest and most commonly used measure of biodiversity (Bond, 1989).

Hunter *et al.* (1988) consider, however, that the selection of protected areas should be more strongly influenced by the distribution of physical environments than by that of communities, which are transitory assemblages or co-occurrences among taxa that have changed in distribution, abundance and association in response to past climatic changes. Ideally, protected areas should encompass a sufficiently broad range of physical environments to allow organisms to adjust their local distribution in response to long-term environmental changes. Given that landscapes also change, albeit over a longer time span, protected areas should be connected by corridors to allow species to modify their geographic distribution.

There is also a growing awareness that conservation planning must also take into account the human dimension, given that most biodiversity is lost directly as a result of human activities. Thus, it is important for socio-economic and political factors to be considered in the design of protected area systems (Forester *et al.*, 1996).

Four complimentary approaches were adopted for the NCR. First, species' distribution patterns were used to define a national network of conservation forests in which species diversity is fully represented. Secondly, to avoid any gross oversights in planning at the ecosystem level, forest types and floristic regions were examined to ensure that they were well represented within the optimum set of conservation forests identified from species' distribution patterns. Thirdly, in the interests of the long-term preservation of Sri Lanka's biodiversity, particularly with respect to changes in global climate anticipated over the next century, edaphic (soil) zones were examined to ensure that the full range of the island's physical environments were represented within the optimum set of conservation forests. In practice, it was necessary to combine the floristic and edaphic analyses due to current limitations with the available classifications. Finally, potential threat from human development pressures was considered by assessing the wilderness value of forests and maximising the protection of relatively undisturbed forests.

4.1.2 Gradsect sampling

In order to define a national network of conservation forests in which species diversity is fully represented, it is necessary first to determine the distributions of species, and then to identify an optimum set of forests which encompasses all species through some form of pattern analysis. Surveys intended to provide data for defining a representative protected forests network require a procedure which ensures that the full range of biodiversity is sampled. Such surveys are concerned with gathering information about species' distribution patterns, rather than obtaining unbiased estimates of the abundance of individual species using standard, statistical, sampling techniques. Stratification is essential but practical problems of travel costs and accessibility must be incorporated into any cost-effective survey.

Gradient-directed transect (gradsect) sampling is the deliberate selection of transects which contain the steepest environmental gradients with maximum access present in an area (Austin and Heyligers, 1991). It was selected for the NCR as being the most appropriate technique for rapidly assessing species diversity within natural forests.

Gradsect sampling is designed to provide a description of the full range of biodiversity within a region, overcoming problems of inadequate representative sampling and accessibility, while minimising survey costs. Gradsects are deliberately selected to contain the strongest environmental gradients within a region to optimise the amount of information gained relative to expenditure of time and effort. Sampling along a gradsect maximises variation between plots, and accessibility can be enhanced by choosing localities with an adequate road network to reduce travel time. It has been shown statistically that gradsects capture more information than randomly placed transects of similar length (Gillison and Brewer, 1985; Austin and Heyligers, 1989).

4.1.3 Conservation evaluation

Historically, the selection of protected areas has tended to be *ad hoc*, often depending on the availability of land unsuitable for other forms of land use and influenced strongly by perceived threat (Leader-Williams *et al.*, 1990). This is unsatisfactory because it results in a bias of the range of species protected.

A widely-used, more systematic alternative is to rank candidate sites according to various criteria of conservation value, such as diversity, rarity, naturalness, size and representativeness as mentioned above. Combining ranks for different criteria to derive an index of conservation value, however, inevitably involves weighting of the criteria according to a subjective assessment of their relative importance (Margules, 1989). Moreover, a major draw back in ranking sites for their conservation value on the basis of a single application of a formula is that sites of lower conservation priority may duplicate species represented in sites of higher conservation priority (Kirkpatrick, 1983). Other problems associated with combining ranks to derive a conservation value index are reviewed by Margules *et al.* (1991).

An alternative approach is to use patterns of species' distributions to identify a set of sites which encompasses all species (Margules *et al.*, 1988, 1991). This minimum set of sites in which all species (or other units of diversity) are represented at least once is the bottom line: the bare minimum. Anything less would constitute an inadequate representation of biodiversity.

Algorithms can be employed to identify minimum networks of sites in which biodiversity is adequately represented. Two approaches are commonly used, both of which use complementarity as a criterion for site selection. The *greedy* or *richness* heuristic algorithm identifies sites which contribute most new species to the network, beginning with the most species rich site. The other, *rarity* algorithm is slightly more efficient in terms of minimising the number of sites necessary for all species to be represented. The site with the rarest species is selected first; thereafter the site with the next rarest species and greatest complement of species to the network is selected (Csuti and Kiester, 1996). Such algorithms can be constrained in various ways: for example, to ensure that each species is represented in at least two sites. The large area of land required to represent biodiversity, even when the number of sites is minimised, makes it unlikely that all, or even most, species will be represented in a protected areas network. However, the minimum set approach identifies explicitly which sites are needed to maximise biodiversity and, therefore, which species will not be represented in a proposed system that does not include all of those sites (Margules, 1989).

4.2 CRITERIA USED TO IDENTIFY FORESTS

Natural forests were identified from the *New 1:500,000 Scale Forest Map of Sri Lanka* (Legg and Jewell, 1992)[10]. However, as this map was not available at the beginning of the NCR, forests in Galle, Matara and Hambantota districts were identified from the 1:100,000 Land Use series. Forests were selected for inclusion in the NCR on the basis of the following criteria:

- any legally designated reserve[11] containing closed canopy natural forest, as defined in the *New 1:500,000 Scale Forest Map of Sri Lanka*, irrespective of its size; and
- any proposed reserve or other state forest with at least 200 ha[12] of closed canopy natural forest, or any other smaller forest known to be of particular biological importance.

The 30 forests previously surveyed under the Accelerated Conservation Review (TEAMS, 1991) were also included to ensure that a consistent, systematic approach was applied to all forests.

The distribution of natural, closed canopy forest, based on the new 1:50,000-scale forest map (Legg and Jewell, 1995), is shown previously at a greatly reduced scale in Figure 2.1 (Section 2.2.1). For purposes of the NCR, the wet zone is delimited by the 2500 mm isohyet and includes montane forest, sub-montane forest and lowland rain forest. The boundary between the intermediate and dry zones is defined by the 1800 mm isohyet.

4.3 INVENTORYING SPECIES DIVERSITY

4.3.1 Gradsects

Previous studies have shown that rock type, precipitation and temperature have a strong influence on the distribution of plant species (Austin 1978, Austin *et al.*, 1984). Altitude, which is closely correlated with temperature, was chosen as the main environmental variable for the NCR because of the ready availability of such information from topographical maps (1:63,360 series). Aspect was also taken into consideration.

Transects were oriented along altitudinal gradients in order to sample the full range of biodiversity within a forest. Reference to the 1:63,630 series of topographic maps enabled transects to be positioned at right angles to contours, ensuring that the full range of altitudes and aspects was covered by one or more transects within each forest. Schematic diagrams in Figure 4.1 show how transects were aligned along altitudinal gradients (a), changing direction to maximise variability and taking advantage of available access routes (b). Narrow

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[10] This was later revised and the final version published in a Special Issue of the *Sri Lanka Forester* on remote sensing (A 1:50,000-scale forest map of Sri Lanka: the basis for a national forest geographic information system, Legg, C. and Jewell, N, 1995).

[11] The term *legally designated* denotes any forest reserve or national heritage wilderness area administered by the Forest Department, and any national reserve (i.e. strict natural reserve or national park) or sanctuary administered by the Department of Wildlife Conservation.

[12] Originally, a threshold of 50 ha was applied to Galle, Matara and Hambantota districts at the outset of the NCR, but this was later raised to 100 ha to expedite the survey. On 19 May 1993 a decision was taken to raise the threshold again to 200 ha to further expedite the survey.

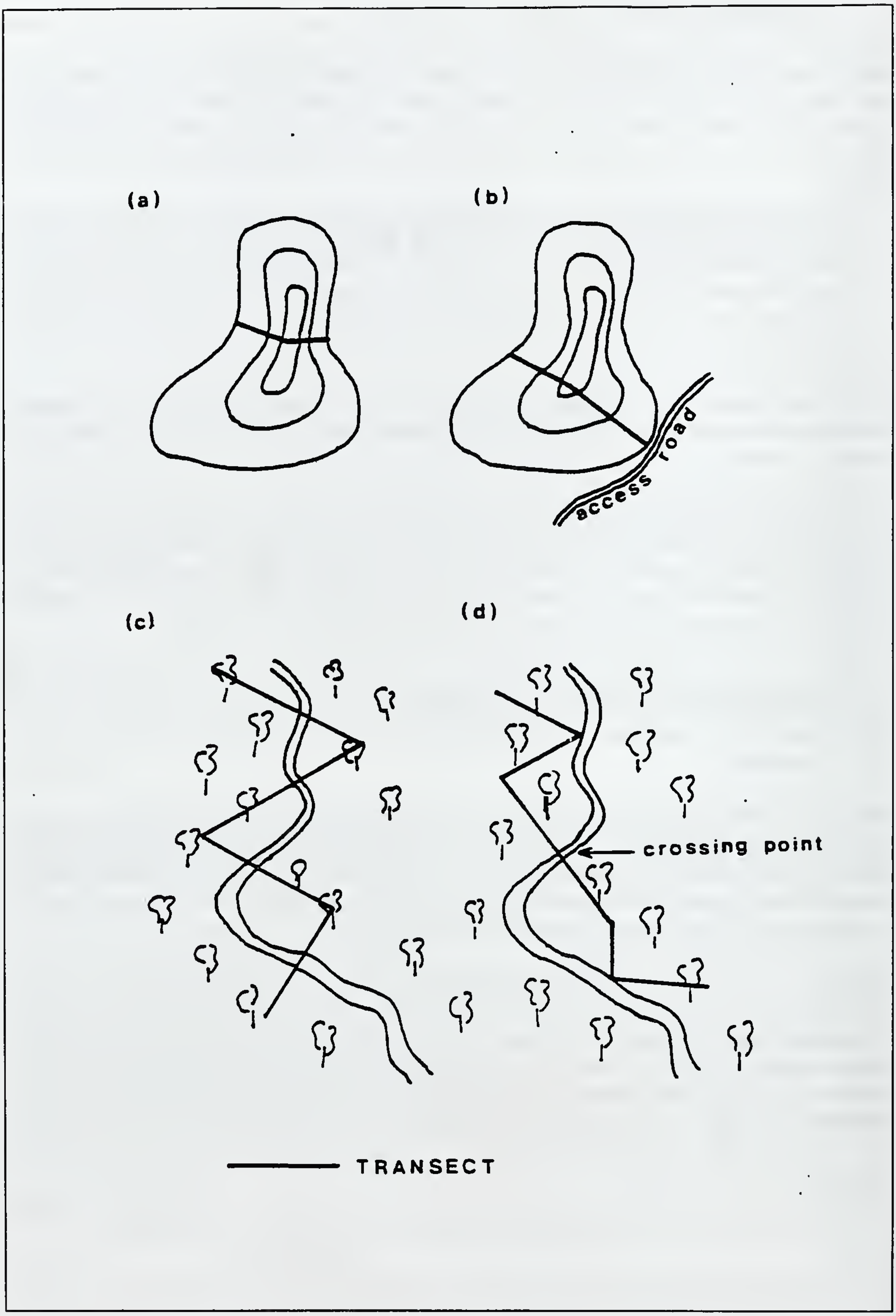

Figure 4.1 Schematic diagram showing alignment of transects in relation to (a) altitudinal gradient, (b) access routes, (c) riverine and (d) coastal vegetation. [Not to scale]

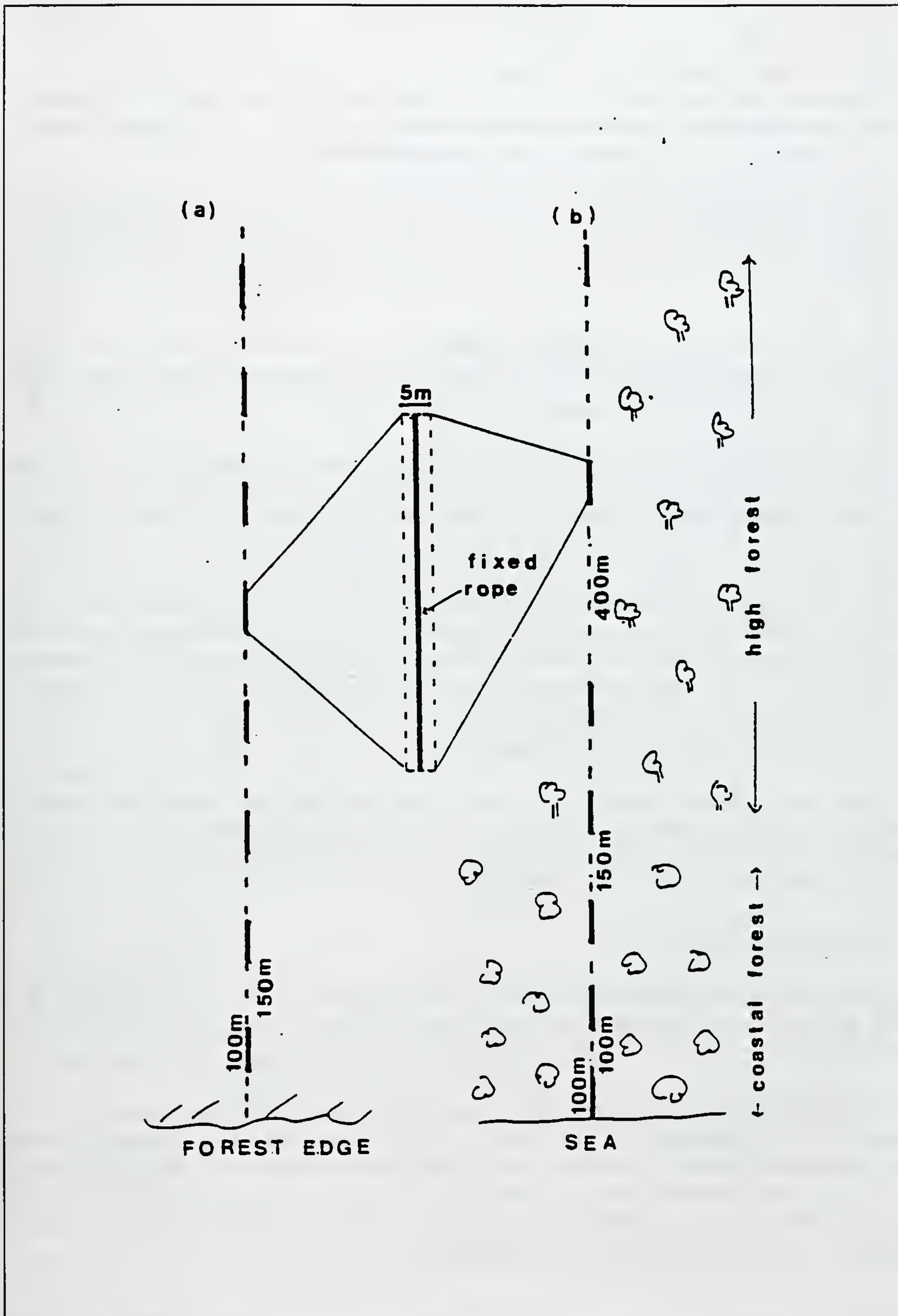

Figure 4.2 Schematic diagram of plots aligned along transects at regular intervals in (a) wet zone forests and (b) dry zone forests. [Not to scale]

belts of vegetation, such as riverine forest, were sampled in a zigzag direction along the width of the forest, crossing between banks as conditions permitted (c, d).). In the case of extensive forests, Landsat Thematic Mapper false-colour images (scale 1:50,000) were used to differentiate between community types and ensure that each was sampled. While large-scale maps of the soil and vegetation would have helped in deciding where to align transects, such information was not available for the majority of forests.

A single gradsect with at least five plots was considered to be a minimum for sampling small forests of about 200 ha, but at least four or five gradsects were required for those of about 10,000 ha, particularly in the case of forests in the wet zone where species diversity is higher.

Forests were reached in the field via the most readily accessible routes to keep time spent travelling to a minimum. Gradsects were walked along fixed bearings, using a compass, and sampled at regular intervals within plots of 100 m x 5 m.

The first plot was positioned at the beginning of the gradsect when starting on the coast, in a valley or on a ridge, but otherwise it was placed 100 m inside the perimeter of the forest to avoid peripheral, disturbed areas. Plots were spaced 150 m apart (i.e. 4 plots per km of gradsect), the distance between plots being paced. This was generally adequate in rain forest and/or steep terrain, where species composition tended to be fairly heterogeneous (Figure 4.2a). In the dry zone, where the topography is fairly uniform (i.e. level terrain) and there are extensive patches of relatively homogenous forest, plots were spaced up to 400 m apart (i.e. 2 plots per km), as illustrated in Figure 4.2b. Spacing of plots did not exceed 400 m because of the high investment in time and energy required to walk the gradsect. Occasionally, it was necessary to space plots as close together as 100 m, as in the case of narrow bands of coastal vegetation (Figure 4.2b).

Gradsects and plots were permanently marked so that they could be revisited for checking data or carrying out further fieldwork. Trees were marked with yellow paint at 10-20 m intervals. Plots were distinguished by means of coloured nylon rope tied out of reach round a branch of the first and last tree in each plot.

4.3.2 Sampling within plots

Plots were 100 m long, aligned along the length of the gradsect, and 5 m wide (Figure 4.2). They were measured along the centre-line using a brightly-coloured nylon rope, which changed from one colour to another at its mid-point (50 m) to facilitate sampling (see below).

The exact location of each plot was determined with a Global Positioning System (GPS)[13]. Interference from dense canopy cover was overcome by climbing a tree in order to obtain an unobstructed fix from the satellites. Various physical parameters were measured at 0 m, 50 m and 100 m intervals along the plot, and the condition of the vegetation was also assessed. The data were recorded on the Plot Description Form (Box 4.1) and subsequently entered into the Environmental Information Management System (EIMS).

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[13] As the GPS was not available at the start of the NCR, plots in Galle, Matara and Hambantota districts were marked on topographic maps (1:63,630) to obtain the geographic coordinates.

Box 4.1

Plot Description Form

DATE:
NAME OF SITE: NO. OF SITE: LEGAL DESIGNATION:
BRIEF DESCRIPTION OF SITE CONDITION:

TRANSECT/PLOT NO.											
GEOG. COORD.	- LATITUDE - LONGITUDE										
TIME	- START - END										
WEATHER	- CLOUD COVER[1] - CONDITIONS[2]										
ALTITUDE (M)	- MIN. - MAX.										
	MEAN										
ASPECT	@ 0M @ 50M @ 100M										
	MEAN										
SLOPE (°)	@ 0M @ 50M @ 100M										
	MEAN										
VISIBILITY (°)[3]	@ 0M @ 50M @ 100M										
	MEAN										
FOREST FLOOR[4]											
CANOPY HEIGHT (M)											
CANOPY COVER[5]											
DISTURBANCE[6]											

1. 1/8, 2/8 etc.
2. 1 = dry
   2 = moist
   3 = wet
3. Mainly with respect to direct observation of mammals & birds
4. 1 = rocks
   2 = exposed
   3 = leaf litter
   4 = herbs
5. 0 = zero
   1 = 1-5%
   2 = 6-25%
   3 = 26-50%
   4 = 51-75%
   5 = 76-100%
6. 1 = undisturbed
   2 = slight disturbance (a few tree stumps evident)
   3 = disturbed (canopy intact but numerous tree stumps)
   4 = semi-degraded (up to 50% canopy removed)
   5 = degraded (>50% canopy removed)

Date of database entry:
Signed:

Box 4.2 **Species Inventory Form**

DATE:
NAME OF SITE: NO. OF SITE: LEGAL DESIGNATION:

PLANTS[1]/ANIMALS[2] (delete as appropriate)

TRANSECT/PLOT NO.										
SPECIES[3]										

1 For plants, the number of individuals exceeding 10cm DBH is recorded for each species. A plus indicates the presence of a species but with no individual exceeding 10cm DBH.

2 For animals, the number of individuals of all vertebrate groups except fishes (i.e. mammals, birds, reptiles and amphibians) and certain invertebrate groups (i.e. butterflies, molluscs and termites which build mounds) directly observed or heard is recorded. A plus sign indicates that a species is present. In the case of indirect observations the following code is used:

B = burrow	D = defecation	F = feeding sign	H = heard
L = lying site	R = rubbing site	T = tracks	

3 Species identified in the field are recorded by their scientific name or species code. Unidentified species are collected for subsequent classification and recorded by their accession or herbarium number.

Date of database entry:
Signed:

The fauna and flora were observed within each plot and recorded on the Species Inventory Form (Box 4.2). The time required to inventory the species within a plot ranged from less than one hour in dry monsoon forest to two or even three hours in rain forest. Inventory forms with a check-list of species and their codes were automatically generated from EIMS, based on inventories of one or more forests previously surveyed in the vicinity. This reduced time spent writing species' names in the field and hastened data entry by using the species' codes.

Fauna

The plot was first walked by the zoologist who recorded any animals (vertebrates, molluscs and butterflies) seen or heard within the range of visibility - this usually took up to 30 minutes. The zoologist was followed by his assistant carrying the 100 m length of rope, and by a painter who marked the trunks of trees at 10-20 m intervals along the centre-line. The zoologist and his assistant then retraced their footsteps either side of the fixed rope, disturbing the leaf litter and undergrowth as necessary to record the more cryptic and often smaller animals, their tracks and signs within a 5 m belt (i.e. up to 2.5 m either side of the fixed rope). The edge of the plot was determined using a 2.5 m long stick held at right angles either side of the fixed rope.

The faunal survey was restricted to mammals, birds, reptiles, amphibians and two representative invertebrate groups (molluscs and butterflies). Molluscs were chosen because their presence can be readily detected from their shell remains, and butterflies because they tend to be highly visible and are best known among insects. Freshwater fishes were recorded opportunistically, as time and conditions permitted. Species were recorded on a presence or absence basis from their tracks and other signs, but the number of individuals was recorded in the case of direct observations (Box 4.2).

Flora

Once the centre-line of the plot was fixed by the rope, the botanist proceeded to walk along the length of the plot recording all woody plant species within a 5 m width (i.e. up to 2.5 m either side of the fixed rope, measured with a stick). Specimens of unidentified species were collected and numbered for subsequent identification at the National Herbarium, Peradeniya. The number of individuals exceeding 10 cm DBH was recorded for each species, but species with no individuals exceeding 10 cm DBH were recorded only on a presence/absence basis (Box 4.2). The botanist was assisted by one person who checked the width of the plot using a 2.5 m-long stick and a second who collected, labelled and pressed specimens for the herbarium. Sometimes it was necessary to climb trees to collect suitable herbarium material.

The floral survey was restricted to woody plants because of time constraints. It was not possible to revisit plots in different seasons in order to comprehensively inventory herbs. The floral survey was similar in duration to the faunal survey, but tended to take less time in dry forest and longer in rain forest. In order to maximise efficiency, the first of either the floral or faunal survey parties to complete a plot proceeded to locate the next plot.

4.3.3 Sample size

The adequacy of sample size was routinely assessed in the field by regular reference to the relationship between the accumulative number of woody plant species recorded and the total area (denoted by total number of plots) sampled. Once the asymptote was reached (i.e. the majority of species had been recorded) sampling was discontinued for that particular forest. In practice, sampling continued until the number of new species of woody plants recorded within at least two successive plots did not exceed 5% of the total number of recorded species.

An example is shown in Figure 4.3 for Sinharaja National Heritage Wilderness Area, part of the largest remaining block of rain forest in the country. In this particular example,

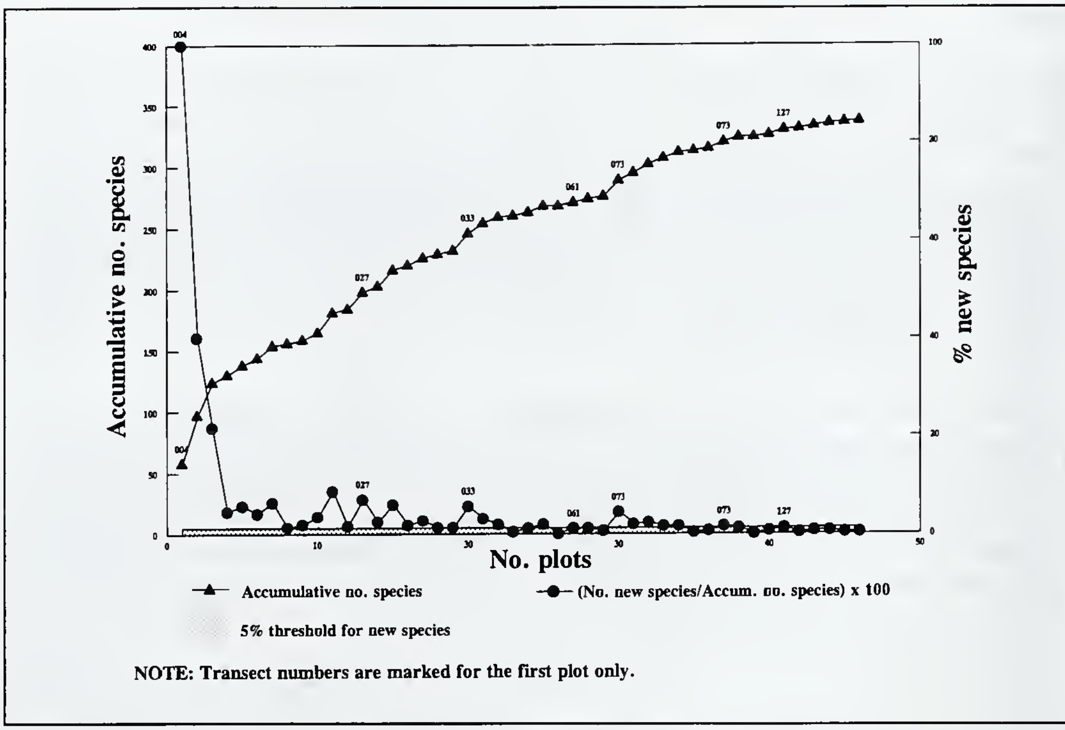

Figure 4.3 Accumulative number of woody plant species recorded in consecutive plots in Sinharaja. Sampling is discontinued once the number of new species inventoried in at least two consecutive plots falls below the 5% threshold.

because of the large size of Sinharaja, it was necessary to stratify the forest and sample the full range of community types along a number of different gradsects. As shown in Figure 4.3, the number of new species recorded within each plot declined along each gradsect, often dropping below the 5% threshold, but then rose at the beginning of a new gradsect. In such cases, with large forests, it was necessary to continue sampling until the 5% threshold was not exceeded even with the establishment of a new gradsect in a different part of the forest.

It is instructive to note that the total of 276 woody plant species recorded within plots 1-29 (gradsects 4, 27, 33 and 61 in Figure 4.3), representing a total sample area of 1.45 ha, is well in excess of the 184 woody species recorded within a total sample area of 15 ha by Gunatillake and Gunatillake (1981). Although their research objectives were different to those of this study, they found that a minimum area of 3.75 ha was required to sample woody plants in the rain forests of Sinharaja. Such comparisons provide an indication of the cost-effectiveness of gradsect sampling.

4.3.4 Observations between plots

Noteworthy fauna and flora observed along a gradsect while walking between plots were recorded, and specimens collected if their identity was uncertain. Such data were entered into EIMS, but not used in any of the analytical procedures because this would have biased the results.

4.3.5 Analysis of inventory data

An iterative method (after Kirkpatrick, 1983) was used to define a minimum set of sites necessary to conserve the species diversity contained within Sri Lanka's natural forests. A *greedy* heuristic algorithm was developed to select a set of forests in which all species occur at least once. It consisted of the following steps (adapted from Margules *et al.*, 1988):

(i) The forest containing the most species was selected.

(ii) From the remaining forests, the forest which had the highest complement of species not already represented in the previously selected forest was selected next.

(iii) Where two or more forests contributed an equal number of additional species, the first forest encountered was selected.

(iv) The previous step (ii) was repeated until all species were represented in one or more forests.

Both woody plant and animal datasets were submitted to this iterative procedure which was programmed within EIMS. The analyses were also restricted to endemic forest species of woody plants and animals.

An alternative *rarity* algorithm was also programmed within EIMS. This weights for rarity by selecting forests in order of their contribution of unique species to the network, a unique species being one recorded within only one particular forest. Both procedures produced identical or almost identical minimum sets of forests. This was due to the large number of forests containing one or more unique species - by the time all unique species had been selected, so had most other species. For the sake of brevity, therefore, only the results of the first *greedy* algorithm are presented in this report.

The algorithms developed for EIMS can be constrained to determine the minimum set of forests needed to represent all species twice, three or more times. While it would be highly desirable to ensure that all species are conserved within at least two forests, in practice this was not an option due to the many species recorded from only a single forest.

Individual and contiguous forests

Legally designated forests and other state forests (OSFs) having closed canopies and contiguous with each other were treated as single units, referred to as *contiguous forests*. Treatment as single units ensures that conservation forests are as large as possible, in line with this main tenet of conservation biology theory. It also enabled data from adjacent forests to be combined, thereby increasing the incidence of adequately surveyed forests due to the larger sample sizes.

4.4 GAP ANALYSIS

Gap analysis is a method of conservation risk assessment that evaluates the protection status of biodiversity, often at the ecosystem level, by overlaying its distribution on a map of existing protected areas. It can be readily undertaken using a Geographic Information System (GIS).

Gap analysis techniques were used to assess the representativeness of Sri Lanka's existing designated areas network at the ecosystem level, as well as to consider its wilderness quality. Each gap analysis is described in the subsequent sections below.

The GIS coverage used for designated areas was that held within the Forest Department's National Forest Geographic Information System. It is reasonably comprehensive, covering both forest and wildlife sectors, but not all the boundaries of forest reserves or proposed reserves have been digitised due to a lack of mapped information. Thus, there are a few discrepancies between this coverage and the list of designated areas provided in Annex 1. In addition, it was not possible to include the seven conservation forests with OSF status because their boundaries have yet to be defined, mapped and digitised. Omission of these seven OSF conservation forests makes only a relatively small difference to the analyses because their total area is only approximately 7,500 ha.

The designated areas coverage was corrected for overlapping designations, arising from reserves transferred from the Forest Department to the Department of Wildlife Conservation and designated as national reserves or sanctuaries. Double counting amounted to a total of 934.31 km^2, a breakdown of which is provided in Table 4.1.

Table 4.1 Area of overlap (km^2) between designated areas within the forestry and wildlife sectors

Designation:	**Department of Wildlife Conservation**				
Forest Department	National Park	Nature Reserve	Sanctuary	Strict Natural Reserve	Totals
Conservation Forest	-	-	22.95	-	22.95
Forest Reserve	351.26	26.62	263.26	11.39	652.53
Proposed Reserve	62.38	7.89	188.51	0.05	258.83
Totals	413.64	34.51	474.72	11.44	934.31

4.4.1 Forest types

Spatial datasets of existing designated areas and closed canopy natural forest cover types, from the 1:50,000-scale forest map of Sri Lanka (Legg and Jewell, 1995), were superimposed using an ARC.INFO-based GIS. The extent to which each forest type is represented within each type of designated area was computed using GIS techniques.

4.4.2 Wilderness

The World Conservation Monitoring Centre has developed a wilderness map for Sri Lanka, using GIS techniques, as part of a separate study of forest condition. The concept of wilderness can be defined in terms of the extent to which nature is changed or disturbed due to the influence of modern society on its attributes, remoteness and primitiveness (Lesslie and Taylor, 1985). As wilderness cannot be measured in absolute terms, it is best conceptualized as a continuum from non-wilderness to wilderness, or low wilderness quality to high wilderness quality as in this study.

The method was based on the approach developed by the Australian Heritage Commission (Lesslie *et al.*, 1988), using the following indicators to derive a wilderness index:

- **remoteness from settlements** (i.e. permanently occupied buildings, cleared agricultural land, plantation forests)
- **remoteness from access** (e.g. roads, railways, aircraft runways)
- **aesthetic naturalness** - the degree to which the landscape is free from the presence of permanent structures of modern technological society (e.g. all man-made structures, ruins, quarries)

Primary data on these three indicators were derived from the Digital Chart of the World (DCW), a GIS that is based on the Operational Navigation Charts and Jet Navigation Charts (ESRI, 1992). DCW has 16 thematic layers, ranging from settlements to drainage networks. In order to derive values for each wilderness indicator, a grid was computer-generated and overlaid on the appropriate thematic layer. Indicator values were determined for each grid point by measuring the distance from the grid point to the nearest appropriate feature.

The *1:50,000-scale forest map of Sri Lanka* (Legg and Jewell, 1995) was used in conjunction with DCW to derive the aesthetic naturalness indicator. Each grid point was evaluated with respect to its proximity to non-closed canopy forest. The three indicators were then to derive a wilderness index for each grid point. This index provides a measure of socio-economic influences and threats to remaining closed canopy natural forests.

The designated areas coverage was superimposed on the wilderness map of Sri Lanka and the extent of protection of each wilderness zone was computed using GIS techniques. Four wilderness zones were defined approximately as follows:

- Category 1 Low wilderness (Wilderness index < 5)
- Category 2 Medium-low wilderness (Wilderness index 5- 9)
- Category 3 Medium-high wilderness (Wilderness index 9-13)
- Category 4 High wilderness (Wilderness index 13-20)

4.4.3 Floristic regions and edaphic zones

As yet, there is no biogeographic or vegetation map of Sri Lanka that is sufficiently detailed to be useful for gap analysis purposes. Ashton and Gunatilleke (1987) have defined 15 floristic regions for the country, but the dry zone is treated as a single region (Figure 4.4 and Table 4.2). The Department of Wildlife Conservation is currently working on a biogeographic map of the country, in collaboration with the Survey Department, but so far has only mapped soil-edaphic units for the intermediate and dry zones (Figure 4.5 and Table 4.3), corresponding almost exactly with Floristic Region II (dry and arid lowlands). Given that the two classifications are complementary, Floristic Region II was subjected to a more detailed gap analysis by using the soil-edaphic classification.

The two maps were digitised and combined into a single coverage for gap analysis purposes. The combined coverage was overlaid with the designated areas coverage and representativeness computed, as in the case of the previous gap analyses.

Table 4.2 Floristic regions, with their principal natural vegetation types and dominant plant communities (Source: Ashton and Gunatilleke, 1987)

No.	Floristic Region	Characteristic natural vegetation types (dominant plant communities)
I	Coastal and marine belt	Marine, mangroves, salt marsh, sand dunes, and strand vegetation
II	Dry and arid lowlands	Tropical dry mixed evergreen forests Manilkara community Mixed community (*Chloroxylon-Vitex-Berrya-Schleichdera* series) Tropical thorn forests (*Manilkara-Chloroxylon-Salvadora-Randia* series) *Damana* and *Villu* grasslands Flood-plain wetlands Riverine and gallery forests
III	Northern intermediate lowlands	Tropical moist semi-evergreen forests (*Filicium-Euphoria-Artocarpus-Myristica* series)
IV	Eastern intermediate lowlands	Tropical moist semi-evergreen forests Savannah forests
V	Northern wet lowlands	Tropical wet evergreen forests
VI	Sinharaja and Ratnapura	Tropical wet evergreen forests (lowland hill Dipterocarp forests - *Mesua-Doona* community, Talawa-grasslands, fernlands)
VII	Southern lowland hills	Tropical wet evergreen forests (*Dipterocarpus* community, *Mesua-Doona* community)
VIII	Wet zone freshwater bodies	Streams, rivers, and other freshwater bodies
IX	Foothills of Adam's Peak and Ambagamuwa	Tropical wet evergreen forests
X	Mid-mountains	Submontane forests (*Shorea-Calophyllum-Syzgium* series)
XI	Kandy and Upper Mahaweli	Tropical wet evergreen forests humid zone dry, pathana grasslands
XII	Knuckles	Tropical submontane forests (*Myristica-Cullenia-Aglaia-Litsea* community) Tropical montane forests (*Calophyllum* zone)
XIII	Central Mountains, Ramboda, Nuwara-Eliya	Tropical montane forests (*Calophyllum-Walkeri-Syzgium* community, wet pathana grasslands)
XIV	Adam's Peak	Tropical montane forests Tropical submontane evergreen forests
XV	Horton Plains	Tropical montane forests upper wet pathana grasslands

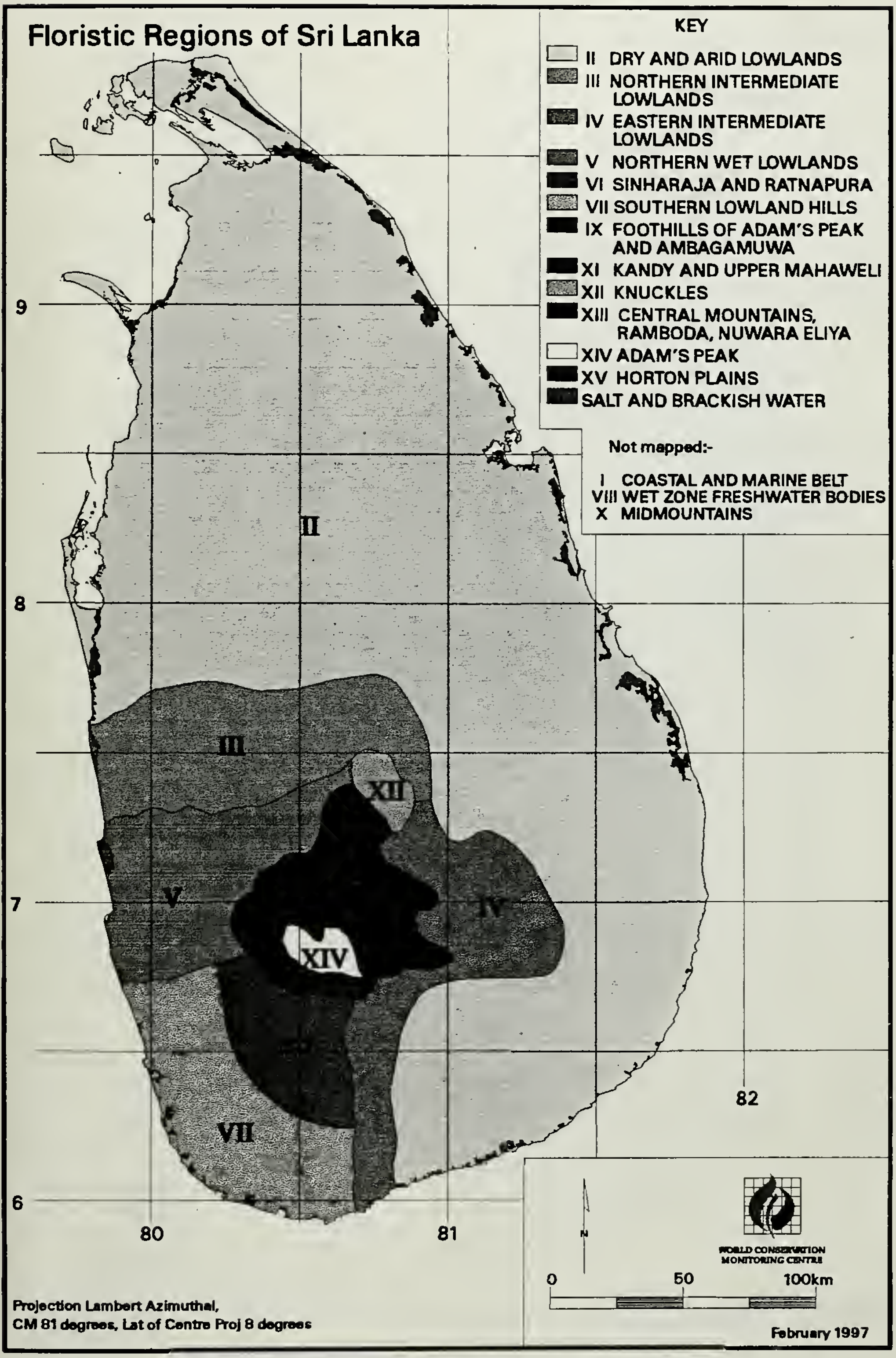

Figure 4.4 Floristic regions of Sri Lanka (Source: Ashton and Gunatilleke, 1987)

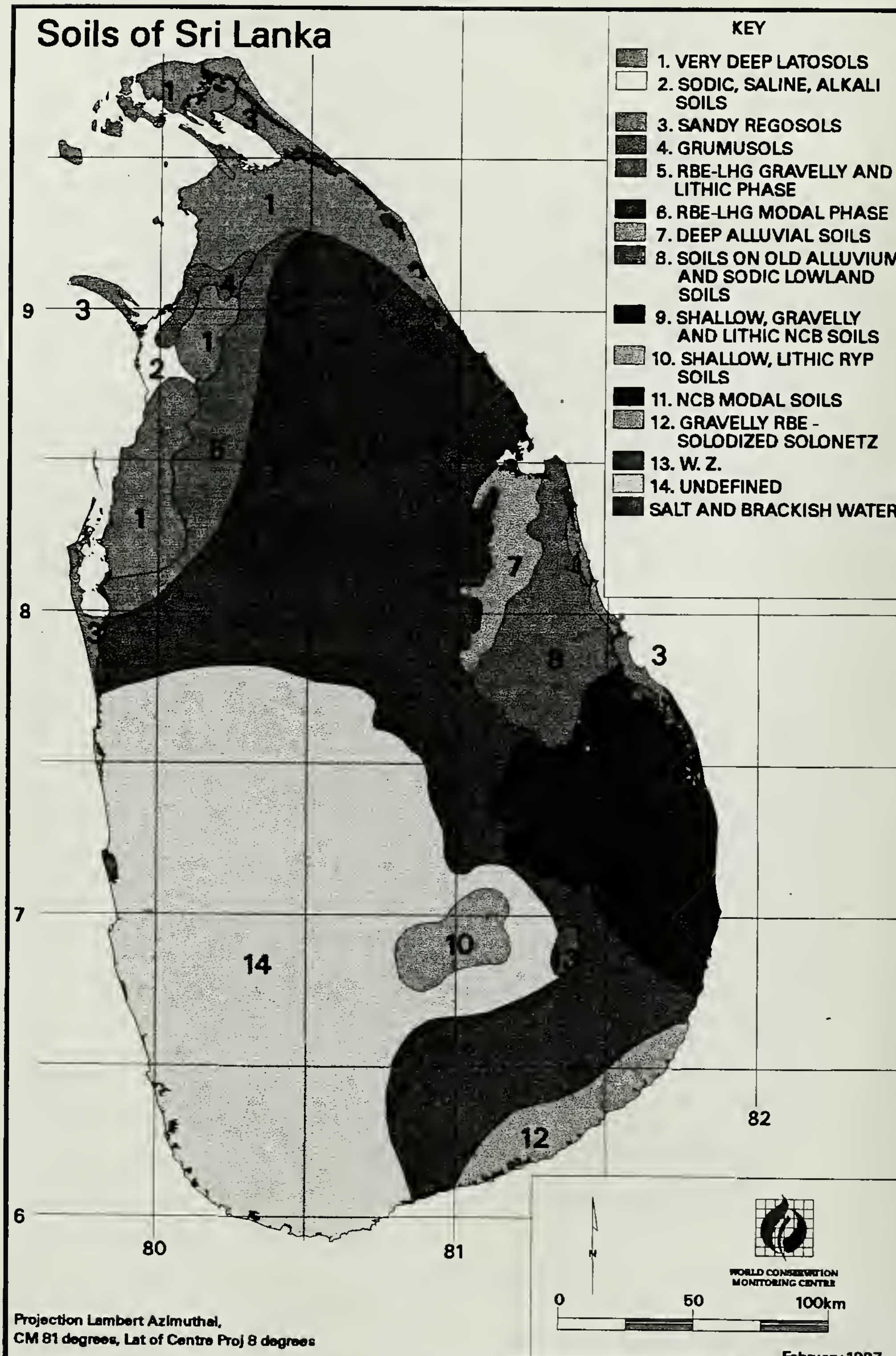

Figure 4.5 Soil-edaphic units of Sri Lanka (Source: Survey Department)

Table 4.3 Soil edaphic units of the dry and intermediate zones of Sri Lanka

Unit no.	Soil type (Agro-ecological region)	Characteristic vegetation
1	Very deep latosols (DL3)	Dry and very dry fasciation - dry mixed evergreen forest
2	Sodic, saline, alkali soils (DL4)	tropical thorn forest
3	Sandy regosols (DL3, DL4, DL2)	sparse, stunted - dry mixed evergreen forest
4	Grumusols - black clayey sticky soils (DL3, DL4)	severely stunted - dry mixed evergreen forest and thorn scrub
5	Reddish brown earths - low humic gley soils, gravelly and lithic phase (DL3)	Dry and very dry fasciation of dry mixed evergreen forest
6	Reddish brown earths - low humic gley soils, modal phase (DL1)	Dry and moist fasciation of dry mixed evergreen forest
7	Deep alluvial soils (DL1, DL2)	Riparian, riverine forest and villu grassland
8	Soils and old alluvium and sodic lowland soils (DL2)	Damana parkland, grassland and stunted - dry mixed evergreen forest
9	Shallow, gravely and lithic reddish brown earths (IL2)	Savannah forest - grassland
10	Shallow, lithic reddish yellow podsols (IU3)	Dry patana grassland
11	Non-calcic brown soils, modal phase (DL2)	Dry and moist fasciation - dry mixed evergreen forest
12	Gravelly reddish brown earths - solodized solonetz (DL5)	Very dry fasciation - dry mixed evergreen forest

4.5 ENVIRONMENT INFORMATION MANAGEMENT SYSTEM

All field data were entered into the Environmental Information Management System (EIMS). This database management system was developed specifically for the Environmental Management in Forestry Development Project using dBase software. It is fully documented elsewhere (Hughell, 1993).

It was subsequently necessary to upgrade the software to Microsoft FoxPro (Version 2.6 for Windows) in order to be able to accommodate large datasets and analyse them relatively quickly. Following the upgrade in 1996, computing time for some of the iterative procedures described in Section 4.3.5, for example, was reduced from about 6 hours to 30 minutes.

The NCR component of EIMS comprises the following database files:

- ***Ca.dbf*** which holds records of all nationally designated conservation areas, as well as OSFs included in the NCR.
- ***CrPlot.dbf*** which holds records of all plots inventoried in the NCR.
- ***PltSp.dbf*** which holds taxonomic records of woody plant species included in the NCR.
- ***AniSp.dbf*** which holds taxonomic records of animal species included in the NCR.

- ***PltDat.dbf*** which holds records of all woody plant species recorded within each plot surveyed in the NCR.
- ***AniSp.dbf*** which holds records of all animal species recorded within each plot surveyed in the NCR.

An indication of the size of some of these databases is provided in Section 6.1.3 (Table 6.1).

Field data were first checked, using programmed routines, and then subjected to two types of analysis. The first produced a summary of biodiversity within each forest and the second defined a minimum set of forests in which all species were represented, based on iterative procedures described in Section 4.3.5.

4.6 CONSTRAINTS

The biodiversity component of the NCR represents an extremely important first attempt to define an optimum system of conservation forests based largely on an assessment of the status and distribution of Sri Lanka's flora and fauna. However, it is very much a preliminary attempt based on rapid survey techniques. It will be necessary to refine this optimum system as further resources become available to improve the information base and as tools are developed to undertake more sophisticated analyses. Some of the major constraints to be addressed in the longer term are identified below.

4.6.1 Sampling floral diversity

In practice, it was not always possible to comprehensively inventory the woody plant flora within the available time, particularly in the case of the smaller forests in the wet zone where diversity was highest. It was necessary, therefore, to distinguish between *adequately* and *inadequately* surveyed forests throughout the analyses. This distinction was made on the basis of the procedure described in Section 4.3.3.

4.6.2 Sampling faunal diversity

It was not possible to comprehensively inventory the selected faunal groups within each plot. This would have required much more time to repeat surveys at different times of the day and in different seasons, as well as trap the more cryptic species, all of which was beyond the resources available to the NCR. By contrast, it was possible to record and, in most cases, identify all woody plants within a plot, the main challenge being to survey sufficient plots to adequately sample a forest, as discussed in the next section.

Consequently, in the first instance, forests important for biodiversity were identified on the basis of their complement of woody plant species. Less emphasis was given to the faunal inventories due to their incompleteness, although the results of faunal surveys were used to supplement those of the floral surveys.

For purposes of this study, it is assumed that plant and animal diversity are closely related: forests rich in woody plant species are also rich in animal species. This is shown in Figure 4.6 using inventory data for forests considered to have been *adequately* surveyed, as defined in Section 4.3.3. Despite the incompleteness of the faunal data, which is assumed to apply in a consistent manner to all forests surveyed, the relationship between plant and animal diversity is close, particularly for endemics as shown in this example (Figure 4.6). On the basis of the analytical procedures used to identify optimum systems of conservation forests, as described in Section 4.3.5, this means that forests rich in animal species can expect to have been included, but the full range of animal species diversity may not necessarily be represented.

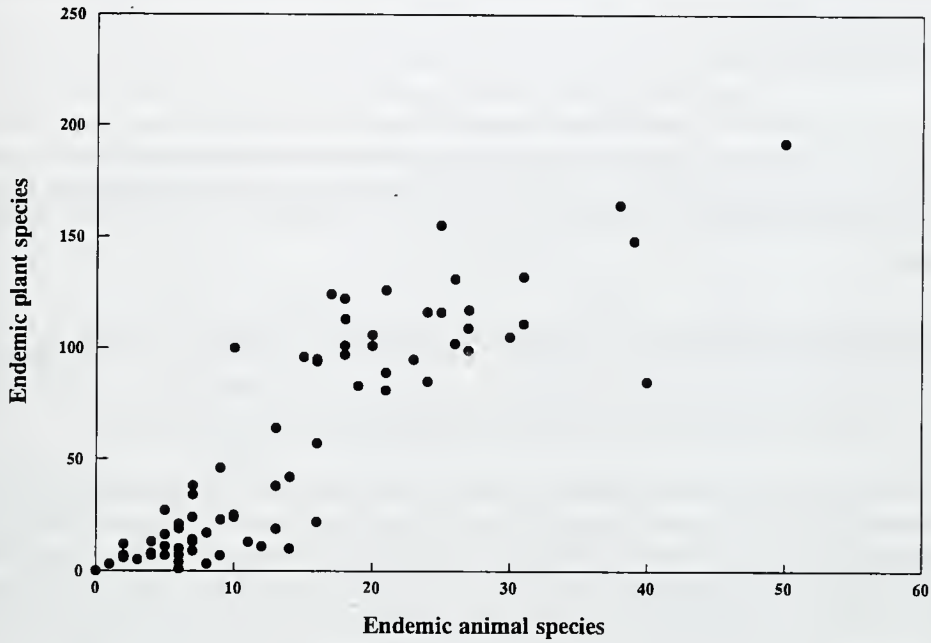

Figure 4.6 Relationship between endemic plant and animal species diversity in natural forests. Each data point represents a forest *adequately* surveyed during the NCR.

4.6.3 Taxonomic distinctness and genetic diversity

The number of species is not an adequate measure of biodiversity because speciation is not necessarily correlated with ecological differentiation (Bond, 1989). Thus, the species in a genus or higher taxonomic unit may be ecologically monotonous. In contrast to large genera with many ecologically similar species is the case in which extraordinary variability is found within a single species, perhaps necessitating conservation of individual populations throughout its entire range. In order to prioritise the selection of protected areas systems for biodiversity conservation, taxonomic distinctness should be considered in addition to species richness and complementarity (Vane-Wright *et al.*, 1991a).

Species richness (number of species) and complementarity (i.e. relative contributions of individual biotas to the network) are incorporated in the existing conservation evaluation procedure (Section 4.1.3). Thus, the ideal first choice is the site with the most species (or rare species); subsequent sites are selected on the basis of their representation of the residual complement. However, this model does not take into account taxonomic distinctness, the difference between species in relation to their place in the natural hierarchy. This can be evaluated by root weighting, whereby species are weighted for distinctness according to their position in the taxonomic hierarchy (Vane-Wright *et al.*, 1991b). Software systems are being developed to enable taxic diversity measures to be combined with complementarity for a range of different organisms, but they were not available during the life of this project.

Chapter 5

RESULTS - SOIL AND WATER CONSERVATION ASSESSMENT

5.1 INTRODUCTION

A total of 281 legally designated forests and other state forests (OSFs) were assessed with respect to their importance for soil and water conservation using the methodology described in Chapter 3. Natural forests were identified from the *New 1:500,000 Scale Forest Map of Sri Lanka* (Legg and Jewell, 1992), as described in Section 4.2 for the biodiversity assessment.

The assessment was principally a desk exercise, with some checking in the field to validate the results. In practice, this meant that rather more forests were evaluated for their soil and water conservation than for their biodiversity importance. Biodiversity surveys took much longer; moreover, some forests could not be surveyed due to LTTE activities.

A full report of the soil and water conservation assessment is provided elsewhere (Gunawardena, 1995). The main findings from the study are presented in this chapter, and they are integrated with the results of the biodiversity assessment in Chapter 7. The results of the assessment of importance of forest for protection of headwaters are presented in this chapter, but they were not used in the final identification of forests important for soil and water conservation for reasons given in Section 3.6.3. It should also be noted that, for the same reasons, the results of the final ranking procedure described in Section 3.6.2 are not included in this chapter, but they are presented in the full report by Gunawardena (1995).

5.2 SOIL EROSION

The results of the soil erosion assessment are given in Annex 2, each forest being ranked in order of its importance for soil protection. Two forests, Kalubowitiyana OSF and Habarakada Proposed Reserve, exceed a soil erosion potential of 2000 t ha^{-1} yr^{-1}. Both are very small forests, with rock outcrops covered by natural forest and steep slopes on all sides. Landslides were evident during the field visits, mainly due to the high rainfall, shallow soils and steep slopes. Three other forests have soil erosion values in excess of 1500 t ha^{-1} yr^{-1}, namely Auwegalakanda OSF, Peak Wilderness Sanctuary and Messana Proposed Reserve. They all occur in high rainfall areas and feature steep terrain.

The results are summarised according to climatic zone and district in Table 5.1. They show that very few forests are important for soil conservation in the dry zone. Exceptions, which exceed the conservation threshold value of 300 t ha^{-1} yr^{-1}, are:

- Anuradhapura District — Ritigala SNR
- Hambantota District — Rammalakanda FR
- Monaragala District — Dummalahela OSF, Monerakelle OSF, Velihela OSF, Wadinahela OSF
- Polonnaruwa District — Gunner's Quoin OSF

Although rainfall is relatively low (<2000 mm), erosion is potentially high due to the steep terrain.

As shown in Table 5.1, Kegalle, in particular, and also Badulla, Galle and Ratnapura districts have the highest percentage of forests with soil erosion values exceeding the threshold of 300 t ha^{-1} yr^{-1} . Forests in these districts have steep slopes and, in general, are located on south-western aspects which experience the full impact of the south-west monsoon. In Kalutara District, forests tend to lie in the coastal plain where the landscape is less precipitous. Some of the forests in Kandy District, such as Victoria-Randenigala-Rantambe Sanctuary, are situated in the rain shadow of the south-west monsoon, hence their lower potential for soil erosion. Nuwara Eliya District has a relatively low percentage of forests above the threshold, primarily due to lower rainfall and less steep slopes.

Table 5.1 Soil erosion values of forests summarised by climatic zone and district. Values above the threshold of 300 t ha^{-1} yr^{-1} are shaded.

Climatic Zone District	**Total no. forests**	**Soil erosion (t ha^{-1} yr^{-1})**						**% forests >300**
		>1500	**1500-1000**	**1000-500**	**500-300**	**300-100**	**<100**	
Dry Zone								
Anuradhapura	24	0	0	0	1	3	20	4.2
Hambantota	10	0	0	0	1	2	7	10.0
Monaragala	36	0	0	0	4	15	17	11.1
Polonnaruwa	15	0	0	0	1	0	14	6.6
Puttalam	7	0	0	0	0	0	7	0.0
Subtotal	92	0	0	0	7	20	65	7.6
Wet and Intermediate Zones								
Badulla	12	0	0	3	6	2	1	75.0
Colombo	4	0	0	0	2	2	0	50.0
Galle	20	2	3	4	6	4	1	75.0
Gampaha	1	0	0	0	0	1	0	0.0
Kalutara	12	0	1	2	4	5	0	58.0
Kandy	12	0	0	4	2	5	1	50.0
Kegalle	8	1	2	4	1	0	0	100.0
Kurunegala	17	0	0	3	5	3	6	47.0
Matale	19	0	0	4	4	8	3	42.0
Matara	17	1	2	3	3	3	5	52.9
Nuwara Eliya	13	0	0	1	4	7	1	38.5
Ratnapura	54	1	4	24	15	8	2	81.5
Subtotal	189	5	12	52	52	48	20	64.0
Total	**281**	**5**	**12**	**52**	**59**	**68**	**85**	**45.6**

5.3 HEADWATERS PROTECTION

The results of the headwaters protection assessment are given in Annex 3, each forest being ranked in order of its importance. Forests in the mid- and up-country districts rank high in importance.

As summarised in Table 5.2, nine of the 13 forests in Nuwara Eliya District fall within the 25 most important forests. All forests in Nuwara Eliya, Kandy and Badulla districts, with single exceptions in Badulla and Kandy, lie within the 100 most important forests. These results clearly demonstrate that forests in the south-central massif, from where all of the major rivers originate, are important for protecting the headwaters of these rivers.

Table 5.2 Headwaters protection ranks of forests summarised by climatic zone and district

Climatic Zone District	Total no. forests	Headwaters rank									
		1-25	26-50	51-75	76-100	101-125	126-150	151-175	176-200	201-225	226-251
Dry Zone											
Anuradhapura	24	3		2	1	1	3	1	3	1	9
Hambantota	10		1		1	1					7
Monaragala	36		5	2	1	6	2	2	5	2	11
Polonnaruwa	15	1	1		2	3		1			6
Puttalam	7					1			1	1	4
Subtotal	92	4	7	4	5	12	5	4	9	4	37
Wet and Intermediate Zones											
Badulla	12	3	2	3	3			1			
Colombo	4						1	1	1	1	
Galle	20	2	4	2	3		2	1	2	2	2
Gampaha	1										1
Kalutara	12			1	1		2	2	2	2	2
Kandy	12	2	4	4	1		1				
Kegalle	8	1			3		1	2	1		
Kurunegala	17			2	4	1	1	3	1	1	4
Matale	19	2	4	3		3	2	3			2
Matara	17	1				3	1	1	1	2	8
Nuwara Eliya	13	9	2	1	1						
Ratnapura	54	1	2	5	4	7	8	7	8	12	
Subtotal	189	21	18	21	20	14	19	21	16	20	19
Total	**281**	**25**	**25**	**25**	**25**	**26**	**24**	**25**	**25**	**24**	**56**

In the other districts of the wet and intermediate zones, importance for headwaters protection is much more variable, depending on the individual forest. For example, in Matara District, Diyadawa Forest Reserve is 18th most important for headwaters protection, while Kekanadura is tied last in rank (Annex 3). The former encompasses the headwaters of the Nilwala and Gin Ganga. In contrast, Kekanadura lies close to the coast and no rivers originate from it. Forests in Kalutara District rank fairly low in importance. Although the mean annual discharge from the Kalu Ganga is the second highest in the country, its headwaters lie outside Kalutara in the adjacent districts of Kegalle and Ratnapura.

It should be noted that three forests in Anuradapura District are among the top 10 most important for headwaters protection. They are Kahalla-Pallekele Sanctuary, which protects the headwaters of the Deduru Oya, Mi Oya and Kala Oya, and Hurulu Forest Reserve and Anaolundewa Proposed Reserve, within which lie part of the headwaters of the Mahaweli Ganga and Yan Oya. Forests in the north-west coastal districts of Gampaha and Puttalam are among the lower ranks for protection of headwaters.

5.4 FLOOD HAZARD

The results of the flood hazard assessment are given in Annex 4, each forest being ranked in order of its importance for flood control. Peak Wilderness Sanctuary, Knuckles Conservation Forest and Sinharaja National Heritage Wilderness Area have a mean annual flood well in excess of 200 $m^3 s^{-1}$, due mainly to the high rainfall and their large area.

The distribution of mean annual flood values is shown by climatic zone for each district in Table 5.3. The pattern is similar to that for soil erosion (Table 5.1), reflecting to some extent the fact that mean annual rainfall is a variable common to both indices. Also, slope and stream frequency, which were used in estimating soil erosion and mean annual flood, respectively, are related: both the number of streams and stream junctions tends to be higher in steeper terrain. However, the influence of forest area over all of these variables is predominant, as shown for example by the high mean flood values for Wasgomuwa, Gal Oya Valley and Uda Walawe national parks (Annex 4).

5.5 FOG INTERCEPTION

Estimates of the total volume of water intercepted from fog are shown in Table 5.4 for forests above 1,500 m above sea level. Rainfall and altitude provide the basis for estimating the annual contribution from fog, which is converted to a volumetric value by multiplying by the area of the forest (Section 3.5).

Peak Wilderness Sanctuary intercepts by far the most fog (Table 5.4). Although its altitude is lower than many other forests in Nuwara Eliya District, rainfall is high and the forest is very extensive. Together, with Knuckles Conservation Forest and Pedro Proposed Reserve, which rank second and third, respectively, these three forests lie in the headwaters of the island's major rivers.

Table 5.3 Mean annual flood values of forests summarised by climatic zone and district. Forests with flood values above the threshold of 10 $m^3 s^{-1}$ are shaded.

Climatic Zone District	Total no. forests	Mean annual flood ($m^3 s^{-1}$)							% forests >10
		>100	100-50	50-25	25-10	10-5	1-5	<1	
Dry Zone									
Anuradhapura	24	0	1	2	1	2	7	11	16.7
Hambantota	10	0	0	1	1	2	1	5	20.0
Monaragala	36	0	1	4	3	12	9	7	22.2
Polonnaruwa	15	0	1	1	3	2	4	4	33.3
Puttalam	7	0	0	0	2	1	2	2	28.6
Subtotal	92	0	3	8	10	19	23	29	22.8
Wet and Intermediate Zones									
Badulla	12	0	0	4	2	2	4	0	50.0
Colombo	4	0	1	1	0	2	0	0	50.0
Galle	20	2	3	4	7	2	2	0	80.0
Gampaha	1	0	0	0	0	0	1	0	0.0
Kalutara	12	1	3	2	3	1	2	0	75.0
Kandy	12	2	1	1	2	3	3	0	50.0
Kegalle	8	1	0	3	2	2	0	0	75.0
Kurunegala	17	0	0	0	2	4	7	4	11.8
Matale	19	0	0	2	3	5	7	2	26.3
Matara	17	0	2	1	3	4	4	3	35.3
Nuwara Eliya	13	1	3	3	2	4	0	0	69.2
Ratnapura	54	1	4	9	15	12	13	0	53.7
Subtotal	189	8	17	30	41	41	43	9	50.8
Total	**281**	**8**	**20**	**38**	**51**	**60**	**66**	**38**	**41.6**

One of the positive hydrological benefits of forests in the cloud base is their additional contribution of water intercepted from wind-driven fog, as shown by ongoing studies at Horton Plains (Section 3.5.1). In the final selection of forests for soil and water conservation (Section 5.6), this single factor of fog interception is considered to be sufficiently important to justify protection of all 20 natural forests that lie above the cloud base.

Table 5.4 Depth and volume of fog intercepted by forests above 1,500 m

EMD No.	Forest name, designation	Area (km^2)	Fog interception		Fog rank
			Depth (mm)	Volume (m^3)*1000	
361	Peak Wilderness S	280.45	858	240,581	1
522	Knuckles OSF (CF)	300.00	281	84,277	2
362	Pedro PR	67.57	1,119	75,611	3
1	Agra-Bopats PR	69.34	975	67,591	4
197	Kikilimana FR	45.81	1,127	51,629	5
40	Bogawantalawa PR	42.90	1,111	47,665	6
140	Horton Plains NP	31.60	1,426	45,075	7
172	Kandapola Sita Eliya FR	26.16	915	23,924	8
327	Ohiya PR	17.69	944	16,706	9
248	Mahakudagala PR	16.39	957	15,678	10
358	Pattipola-Ambawela PR	14.80	1,045	15,470	11
123	Hakgala SNR	11.42	962	10,982	12
52	Conical Hill PR	7.08	1,045	7,399	13
270	Meepilimana FR	7.72	929	7,169	14
468	Welegama PR	6.39	955	6,105	15
307	Nanu Oya PR	4.16	1,093	4,547	16
128	Harasbedda PR	3.64	930	3,384	17
383	Ragala FR	2.68	1,022	2,738	18
306	Namunukula PR	2.79	761	2,123	19
426	Tangamalai S	1.32	756	998	20

Note: Fog interception is negligible for all other forests located below 1,500 m.

5.6 CONSERVATION PRIORITIES

5.6.1 Individual Forests

A total of 85 forests, listed in Table 5.5, were identified as highest importance for conservation on the basis of their value for soil protection and flood control, or fog interception. Of this total, 75 forests exceed the thresholds of both 300 t ha^{-1} yr^{-1} for soil erosion and 10 m^3 s^{-1} for mean annual flood. There are an additional 10 forests important for

Table 5.5 List of forests of highest importance for soil and water conservation, based on their importance for soil protection (S), flood control (F) and fog interception (I)

EMD No.	Forest name, designation	S	F	I	EMD No.	Forest name, designation	S	F	I
1	Agra-Bopats PR	*	*	*	522	Knuckles OSF(CF)	*	*	*
549	Alutwelawisahena PR	*	*		205	Kobahadunkanda PR	*	*	
7	Amanawala-Ampane PR	*	*		217	Kudumiriya PR	*	*	
528	Asantanakanda OSF	*	*		222	Labugama-Kalatuwana FR	*	*	
509	Auwegalakanda OSF	*	*		241	Magurugoda FR	*	*	
19	Ayagama PR	*	*		248	Mahakudagala PR		*	*
28	Bambarabotuwa FR (CF)	*	*		253	Malambure FR	*	*	
511	Bambarawana OSF	*	*		270	Meepilimana FR			*
38	Beraliya (Kudagala) PR	*	*		274	Messana PR(CF)	*	*	
40	Bogawantalawa PR	*	*	*	288	Morahela FR(CF)	*	*	
552	Butawella OSF	*	*		289	Morapitiya-Runakanda	*	*	
52	Conical Hill PR		*	*	293	Mulatiyana FR	*	*	
57	Dambuluwana FR	*	*		303	Nakiyadeniya PR(CF)	*	*	
65	Dediyagala FR	*	*		306	Namunukula PR	*		*
515	Dedugalla-Nangala OSF	*	*		307	Nanu Oya PR			*
68	Delgoda PR	*	*		327	Ohiya PR	*	*	*
69	Dellawa PR(CF)	*	*		561	Opalagala OSF	*	*	
71	Delwela PR(CF)	*	*		343	Panilkanda FR	*	*	
77	Diyadawa FR(CF)	*	*		547	Paragala OSF	*	*	
529	Dotalugala PR	*	*		358	Pattipola-Ambawela PR		*	*
100	Galaha PR	*	*		361	Peak Wilderness S	*	*	*
571	Gederagalpatana OSF	*	*		362	Pedro PR	*	*	*
112	Gilimale-Eratne PR(CF)	*	*		383	Ragalla PR			*
546	Gongala OSF(CF)	*	*		386	Rammalakanda PR	*	*	
544	Gorangala OSF	*	*		388	Rammalekanda FR(CF)	*	*	
120	Habarakada PR	*	*		392	Ravana Ella S	*	*	
123	Hakgala SNR	*	*	*	394	Rilagala PR	*	*	
545	Handapan Ella OSF(CF)	*	*		514	Sembawatte OSF	*	*	
128	Harasbedda PR			*	499	Silverkanda OSF(CF)	*	*	
129	Haycock FR(CF)	*	*		414	Sinharaja NHWA	*	*	
507	Homadola OSF	*	*		426	Tangamalai S	*		*
138	Horagala-Paragala OSF	*	*		328	Tawalama PR	*	*	
140	Horton Plains NP		*	*	432	Tibbutukanda PR	*	*	
146	Indikada Mukalana PR	*	*		506	Tiboruwakota OSF(CF)	*	*	
541	Kabarakalapatana OSF	*	*		551	Usgala OSF	*	*	
497	Kalubowitiyana OSF(CF)	*	*		512	Vellihallure OSF	*	*	
166	Kalugala PR(CF)	*	*		455	Walankanda FR	*	*	
172	Kandapola Sita Eliya FR	*	*	*	456	Walawe Basin FR	*	*	
175	Kanneliya FR(CF)	*	*		459	Waratalgoda PR	*	*	
184	Karawita PR	*	*		468	Welegama PR	*	*	*
191	Kelani Valley FR	*	*		476	Wewelkandura PR	*	*	
192	Kelani Valley PR	*	*		489	Yakdessakanda PR	*	*	
197	Kikilimana PR	*	*	*					

S = Soil erosion >300 t ha^{-1} yr^{-1}; F = Mean annual flood >10 m^3 s^{-1}; I = Fog interception (altitude > 1,500 m) fog interception, which do not meet both soil erosion and flood control thresholds. It is worth noting that all three criteria are met by ten forests, namely:

- Agra-Bopats Proposed Reserve
- Bogawantalawa Proposed Reserve
- Hakgala Strict Natural Reserve
- Kandapola Sita Eliya Forest Reserve
- Kikilimana Proposed Reserve
- Knuckles Conservation Forest
- Ohiya Proposed Reserve
- Peak Wilderness Sanctuary
- Pedro Proposed Reserve
- Welegama Proposed Reserve

The distribution of these forests of highest importance with respect to the island's river basin systems is summarised in Table 5.6. As expected, most of these forests lie within the Kalu Ganga river basin which receives the highest amount of rainfall and has the highest runoff/rainfall ratio. Rivers originating from the dry and intermediate zones have fewest of these forests.

The extent of forests of highest importance for conservation is summarised by climatic zone and district in Table 5.7. Only one forest in any of the dry zone districts is identified as a top conservation priority, namely Rammalakanda Forest Reserve in Hambantota District. In fact, most of this forest lies in the adjacent Matara District and all of it falls within the 2500 mm isohyet that demarcates the wet zone.

Of the 281 forests surveyed for the NCR, all in Nuwara Eliya District and most in Kegalle District are identified as highest importance for soil and water conservation (Table 5.7). The findings from this study, that forests in these two districts are the most important for soil and water conservation, is supported by other data which show that 50% of landslides reported between 1930 and 1985 occurred in these two districts.

Other wet zone districts (i.e. Colombo, Galle, Kalutara, Matara and Ratnapura) are also important for soil and water conservation. Reference to column eight of Table 5.7 shows that the extent of top priority forests in these wet zone districts comprises almost 60% or more of the total area of forests surveyed for the NCR. It should be noted, however, that the extent of surveyed forests (column 5) does not necessarily equate to the total area of closed canopy forests (column 3). This is because the surveyed forests include tracts that are sparsely covered or even deforested. Thus, the total area of highest importance forests is not an accurate reflection of the extent of closed canopy forests within them.

The extent of forests of highest importance for soil and water conservation represents 4.3% of the total area of the districts in which they are located, or 3.0% of the country. Overall, this is a small percentage, but it is significant for some districts and represents 15-20% for Galle, Kandy, Kegalle and Nuwara Eliya (Table 5.7).

As shown in Table 5.5, many of these 85 forests of highest importance essentially have no legal conservation status. A total of six are *protected areas*, in so far as they have been designated under the Fauna and Flora Protection Ordinance or, as in the case of Sinharaja, the National Heritage Wilderness Areas Act. Of the 55 forest and proposed reserves, 20 have been declared as conservation forests. However, conservation forests do not yet have any legal basis. The remaining 24 forests are classified as other state forest, for which there are no conservation provisions.

Table 5.6 Distribution of forests of highest importance for soil and water conservation with respect to river basins

River basin	Number of forests	River basin	Number of forests
Kalu Ganga	31	Bentota Ganga	2
Mahaweli Ganga	22	Deduru Oya	2
Gin Ganga	16	Kirindi Oya	1
Kelani Ganga	12	Menik Ganga	1
Nilwala Ganga	11	Kirama Oya	1
Walawe Ganga	8	Kala Oya	1

Table 5.7 Extent of forests of highest importance for soil and water conservation

Climatic Zone District	District (ha)[1]	Closed canopy forest (ha)[1]	Surveyed forests		Highest importance forests for soil and water conservation			
			No.	Area (ha)	No.	Total area (ha)	% surveyed forest	% district area
Dry Zone								
Anuradhapura	722,178	180,083	24	107,258	0	0	0.0	0.0
Hambantota	262,307	24,377	10	41,851	1	1,407	3.4	0.5
Monaragala	576,763	182,601	36	189,318	0	0	0.0	0.0
Polonnaruwa	344,988	115,881	15	85,211	0	0	0.0	0.0
Puttalam	315,485	82,529	7	60,703	0	0	0.0	0.0
Wet and Intermediate Zones								
Badulla	285,673	26,428	12	68,184	6	6,034	8.9	2.1
Colombo	68,469	1,832	4	3,284	2	2,898	88.3	4.2
Galle	161,256	19,089	20	36,233	13	31,584	87.2	19.6
Gampaha	141,890	409	1	103	0	0	0.0	0.0
Kalutara	164,391	20,310	12	20,009	4	11,808	59.0	7.2
Kandy	192,808	27,241	12	81,721	4	33,716	41.3	17.5
Kegalle	168,328	15,446	8	32,371	6	31,889	98.5	18.9
Kurunegala	489,787	9,980	17	14,006	2	2,061	14.7	0.4
Matale	206,050	74,809	19	12,732	2	1,850	14.5	0.9
Matara	130,829	19,901	17	12,732	6	8,994	70.6	6.9
Nuwara Eliya	174,109	39,646	13	33,983	13	33,983	100.0	19.5
Ratnapura	327,034	62,357	54	45,644	26	35,335	77.4	10.8
TOTAL	**4,732,344**	**902,918**	**281**	**845,343**	**85**	**201,559**	**23.8**	**4.3**

[1] Source: Legg and Jewell (1995)

Table 5.8 Values of soil erosion, headwaters protection, flood hazard and fog interception for units of contiguous forest

EMD No.	Contiguous forest (individual forest nos.)	Area (ha)	Mean annual rainfall (mm)	Erosion (t ha^{-1} yr^{-1})	Headwaters protection			Mean flood (m^3 s^{-1})	Fog interception (m^3*1000)
					No. streams	No. catchments	Distance (km)		
-640	Getamalagamakanda (640, 641)	1,150	1,306	40.9	6	1	119	3.78	
-573	Puswellagolla (410, 569, 571, 573)	16,924	1,674	151.8	84	3	431	49.30	
-522	Knuckles/Wasgomuwa (79, 82, 335, 460, 461, 522, 560, 561, 562, 563, 564)	73,559	2,365	376.4	768	1	232	392.30	84,277
-487	Yagirala (486, 487, 512)	2,815	4,454	278.5	57	1	25	83.04	
-455	Walankanda (71, 298, 348, 386, 455, 476, 541, 542)	4,255	3,541	650.7	89	1	112	87.76	
-414	Sinharaja (19, 68, 69, 70, 77, 205, 289, 315, 414, 459, 499, 545, 546, 547)	37,218	3,992	516.4	828	4	371	657.30	
-406	Sellakandal (406, 407)	8,808	1,194	0.5	5	1	26	5.99	
-398	Ruhuna/Yala (186, 187, 398, 399, 400, 401, 402, 491)	128,206	1,101	0.4	108	6	91	62.36	
-362	Pedro (100, 248, 362)	8,639	2,464	347.9	452	1	308	156.30	91,289
-343	Panilkanda (343, 501)	811	3,165	766.2	10	1	76	14.32	
-305	Namaneliya (305, 579)	1,041	1,670	120.9	22	2	162	9.87	
-253	Malambure (253, 369)	1,507	3,981	637.5	56	2	99	57.59	
-208	Kombala-Kottawa (173, 208)	1,984	2,656	125.9	21	3	59	22.25	
-175	KDN (65, 175, 234, 303, 328, 505)	13,276	3,771	373.2	437	3	131	313.00	
-161	Kalahalla-Pallekele (161, 336)	37,740	1,600	9.0	52	3	343	52.77	
-144	Inamaluwa (144, 574)	1,860	1,550	9.9	1	1	133	2.24	
-140	Central Highlands (1, 40, 52, 123, 140, 172, 192, 270, 307, 358, 361, 406, 456, 530, 549, 551)	58,038	3,577	965.3	1205	4	704	796.38	476,507
-129	Haycock (120, 129)	572	4,312	1,420.9	21	1	68	30.20	
-96	Gal Oya Valley (96, 97, 98, 99, 606, 607)	67,490	1,677	35.9	329	4	258	156.47	
-39	Bibilehela (39, 608)	9,106	2,114	172.2	71	2	172	50.42	
-28	Bambarabotuwa (28, 274, 288, 528, 529)	7,696	3,867	559.2	112	2	230	135.09	

5.6.2 Contiguous forests

Given the importance of protecting as large expanses of forest as possible for soil and water conservation purposes, particularly where the terrain is not level, adjacent forests were treated as single units of contiguous forest and the data re-analysed. The results of the re-analyses are summarised in Table 5.8 for contiguous forests only, values for other individual forests having already been presented in Annexes 2, 3, 4 and Table 5.4 for soil erosion, headwaters protection, flood hazard and fog interception, respectively.

Table 5.9 List of contiguous forests of highest importance for soil and water conservation, based on their values for soil protection (S), flood control (F) and fog interception (I)

EMD No.	Forest name	S	F	I	EMD No.	Forest name	S	F	I
-140	Central Highlands	*	*	*	-175	KDN	*	*	
506	Tiboruwakota	*	*		7	Amanawala-Ampane	*	*	
197	Kikilimana	*	*	*	544	Gorangala	*	*	
191	Kelani Valley	*	*		388	Rammalekanda	*	*	
-455	Walankanda	*	*		394	Rilagala	*	*	
509	Auwegalakanda	*	*		552	Butawella	*	*	
-28	Bambarabotuwa	*	*		166	Kalugala	*	*	
-414	Sinharaja	*	*		222	Labugama-Kalatuwana	*	*	
-253	Malambure	*	*		-343	Panilkanda	*	*	
497	Kalubowitiyana	*	*		38	Beraliya (Kudagala)	*	*	
306	Namunukula	*		*	293	Mulatiyana	*	*	
514	Sembawatte	*	*		489	Yakdessakanda	*	*	
184	Karawita	*	*		241	Magurugoda	*	*	
112	Gilimale-Eratne	*	*		511	Bambarawana	*	*	
432	Tibbutukanda	*	*		138	Horagala-Paragala	*	*	
327	Ohiya	*	*	*	507	Homadola	*	*	
217	Kudumiriya	*	*		426	Thangamalai	*		*
-129	Haycock	*	*		383	Ragala			*
-522	Knuckles/Wasgomuwa	*	*	*	128	Harasbedda			*
-362	Pedro	*	*	*	57	Dambuluwana	*	*	
515	Dedugalla-Nangala	*	*		146	Indikada Mukalana	*	*	
392	Ravana Ella	*	*						

A total of 43 units of contiguous forests were identified as being of highest importance for conservation on the basis of their importance for soil protection and flood control, or fog interception (Table 5.9). Of this total, 47 forest units exceed the thresholds of 300 t ha^{-1} yr^{-1} for soil erosion and 10 m^3 s^{-1} for mean annual flood. There are an additional 4 forest units

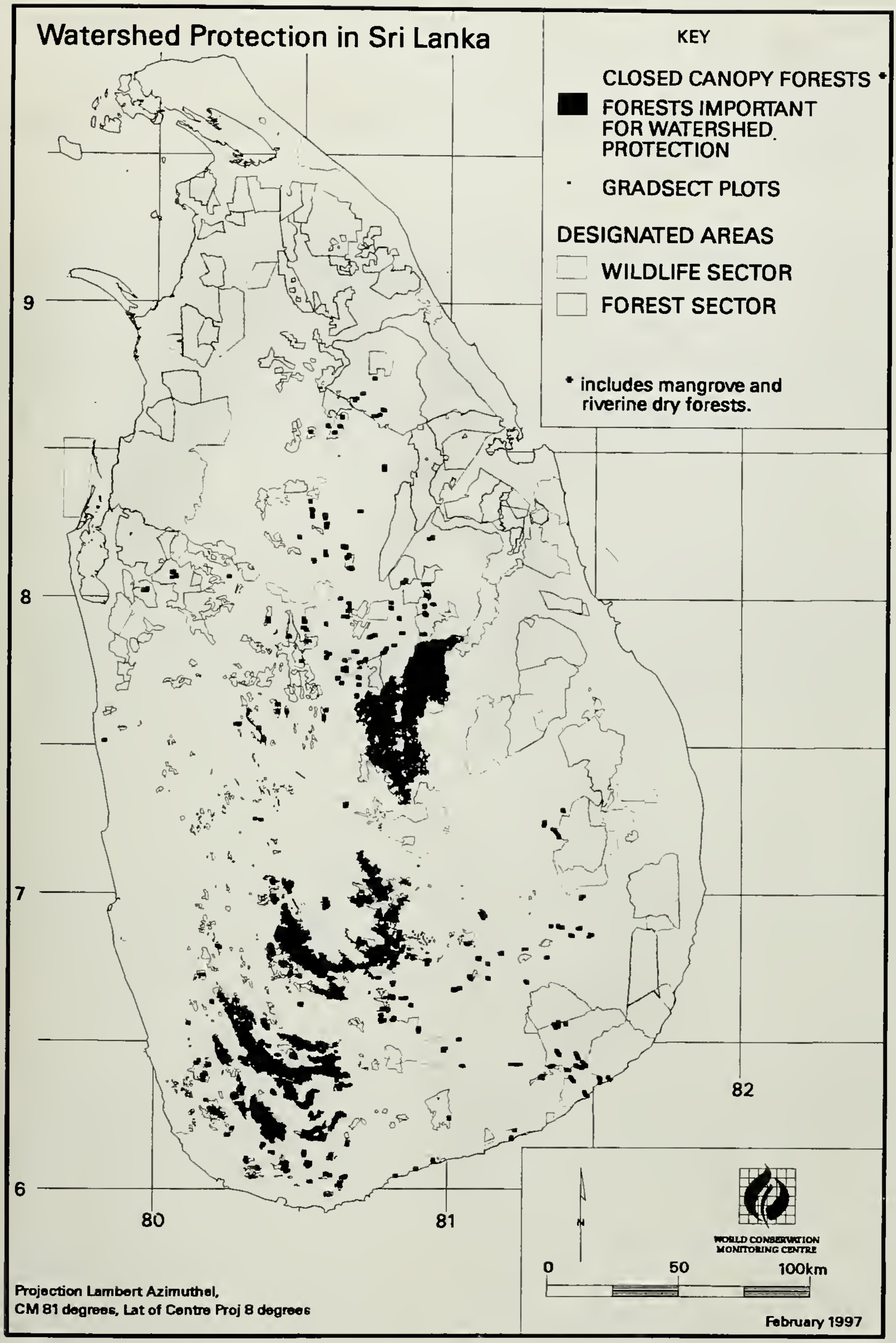

Figure 5.1 Distribution of units of contiguous forest identified as highest importance for watershed protection (i.e. soil and water conservation)

important for fog interception, which do not meet both soil erosion and flood control thresholds. It is worth noting that all three criteria are met by five forest units, namely:

- Central Highlands
- Kikilimana
- Ohiya
- Knuckles/Wasgomuwa
- Pedro

The distribution of these forest units is mapped in Figure 5.1. All of them lie within the wet zone (compare with Figure 2.1), although the Wasgomuwa part of the Knuckles/Wasgomuwa complex extends into the intermediate zone. Wasgomuwa, itself, is ranked 36th for headwaters protection (Annex 3) and it is important for flood control (Annex 4), with a value of 65.72 $m^3 s^{-1} yr^{-1}$ that is well in excess of the 10 $m^3 s^{-1} yr^{-1}$ threshold, but it is not important for soil erosion (Annex 2). The mapped results also clearly demonstrate that very little forest remaining in the wet zone is not important for soil and water conservation.

5.7 CONCLUSIONS AND RECOMMENDATIONS

1. Forests remaining in the wet zone, particularly the more extensive units of contiguous forest, are a top priority for soil and water conservation.

2. All 85 forests of highest importance for soil and water conservation should be upgraded to an appropriate conservation designation. In particular, the status of those which are OSFs will need to be upgraded to at least conservation forest status.

Chapter 6

RESULTS - BIODIVERSITY ASSESSMENT

6.1 INTRODUCTION

In this chapter the importance of forests for biodiversity is assessed in terms of species and ecosystem diversity. Remaining natural forests having a high wilderness value are also identified.

Optimum networks of forests for species conservation are identified. Moreover, the extent to which forest species diversity is represented within the current protected areas system is examined in order to identify additional species conservation requirements. The sizes of the datasets used for the analyses of species diversity are considered in the following subsections.

6.1.1 Forests

A total of 204 legally designated forests and other state forests (OSFs) were surveyed for woody plants and selected animal groups, of which only 81 (40%) were adequately inventoried according to the criteria described in Section 4.3.3. In the case of the remaining 123 sites (60%), the number of new species recorded in the penultimate or last plot exceeded the 5% threshold. The 204 surveyed forests are listed in Annex 5, together with an indication of whether or not they were adequately surveyed. These forests comprised a total of 138 units of contiguous forest, details of which are also given in Annex 5.

6.1.2 Gradsects and plots

A total of 1,725 plots were inventoried along 310 gradsects within the 204 designated forests. The distribution of these plots is shown superimposed on the new 1:50,000-scale forest map in Figure 6.1. It should be noted that 44 plots (2.5%) are absent from this map because their geographic coordinates were not recorded in the field.

6.1.3 Flora and fauna

All analyses were restricted to indigenous, forest species. Thus, exotics were excluded from the woody plants dataset, and both exotics and species associated with predominantly non-forest habitats were excluded from the animals dataset. The distribution of indigenous woody plant and animal species with respect to individual surveyed forests is summarised in Volume 2 of this report, together with their endemic status, as appropriate.

Species recorded opportunistically outside plots were excluded from all analyses. In the case of animals, this amounted to 605 records.

The sizes of the plant and animal datasets, including the number of identified records and species, are given in Table 6.1 according to various criteria. In the case of woody plants, the 76 unidentified records comprise 47 of unknown genera, and 29 of known genera but unknown species. In the case of animals, the 2,287 unidentified records comprise 63 of

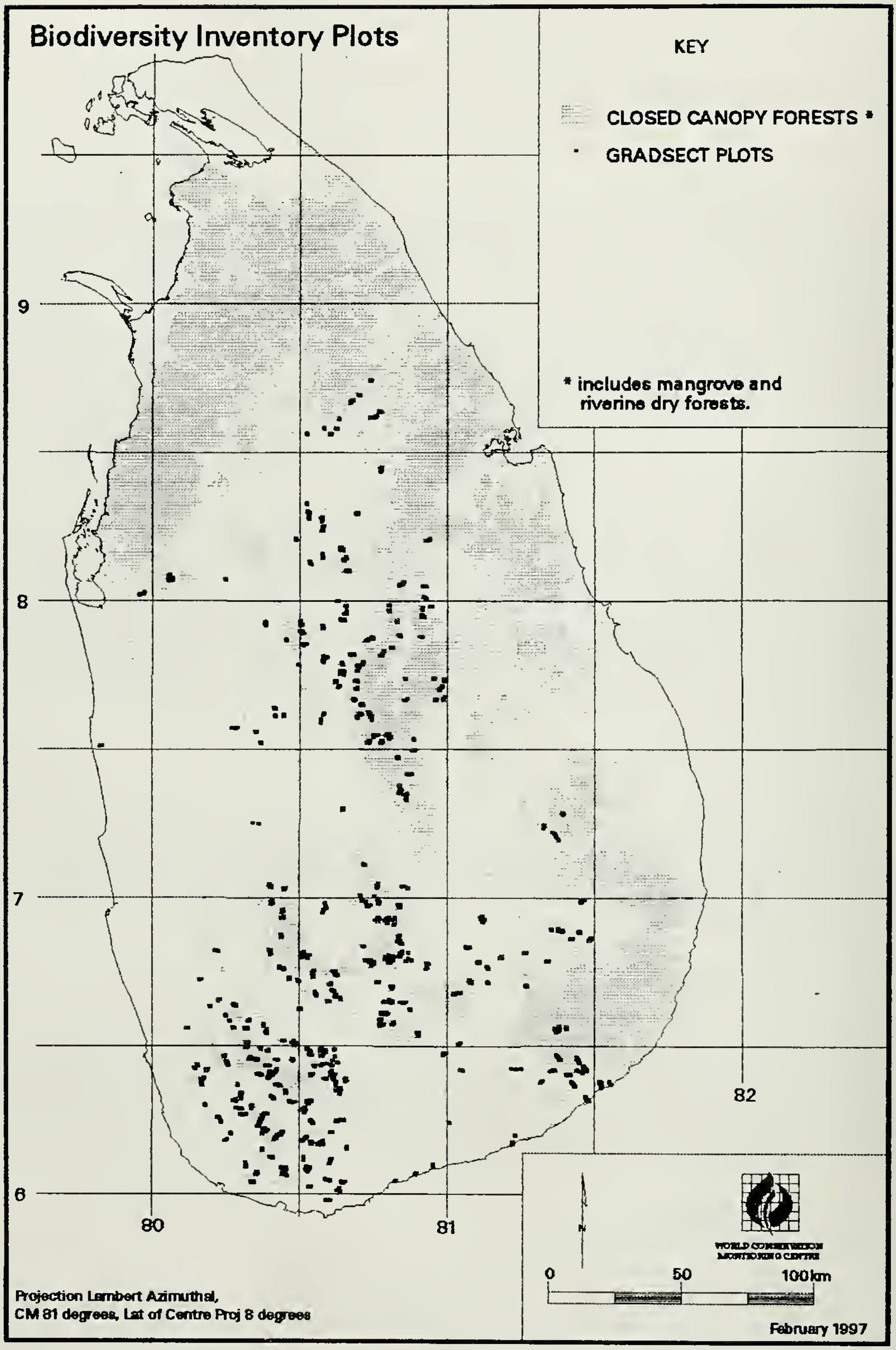

Figure 6.1 Distribution of plots (100 m x 5 m) sampled during the NCR.

unknown genera, and 2,224 of unknown species of known genera. None of these records of unidentified woody plants or animals was used in analyses.

A breakdown of identified and unidentified records of animals by higher taxa shows that molluscs accounted for most (86%) of the 2,287 unidentified records (Table 6.2). Molluscs were the least well identified animal group, with only 48% of records completely identified. Eleven percent of reptile and 8% of amphibian records were not fully identified. At the generic level, however, the level of identification was very high (99.8% of all animal records), with a total of only 63 records unidentified.

Table 6.1 Sizes of plant and animal datasets derived from the NCR. Records used in the analyses are emboldened. **.dbf* refers to the name of the database file within EIMS.

Datasets	Plants *PltDat.dbf*	Animals *AniDat.dbf*
No. records identified	70,472	30,498
No. records unidentified	76	2,287
Total no. records	70,548	32,785
No. species identified	1,158	671
No. species unidentified	37	19
Total no. species	1,195	690
No. records of forest species identified	**69,341**	**24,026**
No. records of forest species unidentified	***64**	**+24**
Total no. records of forest species	**69,405**	**24,050**
No. forest species identified	1,120	405
No. forest species unidentified	33	5
Total no. forest species	1,153	410

* The 64 records of indeterminate forest plant species were included in the analyses because they were considered to be different species from those identified.
+ The 24 records of indeterminate forest animal species were included in the analyses because they were considered to be different species from those identified.

Table 6.2 Unidentified animal records classified by higher taxa

Higher taxon	No. records				
	Unknown genus	Unknown species	Unknown total	Known species	Total
Mammals	0	22	22	5,550	5,572
Birds	6	0	6	16,160	16,166
Reptiles	3	196	199	1,677	1,876
Amphibians	2	71	73	829	902
Fishes	0	0	0	206	206
Molluscs	50	1,917	1,967	1,787	3,754
Butterflies	1	18	19	4,289	4,308
Unrecorded	1	-	1	-	1
Total	**63**	**2,224**	**2,287**	**30,498**	**32,785**

Of the 19 unidentified animal species, 17 were molluscs, the others being a bird (swift) and an amphibian. Of the five unidentified forest animal species, all of which were included in the analysis, three are likely to be new species (two species of the reptile *Ceratophora* and a species of the amphibian *Bufo*). The others are species of *Rhacophorus* (amphibian) and *Beddomea* (mollusc).

6.2 SPECIES DIVERSITY

6.2.1 Individual forests

All species

A total of 1,153 species of woody plants and 410 species of animals (vertebrates, molluscs and butterflies) were recorded within the 204 surveyed forests. Species recorded within individual forests are listed in Volume 2 (Annexes 1 and 2, respectively).

The biodiversity within each forest is summarised in Annexes 6 and 7 for woody plants and animals, respectively. In the case of woody plants, 108 forests are required to conserve all 1,153 species. Of the remaining 96 forests which do not contribute any additional species to the network of 108 forests, only N=31 were adequately surveyed. Thus, additional surveys are needed before managing any of the 65 forests for purposes other than conservation, to avoid the possibility of any negative impact on as yet unrecorded elements of their biodiversity. Details of this analysis are given in Volume 2 (Annex 3).

The results of a similar analysis for animal species (Volume 2, Annex 4) show that all 410 species are represented within 72 forests. All but 25 of these forests are included in the minimum network of forests required for woody plant species. In other words, woody plant and animal diversity is represented within a total of 133 of the 204 forests, but this overlooks the fact that some forests were inadequately sampled for woody plants and that the faunal surveys were not comprehensive.

Endemic species

Restriction of the analysis to endemic species shows that 49 forests are necessary for all 455 endemic species of woody plants to be represented (Annex 5, Volume 2) and 35 forests for all 138 endemic animal species (Annex 6, Volume 2). Endemic woody plant and animal diversity is represented within a total of 71 of the 204 forests. There is much less complementarity between minimum forest networks for endemic woody plants and endemic animals than in the case of all species. This is likely to reflect the larger number of endemic animal species found in the dry zone compared with endemic woody plant species.

6.2.2 Contiguous forests

Given the principle that conservation areas should be as large as possible, contiguous forests were grouped and treated as single units for analysis purposes. Of the 138 units of contiguous forest, the largest are:

Wet zone

- **Bambarabotuwa** (outlier just south of Central Highlands)

- **Central Highlands** (stretching from Peak Wilderness in the west to Horton Plains in the east and north to Hakgala)
- **KDN** (comprising Kanneliya, Dediyagala and Nakiyadeniya)
- **Pedro** (north of Nuwara Eliya)
- **Sinharaja** (comprising 13 forests and including Dellawa and Diyadawa to the south and Handapan Ella to the east)

Wet/Intermediate zones
- **Knuckles/Wasgomuwa** (Knuckles Range and adjacent Wasgomuwa)

Intermediate/Dry zones
- **Puswellagolla** (immediately north of Knuckles Range)

Dry zone
- **Ruhuna/Yala** (Ruhuna, Yala and adjacent forests)

All species

Woody plant diversity (1,153 species) is fully represented within 76 of the 138 contiguous forests (Volume 2, Annex 7). Of the balance of 62 forests, 42 were inadequately sampled.

In the case of animals, all 410 species are represented within 48 contiguous forests (Volume 2, Annex 8). All but 14 of these units are included in the minimum system of forests required for all woody plant species. In other words, woody plant and animal diversity is represented within a total of 90 of the 138 contiguous forests.

The distribution of these contiguous forests is shown in Figures 6.2 and 6.3 for woody plants and animals, respectively.

Endemic species

Restriction of the analysis to endemics shows that 36 of the 138 contiguous forests are necessary to conserve all 455 endemic species of woody plants (Volume 2, Annex 9) and 23 units for all 138 endemic animal species (Volume 2, Annex 10). Endemic woody plant and animal diversity is represented within a total of 48 of the 138 contiguous forests (i.e. 12 units in addition to the 25 units having a full complement of endemic woody plants).

The distribution of these contiguous forests is shown in Figures 6.4 and 6.5 for endemic woody plants and endemic animals, respectively.

6.2.3 Optimum networks for species diversity

The results of the analyses in the previous section are summarised in Table 6.3. They indicate the potential cost of conserving biodiversity, in terms of total land area of forest to be conserved, for a range of options. At the very least, priority must be given to conserving the full range of Sri Lanka's endemic forest species, ideally within a system of larger rather than smaller forests in accordance with principles of conservation biology (Section 1.4.2). Thus, a network of 36 contiguous forests for endemic woody plants, complemented by an additional 12 for endemic fauna, should be considered an absolute minimum for conserving Sri Lanka's endemic forest species.

Table 6.3 Minimum sets of individual forests and contiguous forests necessary for 100% representation of forest species

Taxon	No. species	Minimum set of forests			No. unselected forests inadequately surveyed	Reference (Volume 2)
		No.	Area			
			ha	% total		
Individual forests (N = 204)						
Woody plants	1,153	108	not available		65	Annex 3
Woody plants - endemic	455	49	not available		102	Annex 5
Fauna	410	72	not available		all	Annex 4
Fauna - endemic	138	35	not available		all	Annex 6
Contiguous forests (N = 138)						
Woody plants	1,153	76	494,641	7.5	42	Annex 7
Woody plants - endemic	455	36	238,122	3.6	67	Annex 9
Fauna	410	48	463,641	7.0	all	Annex 8
Fauna - endemic	138	23	427,977	6.5	all	Annex 10

Much of the species diversity can be represented within a small set of the larger contiguous forests. For example, the following set of eight units of contiguous forest:

- Bambarabotuwa
- Central Highlands
- Gilimale-Eratne
- KDN
- Knuckles/Wasgomuwa
- Pedro
- Ruhuna/Yala
- Sinharaja

account for:

- at least 79% of woody plant diversity (see Volume 2, Annex 7),
- at least 88% of endemic woody plant diversity (see Volume 2, Annex 9),
- at least 83% of faunal diversity (see Volume 2, Annex 8), and
- at least 85% of endemic faunal diversity (see Volume 2, Annex 10).

Essentially, this set of contiguous forests represents KDN, Sinharaja complex and much of the south-central massif (stretching from the Central Highlands north to Pedro and beyond to the Knuckles Range) in the wet zone, Wasgomuwa in the intermediate zone and Ruhuna/Yala in the south-east dry zone.

6.2.4 Species represented in existing protected forests

Given that any optimum protected areas system will be designed around protected areas that have already been established, it is instructive to examine the extent to which the present system is representative of species diversity. Of the 204 designated forests inventoried, 54 are currently protected, 33 being conservation forests in the forestry subsector (see Table 2.8) and 21 being protected areas in the wildlife subsector. National biosphere reserves are not taken into consideration, unless they happened to be within conservation forests,

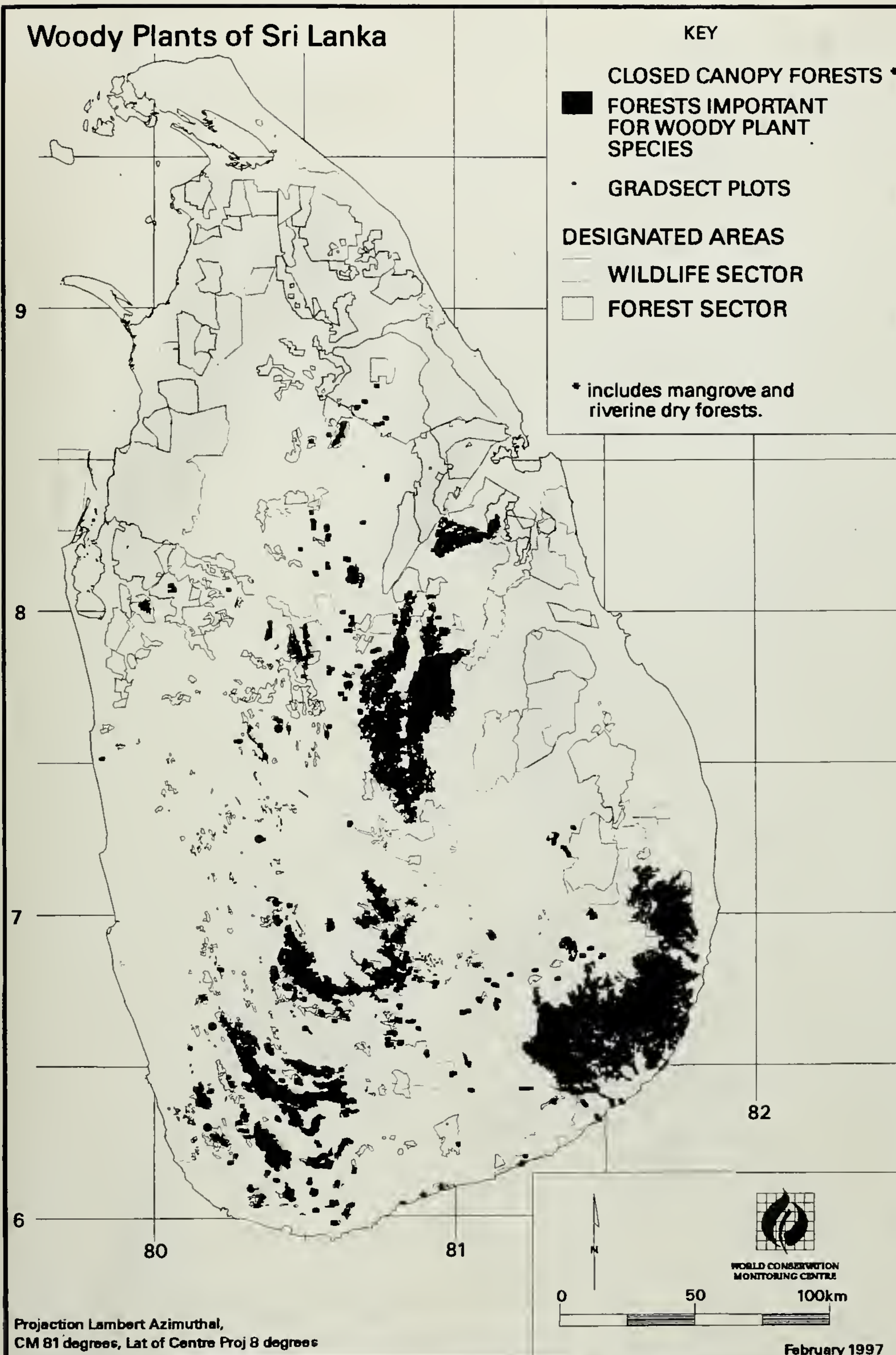

Figure 6.2 Minimum network of contiguous forests in which all 1,153 species of woody plants are represented.

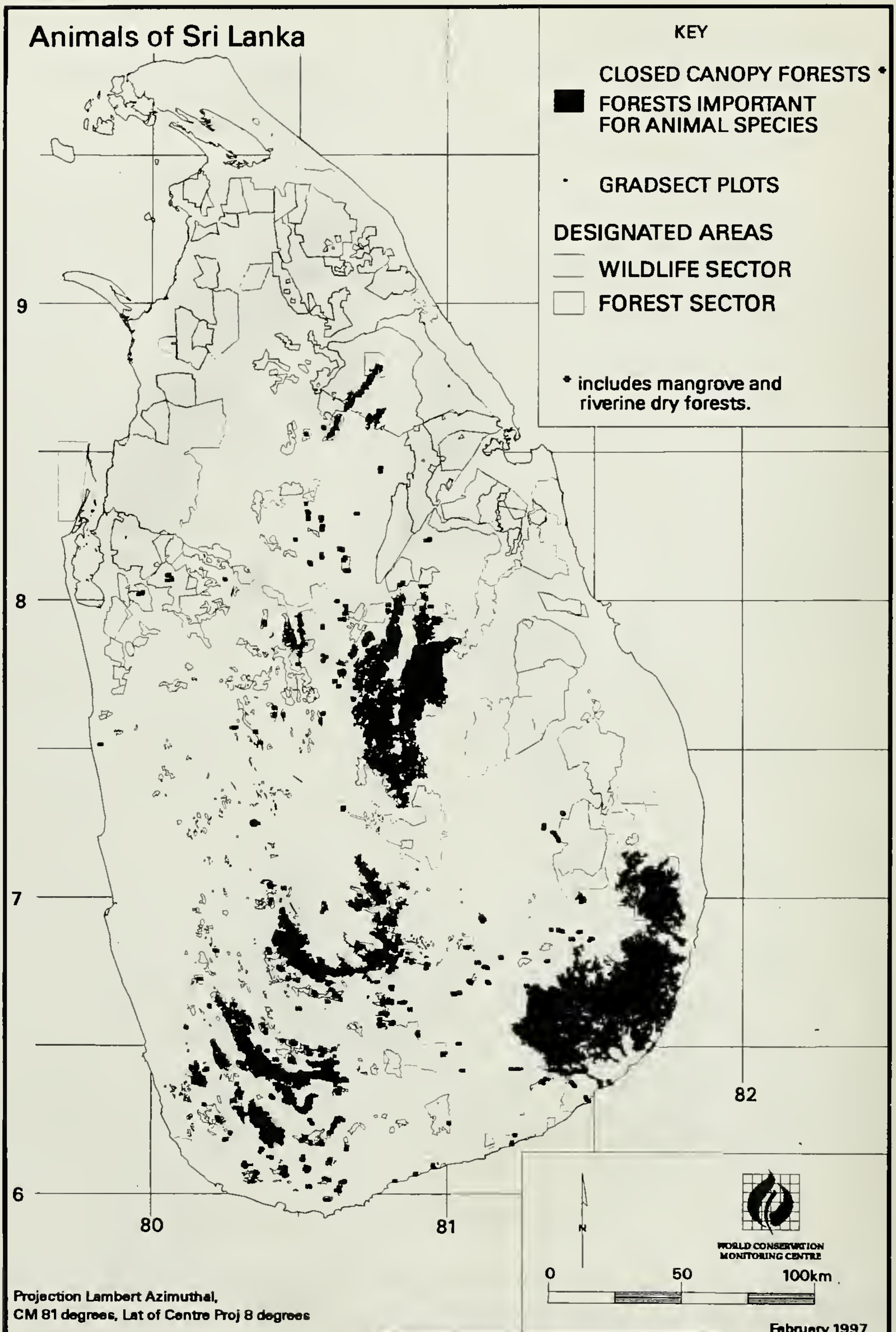

Figure 6.3 Minimum network of contiguous forests in which all 410 species of animals are represented.

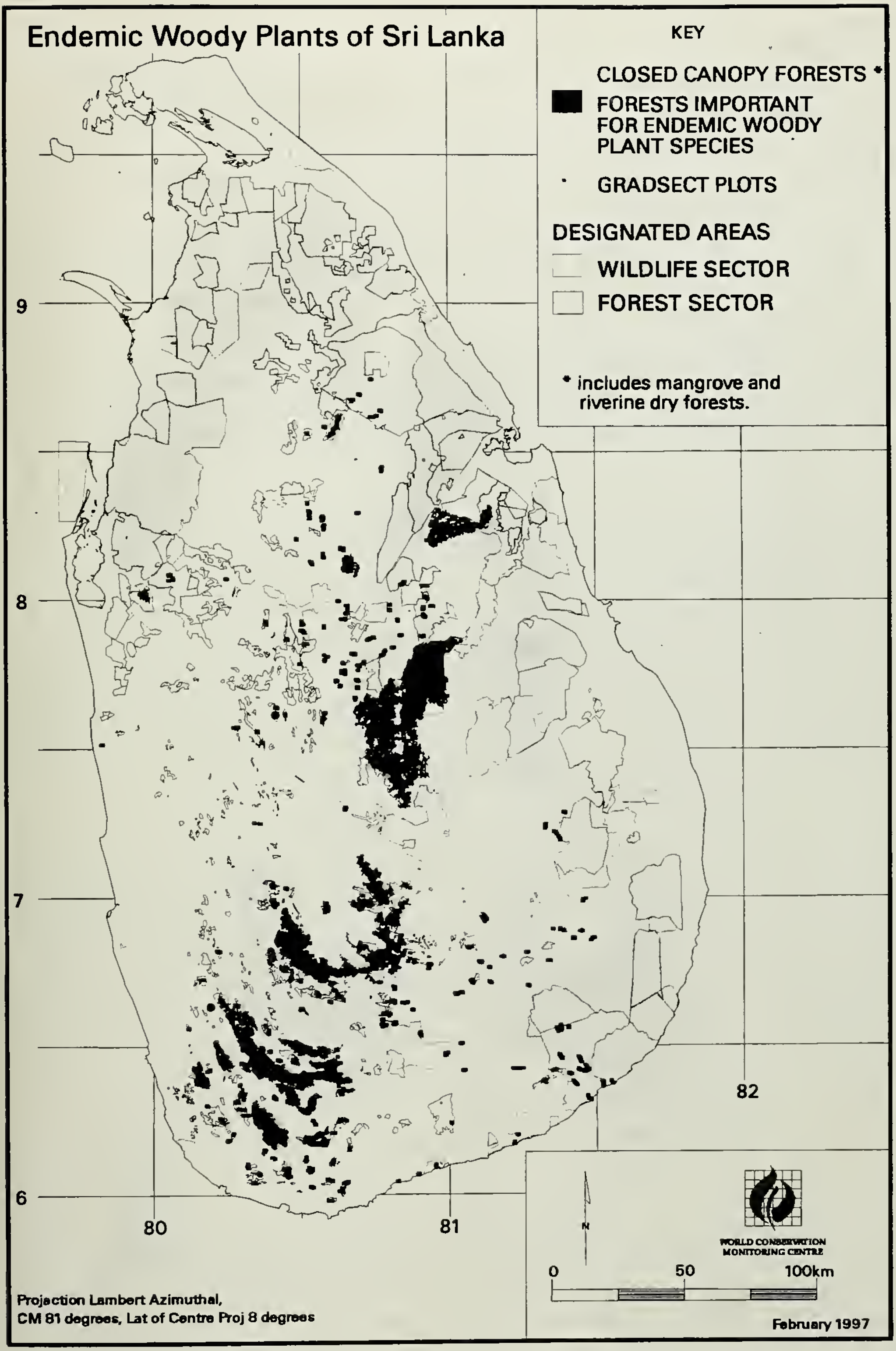

Figure 6.4 Minimum network of contiguous forests in which all 455 endemic species of woody plants are represented.

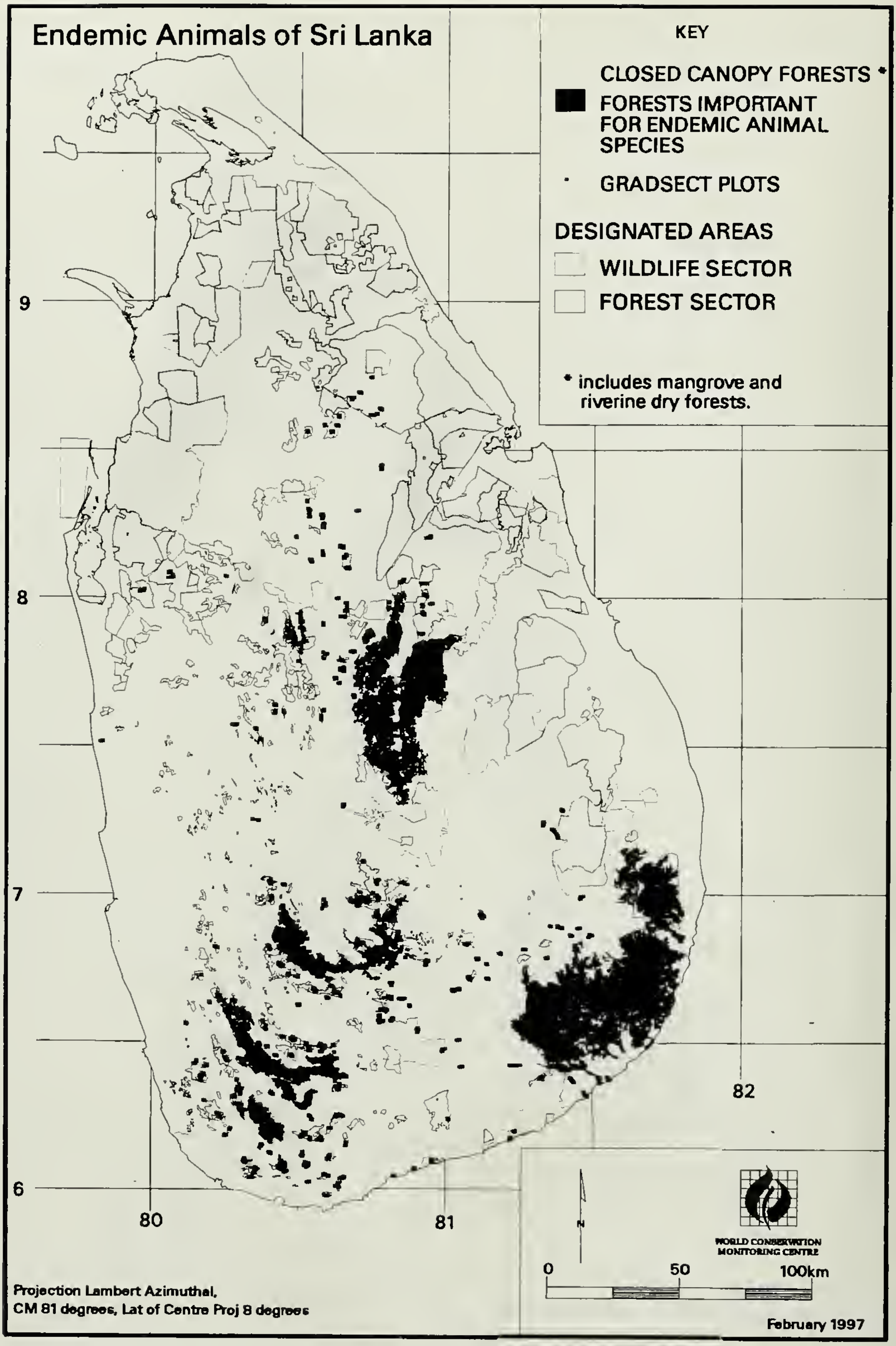

Figure 6.5 Minimum network of contiguous forests in which all 138 endemic species of animals are represented.

because most are small core areas (< 1,000 ha) within forest or proposed reserves that were not necessarily inventoried, *per se*.

The number and percentage of woody plant and animal species represented within existing protected forests are summarised in Table 6.4. The analysis shows that existing protected areas account for nearly 85% or more of forest species diversity, in terms of both endemic and all species of woody plants and animals. Inevitably, a larger number of forests are required for all species to be represented than when defining an optimum set of forests without any preconditions, as shown in Section 6.2.1. However, two important conclusions can be drawn from a comparison between the two sets of analyses summarised in Tables 6.3 and 6.4:

- Existing protected forests tend to complement each other with respect to both woody plant and animal species. For example, when selecting protected areas *a priori*, the number of forests required for 100% representation of woody plant species is 121 (Table 6.4), only 13 more than the minimum set of 108 forests (Table 6.3).

- Existing protected forests fall far short of endemic species' requirements. Although the 54 existing protected areas contain 90% and 85% of endemic woody plant and animal species, respectively (Table 6.4), this set vastly exceeds the minimum number required for 100% representation of either endemic woody plants or endemic animals when selecting protected areas *a priori* (Table 6.3). For example, it is double the minimum set of 35 forests necessary for representation of all endemic animal species.

Table 6.4 Number of woody plant and animal species represented within existing protected forests

Taxon	Total no. species	Species in 54 protected forests		No. additional forests required for 100% species representation	Reference (Volume 2)
		No.	% total species		
Woody plants	1,153	959	83%	67	Annex 11
Woody plants - endemic	455	408	90%	26	Annex 13
Fauna	410	349	85%	41	Annex 12
Fauna - endemic	138	115	84%	18	Annex 14

6.3 GAP ANALYSIS

6.3.1 Forest types

The distribution of forest types in relation to the designated areas network is shown in Figure 6.6. The results of this gap analysis are summarised in Table 6.4. Overall, 31% of natural forests are represented within protected areas and double this percentage lies within designated areas. Individual forest types are well represented (nearly 30% or more) within protected areas, with the exception of mangroves which are limited in extent (8,722 ha) and poorly represented in both protected and designated areas (8% in either case). Better representation of mangroves in protected areas can be achieved only by upgrading OSFs to conservation forest status.

Although well represented (49%) in protected areas, montane forests also have a very limited distribution, covering just 3,121 ha. Given the fragility of montane environments, the valuable contribution of cloud forests to maintaining hydrological regimes (Section 5.5), and their rare and often endemic flora and fauna, there is a strong case for strictly protecting all montane forests. This is readily achievable because the balance lies with proposed reserves, all of which could be designated as conservation forest or even national heritage wilderness areas under existing forest policies and/or legislation.

Of the other forest types, riverine dry and sub-montane forest are the least extensive (<100,000 ha), albeit well represented (>46% and 43%, respectively) in protected areas. There is considerable opportunity for increasing their representation since, in both cases, one third lies within forest and proposed reserves.

These results underestimate by about 0.6% (9,100 ha) the extent of closed canopy forest that is protected for two reasons. First, the designated areas coverage for Sinharaja is based on the boundaries of the original Sinharaja forest and proposed reserves, totalling 9,581 ha, rather than the National Heritage Wilderness Area (11,187 ha). Secondly, this coverage does not include the seven OSFs, covering approximately 7,500 ha, that have been designated conservation forest.

6.3.2 Wilderness

Designated areas superimposed onto a wilderness map of Sri Lanka are shown in Figure 6.7. Comparison of this wilderness map with the forest cover map (Figure 6.6) is illuminating on several accounts:

- The wilderness quality of the extensive closed canopy forest in the north of the island is not as high as might be anticipated. This reflects the proximity of settlements and roads to these forests.

- The east-central portion of the island, notably in the vicinity of Madura Oya National Park and adjacent Nuwaragala Forest Reserve and Baron's Cap Proposed Reserve, has a high wilderness value despite its closed canopy forest being less extensive and fragmented. This reflects the relative absence of settlements and roads in this region.

- None of the closed canopy forest in the wet zone comprises high quality wilderness. The Central Highlands, Knuckles, KDN and Sinharaja forest complexes all fall within Category 3 (Medium-High). Being hill or mountain ranges, their forested slopes lie close to settlements and roads in the lower catchment areas.

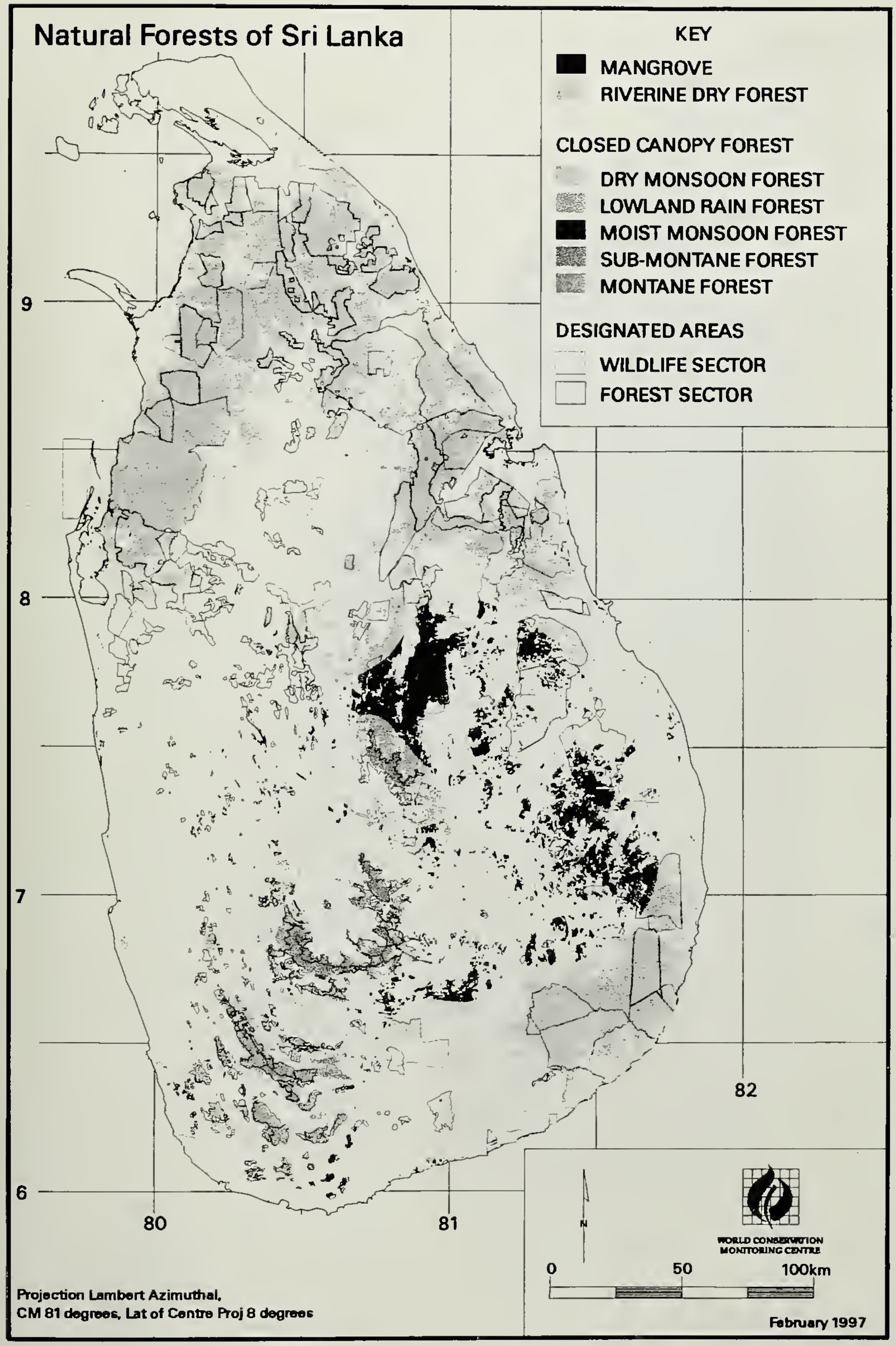

Figure 6.6 Designated areas superimposed on the 1:50,000-scale forest map of Sri Lanka (Legg and Jewell, 1995).

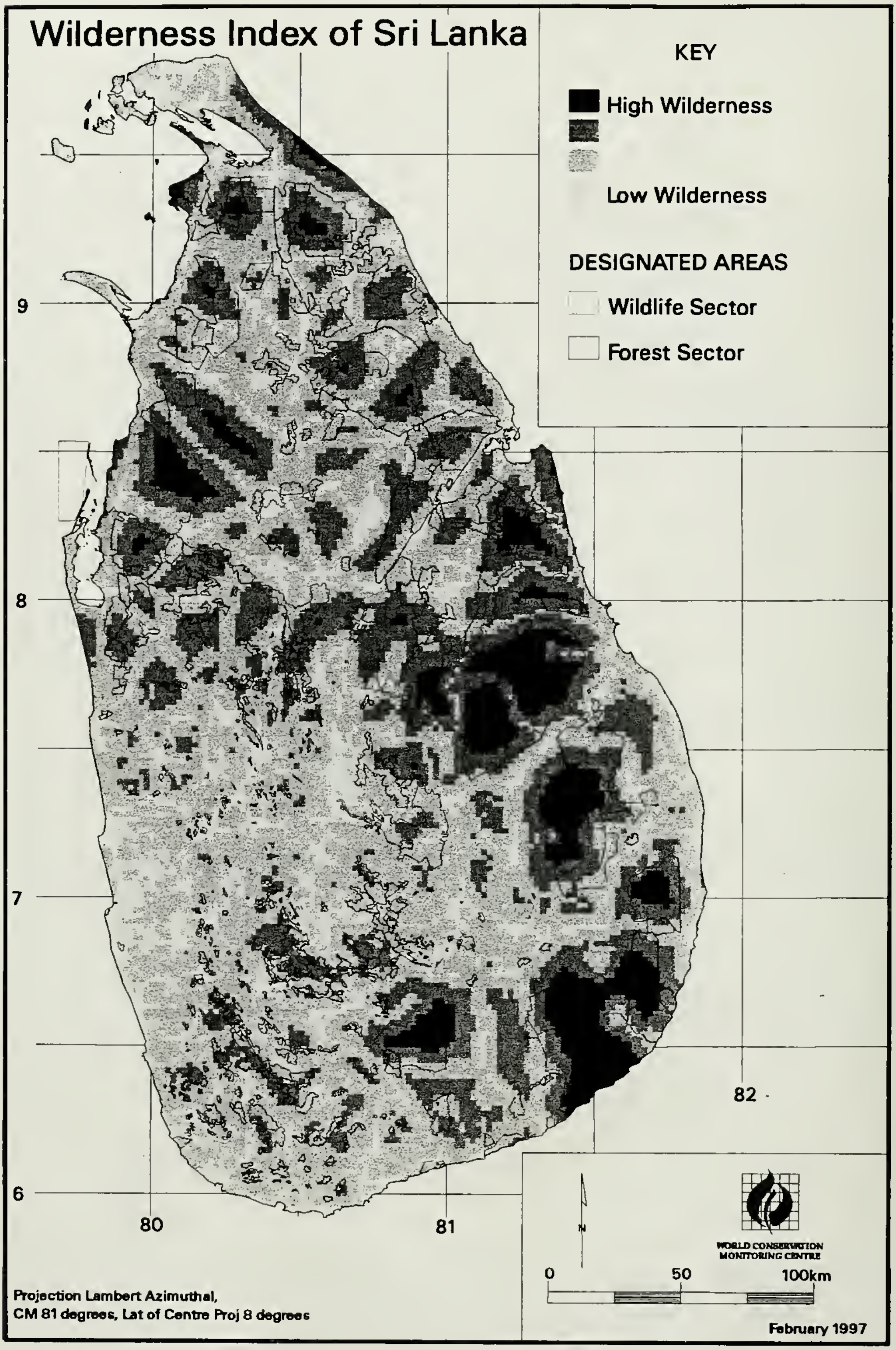

Figure 6.7 Designated areas superimposed on a wilderness map of Sri Lanka.

Table 6.4 Extent of closed canopy, mangrove and riverine forest represented within designated and protected areas (i.e. all designated areas except forest and proposed reserves)

FOREST TYPE	Total area (ha)	Proposed Reserve		Forest Reserve		Conservation Forest		National Park		Nature Reserve		Sanctuary Reserve		Strict Natural Reserve		Total (ha)			
																Designated areas		Protected areas	
Dry monsoon forest	1,098,847	168,523	15.3%	213,171	19.4%	86	0.0%	231,705	21.1%	15,272	1.4%	60,697	5.5%	1,235	0.1%	690,690	62.9%	308,995	28.1%
Lowland rainforest	142,159	13,900	9.8%	9,572	6.7%	40,267	28.3%	0	0.0%	0	0.0%	8,427	5.9%	0	0.0%	72,166	50.8%	48,694	34.3%
Mangroves	8,722	0	0.0%	9	0.1%	0	0.0%	386	4.4%	42	0.5%	291	3.3%	0	0.0%	728	8.4%	720	8.3%
Moist monsoon forest	244,903	22,173	9.1%	14,513	5.9%	672	0.3%	65,658	26.8%	9,340	3.8%	15,298	6.2%	0	0.0%	127,655	52.1%	90,969	37.1%
Montane forest	3,121	1,586	50.8%	0	0.0%	1,028	32.9%	187	6.0%	0	0.0%	167	5.4%	151	4.8%	3,120	100.0%	1,533	49.1%
Riverine dry forest	22,504	4,814	21.4%	2,597	11.5%	0	0.0%	9,016	40.1%	0	0.0%	1,282	5.7%	0	0.0%	17,708	78.7%	10,298	45.8%
Sub-montane forest	69,136	22,617	32.7%	1,263	1.8%	10,859	15.7%	1,703	2.5%	0	0.0%	16,458	23.8%	801	1.2%	53,701	77.7%	29,821	43.1%
TOTAL	**1,589,393**	**233,614**	**14.7%**	**241,125**	**15.2%**	**52,913**	**3.3%**	**308,656**	**19.4%**	**24,654**	**1.6%**	**102,620**	**6.5%**	**2,186**	**0.1%**	**965,768**	**60.8%**	**491,030**	**30.9%**

Table 6.5 Extent of wilderness, classified into four categories, represented within designated and protected areas (i.e. all designated areas except forest and proposed reserves)

Wilderness category	Total area (ha)	Proposed Reserve		Forest Reserve		Conservation Forest		National Park		Nature Reserve		Sanctuary Reserve		Strict Nature Reserve		Total (ha)			
																Designated areas		Protected areas	
1	1,082,275	43,133	4.0%	42,005	3.9%	7,522	0.7%	10,344	1.0%	743	0.1%	28,542	2.6%	387	0.0%	132,676	12.3%	47,537	4.4%
2	3,376,380	226,413	6.7%	198,529	5.9%	42,652	1.3%	97,613	2.9%	10,234	0.3%	123,271	3.7%	2,345	0.1%	701,057	20.8%	276,114	8.2%
3	1,734,146	195,427	11.3%	180,470	10.4%	23,353	1.3%	204,878	11.8%	23,934	1.4%	94,336	5.4%	0	0.0%	722,398	41.7%	346,501	20.0%
4	451,721	39,659	8.8%	58,014	12.8%	0	0.0%	195,266	43.2%	5,374	1.2%	7,314	1.6%	0	0.0%	305,627	67.7%	207,954	46.0%
TOTAL	6,644,522	**504,633**	**7.6%**	**479,018**	**7.2%**	**73,527**	**1.1%**	**508,101**	**7.6%**	**40,284**	**0.6%**	**253,463**	**3.8%**	**2,731**	**0.0%**	**1,861,758**	**28.0%**	**878,106**	**13.2%**

Table 6.6 Extent of floristic regions and soil zones represented within designated and protected areas (i.e. all designated areas except forest and proposed reserves)

FLORISTIC REGION / Soil Zone	Total area (ha)	Proposed Reserve		Forest Reserve		Conservation Forest		National Park		Nature Reserve		Sanctuary		Strict Natural Reserve		Totals (ha) Designated areas		Totals (ha) Protected areas	
II Dry and arid lowlands	4,340,773	420,451	9.7%	441,889	10.2%	0	0.0%	491,510	11.3%	37,396	0.9%	186,110	4.3%	1,528	0.0%	1,578,884	36.4%	716,544	16.5%
1. Very deep latisols	506,099	46,082	9.1%	115,321	22.8%	0	0.0%	78,447	15.5%	0	0.0%	19,248	3.8%	0	0.0%	259,097	51.2%	97,695	19.3%
2. Sodic, saline, alkali soils	31,725	0	0.0%	306	1.0%	0	0.0%	0	0.0%	0	0.0%	1,533	4.8%	0	0.0%	1,839	5.8%	1,533	4.8%
3. Sandy regosols	129,698	68	0.1%	427	0.3%	0	0.0%	0	0.0%	0	0.0%	5,618	4.3%	0	0.0%	6,113	4.7%	5,618	4.3%
4. Grumusols	38,569	803	2.1%	5,064	13.1%	0	0.0%	0	0.0%	0	0.0%	847	2.2%	0	0.0%	6,714	17.4%	847	2.2%
5. RBE-LHG gravelly and lithic phase	223,641	13,069	5.8%	8,081	3.6%	0	0.0%	54,325	24.3%	0	0.0%	19,753	8.8%	0	0.0%	95,228	42.6%	74,078	33.1%
6. RBE-LHG modal phase	2,262,974	269,762	11.9%	209,939	9.3%	0	0.0%	174,267	7.7%	13,170	0.6%	85,717	3.8%	1,528	0.1%	754,383	33.3%	274,682	12.1%
7. Deep alluvial soils	106,729	8,699	8.2%	8,662	8.1%	0	0.0%	43,791	41.0%	2,798	2.6%	63	0.1%	0	0.0%	64,013	60.0%	46,651	43.7%
8. Soils on old alluvium, sodic lowland soils	26,062,713	38,844	14.9%	44,301	17.0%	0	0.0%	15,915	6.1%	21,341	8.2%	7,870	3.0%	0	0.0%	128,271	49.2%	45,126	17.3%
9. Shallow, gravelly and lithic NCBs	17,942,378	0	0.0%	21,374	11.9%	0	0.0%	35,685	19.9%	0	0.0%	2,343	1.3%	0	0.0%	59,403	33.1%	38,028	21.2%
11. NCBs modal	39,934,412	41,949	10.5%	27,292	6.8%	0	0.0%	20,050	5.0%	0	0.0%	23,718	5.9%	0	0.0%	113,010	28.3%	43,768	11.0%
12. Gravelly RBEs - solodized solonetz	140,242	1,176	0.8%	1,121	0.8%	0	0.0%	66,955	47.7%	0	0.0%	6,674	4.8%	0	0.0%	75,925	52.5%	73,629	52.5%
14. Miscellaneous	125																		
Freshwater bodies	61,576	0	0.0%	0	0.0%	0	0.0%	2,075	3.4%	88	0.1%	12,725	20.7%	0	0.0%	14,888	24.2%	14,888	24.2%
III Northern intermediate lowlands	476,579	11,485	2.4%	9,407	2.0%	1,546	0.3%	4,988	1.0%	2,888	0.6%	1,637	0.3%	0	0.0%	31,951	6.7%	11,059	2.3%
IV Eastern intermediate lowlands	411,869	3,997	1.0%	5,573	1.4%	0	0.0%	8,575	2.1%	0	0.0%	33,487	8.1%	0	0.0%	51,631	12.5%	42,061	10.2%
V Northern wet lowlands	377,712	4,699	1.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	510	0.1%	0	0.0%	5,209	1.4%	510	0.1%
VI Sinharaja and Ratnapura	212,983	12,147	5.7%	3,120	1.5%	25,535	12.0%	3,028	1.4%	0	0.0%	0	0.0%	0	0.0%	43,830	20.6%	28,564	13.4%
VII Southern lowlands hills	397,754	12,984	3.3%	14,762	3.7%	22,670	5.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	50,416	12.7%	22,670	5.7%
VIII Freshwater bodies	7,745	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	23	0.3%	0	0.0%	23	0.3%	23	0.3%
IX Foothills of Adam's Peak, Ambagamuwa	93,265	3,655	3.9%	655	0.7%	7,280	7.8%	0	0.0%	0	0.0%	9,455	10.1%	0	0.0%	21,045	22.6%	16,735	17.9%
XI Kandy and Upper Mahaweli	106,384	1,056	1.0%	202	0.2%	0	0.0%	0	0.0%	0	0.0%	5,427	5.1%	0	0.0%	6,685	6.3%	5,427	5.1%
XII Knuckles	44,497	0	0.0%	0	0.0%	16,495	37.1%	0	0.0%	0	0.0%	1,886	4.2%	0	0.0%	18,381	41.3%	18,381	41.3%
XIII Central Mountains, Ramboda, Nuwara Eliya	112,026	22,014	19.7%	1,973	1.8%	0	0.0%	0	0.0%	0	0.0%	206	0.2%	1,204	1.1%	25,397	22.7%	1,409	1.3%
XIV Adam's Peak	37,362	3,009	8.1%	0	0.0%	1	0.0%	0	0.0%	0	0.0%	10,081	27.0%	0	0.0%	13,091	35.0%	10,082	27.0%
XV Horton Plains	25,573	12,448	48.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3,140	12.3%	0	0.0%	15,588	61.0%	3,140	12.3%
TOTAL	6,644,522	507,945	13.5%	480,508	11.9%	73,527	3.2%	508,101	12.0%	40,284	1.0%	251,961	7.1%	2,731	0.1%	1,865,057	43.3%	876,605	23.5%

The results of a gap analysis are summarised in Table 6.5. High quality wilderness (Category 4) is most extensive in the eastern parts of the country where large proportions are represented within:

- Wasgomuwa National Park,
- Madura Oya National Park and adjacent Nuwaragala Forest Reserve and Baron's Cap Proposed Reserve,
- Gal Oya National Park and adjacent Gal Oya Valley North-East Sanctuary and Nuwaragala Forest Reserve,
- Panama Proposed Reserve,
- Ruhuna National Park and adjacent Yala East National Park and Kumbukkan Forest Reserve[14], and
- Uda Walawe National Park.

The other major tracts of Category 4 wilderness are in the north-west, mostly within Wilpattu National Park.

Nearly 50% of Category 1 wilderness is represented within protected areas, and there is considerable potential for ensuring that two-thirds of Category 1 is protected by upgrading its conservation status within forest and proposed reserves. Priority should also be given to protecting as much as practicable of the remaining Category 1 wilderness that lies outside designated areas, notably:

- wilderness west of Baron's Cap Proposed Reserve (sparse forest),
- wilderness north of Gal Oya National Park (closed canopy forest),
- wilderness between Ruhuna (Block IV) National Park and Kumbukkan Forest Reserve (closed canopy forest), and
- Samanalawewa wilderness north-west of Uda Walawe National Park (little closed canopy forest but minimal infrastructural development).

Samanalawewa is a particularly interesting area, described in the 1960 Colombo Plan Survey as wild, rugged, inaccessible and almost uninhabited. Such conditions still prevail except for the construction of a dam below the confluence of the Walawe Ganga with the Belihul Oya (Karunaratne, 1992).

Medium-high wilderness (Category 3) is well represented (20%) within protected areas, much of it providing a buffer to high wilderness areas. There is scope for doubling this level of representation by upgrading the conservation status of existing forest and proposed reserves (Table 6.5).

Much of the south-west of the island falls within the medium-low wilderness category, reflecting the characteristic developed landscapes of coconut, rubber and tea plantations, intermingled with home gardens and paddy. Albeit low in species biodiversity, such landscapes are likely to be high in genetic diversity with respect to crop varieties and remnant specimens of native flora, as well as having important cultural values.

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[14] According to data held in EIMS, which are based on the Forest Department register, Kumbukkan is a proposed reserve, but in the National Forest GIS it is labelled as a forest reserve in accordance with the Department's Ordinance Survey records.

6.3.3 Floristic regions and soil-edaphic units

The distribution of floristic regions in relation to the designated areas network is shown in Figure 6.8. The analyses of floristic regions and, in the case of the dry/arid lowlands, soil-edaphic units show a number of major gaps in the existing protected areas network in terms of its representativeness (Table 6.6). Nearly half of all regions are poorly represented (i.e. <10%), as follows:

- III Northern intermediate lowlands
- V Northern wet lowlands
- VII Southern lowland hills
- VIII Freshwater bodies
- XI Kandy and Upper Mahaweli
- XIII Central Mountains, Ramboda, Nuwara-Eliya

In the case of Floristic Regions III, V, VII and XI, there is very limited opportunity to increase representation within protected areas because very little of the original natural forest remains within these regions. Even if all forest and proposed reserves were upgraded to conservation forest, protected areas coverage would only exceed 10% for Region VII (southern lowland hills). The most under-represented region is V: only 0.1% of the northern wet lowlands of Colombo and adjoining districts lie within protected areas, and a total of 1.4% within designated areas. However, there is considerable scope for increasing representation of Region XIII (Central Mountains, Ramboda, Nuwara-Eliya), principally by upgrading some of the proposed reserves (e.g. Kikilimana and Pedro) to conservation forests.

Importantly, the analysis shows that all regions of limited extent (i.e. XII Knuckles, XIV Adam's Peak, XV Horton Plains, all of which cover <50,000 ha) are well represented in protected areas, the exception being VIII (freshwater bodies) in the wet zone (but not the dry zone - see below). It is not within the scope of this project to consider wetland conservation, but it has been addressed by a Wetland Conservation Project, ongoing at the time of the NCR and undertaken by the Central Environmental Authority with support from DGIS, The Netherlands.

II Dry and arid lowlands

As discussed in Section 4.4.3, the floristic classification defines the dry zone as a single region (II) which is too coarse for conservation planning purposes. Indeed, reference to Table 6.6 shows that, as a whole, this region is well represented (17%) within protected areas.

However, sub-division of this floristic region into soil-edaphic units reveals some significant gaps in representation, with three units poorly represented (i.e. <10%) as follows:

- 2 Sodic, saline, alkali soils
- 3 Sandy regosols
- 4 Grumusols

Zones 2 and 4 have a particularly limited distribution, covering some 32,000 ha and 39,000 ha, respectively. Closed canopy forest has largely disappeared from these three units (Figure 6.6) and wilderness values are low (Figure 6.7), except along the coast of the Jaffna peninsular where infrastructural development within Zone 3 is less intensive (i.e. Category 3 wilderness).

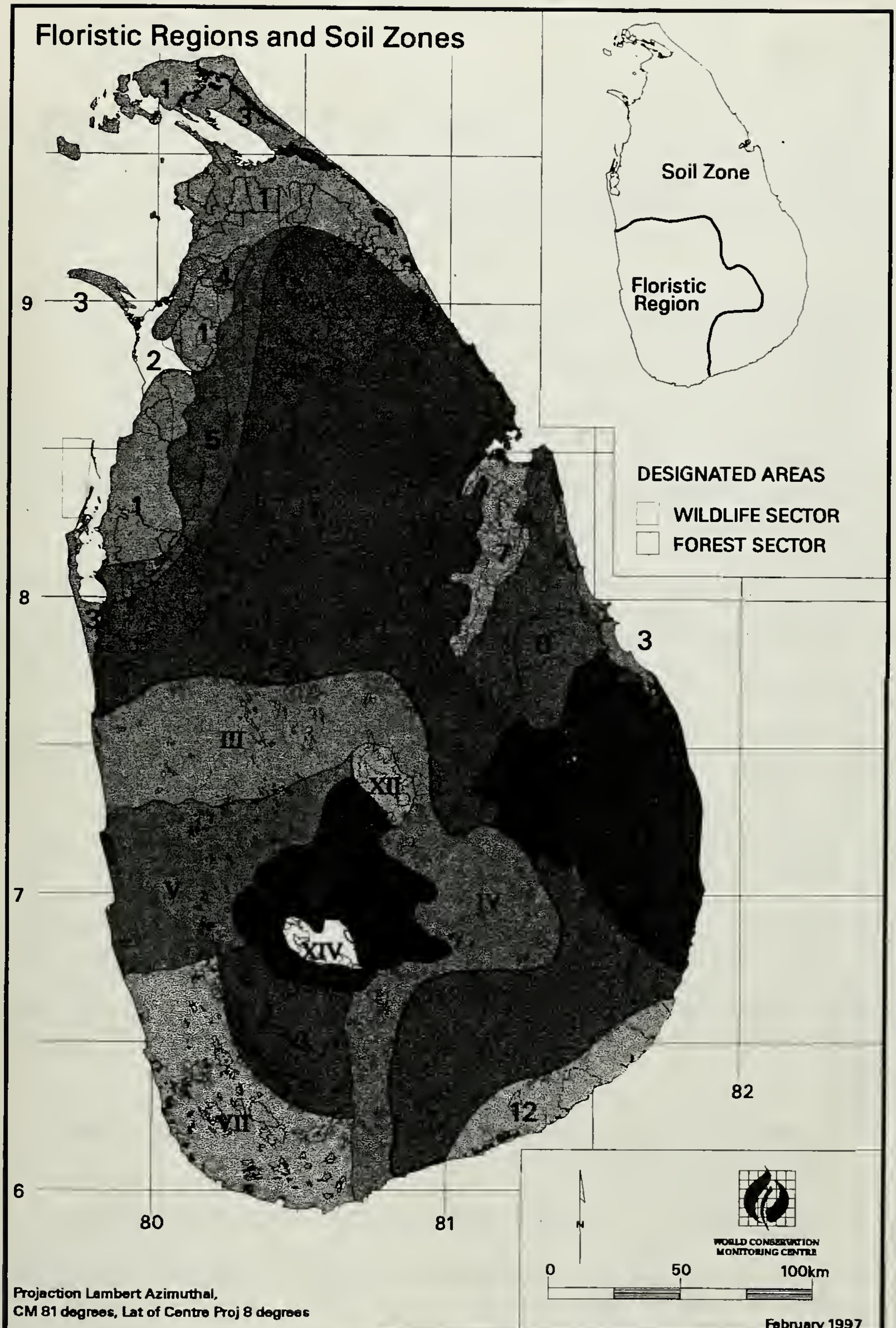


Figure 6.8 Designated areas superimposed on floristic regions. The dry and arid lowlands region is further classified into edaphic zones.

6.4 CONCLUSIONS AND RECOMMENDATIONS

Species diversity

1. Conservation forests should be as large as possible for the long-term maintenance of genetic and species diversity. Much of Sri Lanka's biodiversity is represented in the larger forests, particularly those in the wet zone. Every effort, therefore, should be made to ensure that the largest remaining forests in the wet zone are designated in their entirety as conservation forest, notably:

   - Bambarabotuwa
   - Central Highlands
   - Gilimale-Eratne
   - KDN
   - Knuckles/Wasgomuwa
   - Pedro
   - Sinharaja

2. At the very least, all endemic forest species should be represented within the protected areas system. Based on known species distributions derived from the NCR, 42 forests will need to be protected in addition to those already designated as protected areas (Annexes 13 and 14, Volume 2).

3. Ideally, all forest species covered by this study should be represented within the protected areas system. It is recognised, however, that this priority will need to be rationalized alongside other conservation priorities, as discussed further in Chapter 7.

Ecosystem diversity

4. On the basis of their limited extent and, in the case of mangroves, low level of representation within existing protected areas:

   - protection of mangroves should be maximised by designating as much OSF as possible as conservation forest.

   - all montane forest should be strictly protected by upgrading the status of proposed reserves to conservation forests, or even national heritage wilderness areas.

5. High quality wilderness should form the inner core of protected areas, being areas least likely to be subjected to human impact. Where appropriate and feasible, priorities are:

   - to upgrade forest and proposed reserves containing Category 4 wilderness to national heritage wilderness areas.

   - to protect Category 4 wilderness that presently lies outside designated areas.

   - to ensure that Category 4 wilderness is buffered by Category 3 wilderness, preferably within protected areas.

6. The existing protected areas system is not sufficiently representative of the main floristic regions or, in the case of the dry zone, soil-edaphic units. Where opportunities exist, priorities are:

   - to increase representation of Floristic Regions III, V, VII and XI within protected areas.

   - to increase representation of Floristic Region XIII (Central Mountains etc) within protected areas by upgrading the status of reserves such as Kikilimana and Pedro to conservation forests.

   - to increase representation of soil-edaphic units 2, 3 and 4 within protected areas, particularly in the case of the Category 3 wilderness along the east coast of the Jaffna peninsular in Zone 3.

Chapter 7

WATERSHED PROTECTION AND BIODIVERSITY CONSERVATION

7.1 INTRODUCTION

In the first part of this final chapter, the relationship between the importance of natural forests for watershed protection, in terms of soil protection and flood control, and biodiversity conservation is examined in order to determine the extent to which these attributes are complementary. Obviously, conservation planning will be more cost effective with respect to land required for conservation if forests important for watershed protection are also those rich in biodiversity, including species.

In the second part of this chapter, criteria for designing an optimum system of conservation forests are considered and applied to the findings from the NCR. Future measures necessary to establish an optimum system are briefly discussed in the concluding section.

7.1.1 Datasets used to compare watershed and biodiversity values

Although it was intended that all natural forests should be evaluated for their soil and water conservation importance and their biodiversity value, this was not entirely practicable. The biodiversity surveys took much longer; moreover, it was not possible to survey biodiversity within all forests due to ongoing LTTE activities in the north and east of the country. Also, a number of forests were included in the biodiversity survey after the soil and water conservation assessment had been completed. The sizes of the datasets are summarised in Table 7.1.

Table 7.1 Number of forests assessed for soil and water conservation importance and inventoried for species diversity

Survey	Individual forests	Contiguous forests
Soil/water conservation survey	281	203
Biodiversity survey	204	138
Both surveys	179	118

Note: These summary statistics are derived from data in Table 7.2.

Analyses in this chapter are limited to contiguous forests, given the hydrological and biological importance of conserving as large fragments of remaining natural forest as possible, especially with respect to the wet zone where cloud forests are singularly important for fog interception and moist forests for endemic species of woody (and other) plants and animals.

7.2 AN INTEGRATED APPROACH TO CONSERVATION

7.2.1 Relationship between watershed protection and species diversity

As shown in Figures 7.1 and 7.2, respectively, both total soil erosion and flood control are closely related to biodiversity, measured in terms of woody plant species. The main determinants of these close relationships are likely to be rainfall and altitudinal range, both of which strongly influence species diversity. Thus, forests with steep terrain (i.e. high altitudinal range) and high rainfall support a greater wealth of species and are more important for soil protection and flood control than forests with a fairly level terrain and low rainfall. These findings are consistent with results from other studies which show that species richness is closely related with climatic and physiographic parameters (Allen, 1992).

It should be possible, therefore, to predict species diversity from importance for watershed protection (i.e. soil protection and/or flood control), the advantage being that the latter assessment is much more rapid than the former. Such predictions have limited value, however, because they are concerned only with total diversity. Species distribution patterns are not predicted, preventing minimum forest networks from being defined for biodiversity conservation.

The relative importance of contiguous forests with respect to total soil erosion, flood hazard and biodiversity is shown in Figure 7.3.. Flood hazard is plotted on the -y axis to facilitate direct comparison with total erosion (y axis). In general, as woody plant species diversity diminishes along the x axis, so does importance for soil protection and flood control along the y and -y axes, respectively. The four most important contiguous forests, as shown left to right in Figure 7.3, are Central Highlands, Sinharaja, Knuckles and KDN.

7.2.2 Priorities for watershed protection and species diversity conservation

The results of the soil and water conservation assessment and biodiversity survey are summarised for each unit of contiguous forest in Annex 8 on the basis of their importance for soil erosion, flood control, fog interception, woody plant species, endemic woody plant species, animal species and endemic animal species. Of the 224 units of contiguous forest, 203 were assessed for soil and water conservation and 138 were inventoried for species (Table 7.1).

Units of contiguous forest were prioritised for conservation according to the following criteria:

- **Highest importance**
    - exceed thresholds for both soil erosion and flood hazard, **or**
    - intercepts water from fog (i.e. located above 1,500 m), **or**
    - included within a minimum network of contiguous forests for woody plant species or selected groups of animal species.

- **Important**
    - exceed thresholds for **either** soil erosion **or** flood hazard

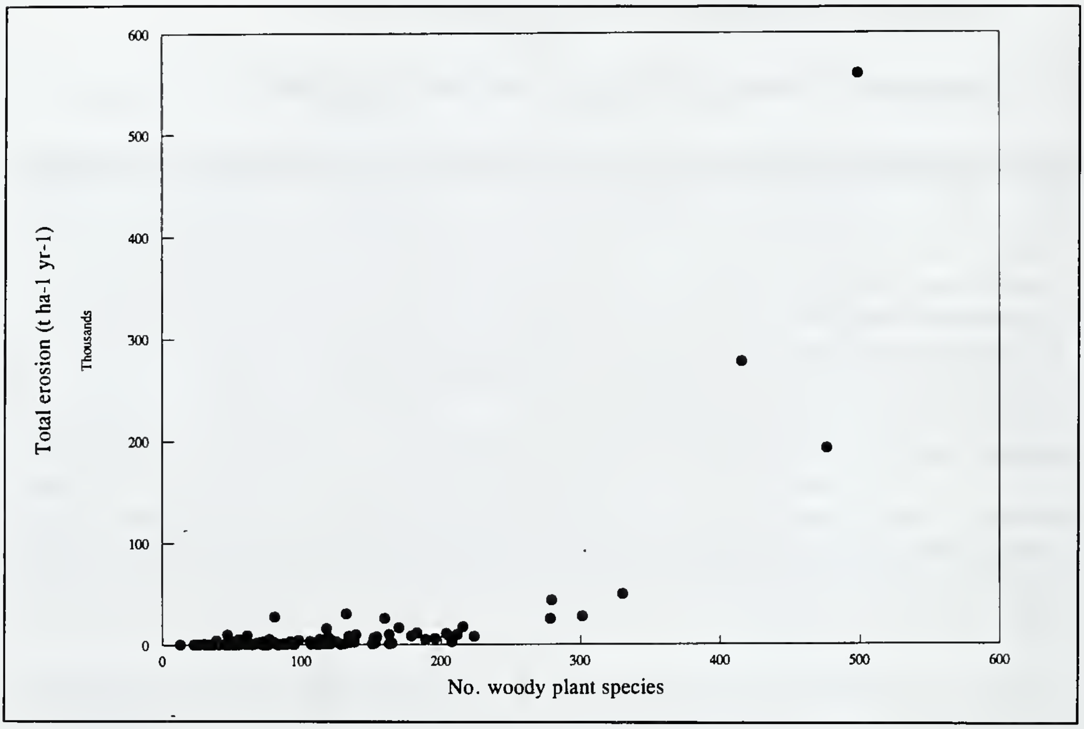


Figure 7.1 Relationship between total soil erosion and woody plant diversity for 118 units of contiguous forest

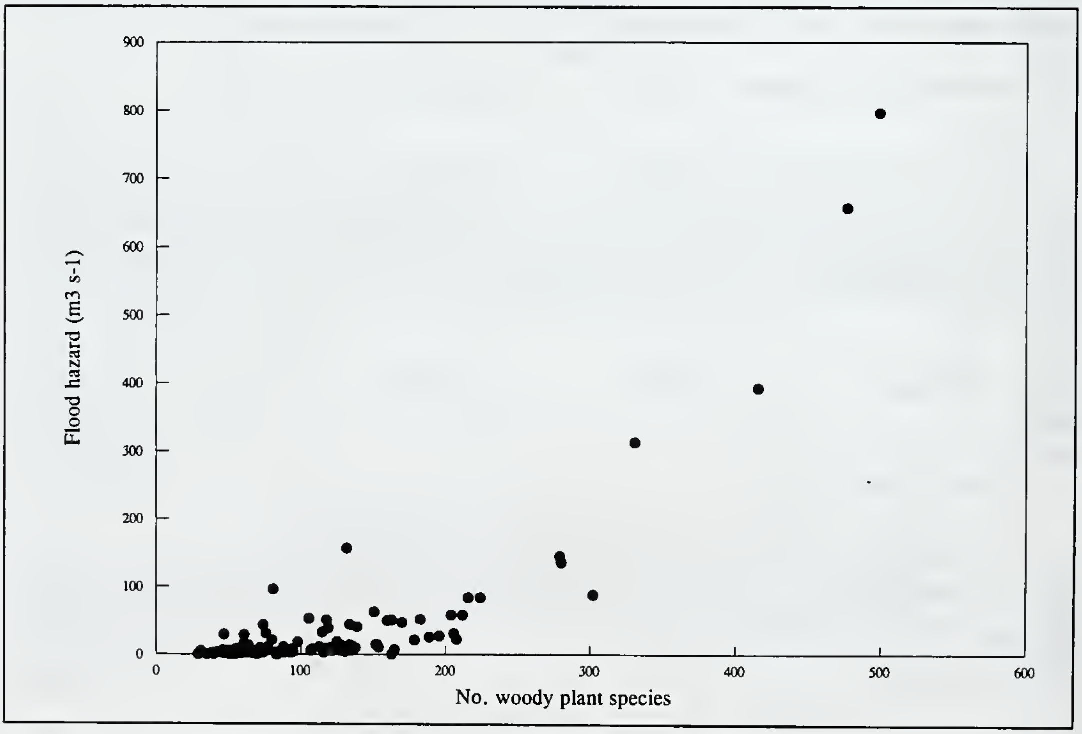


Figure 7.2 Relationship between flood hazard and woody plant diversity for 118 units of contiguous forest

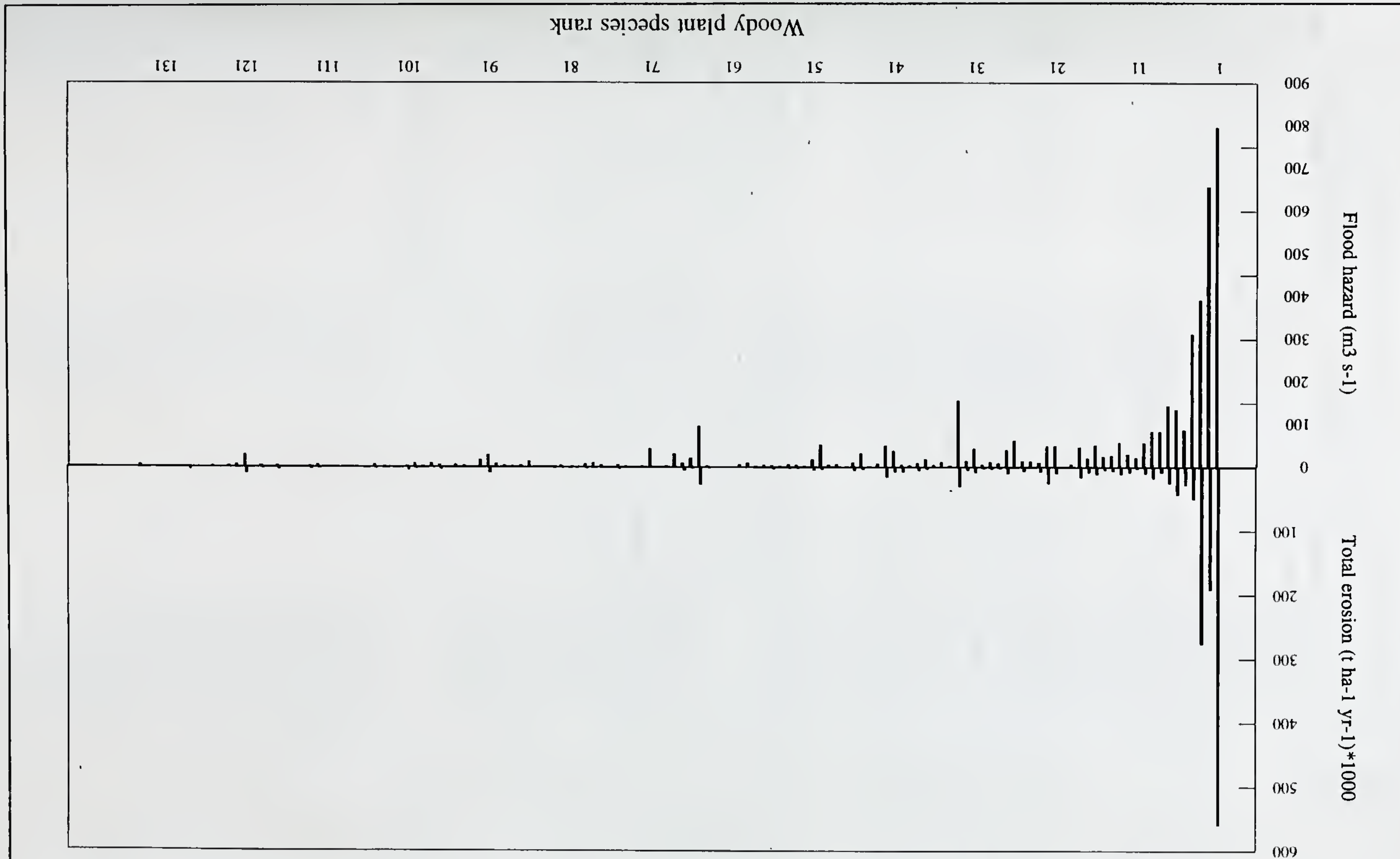


Figure 7.3 Relationships between total soil erosion, flood hazard and woody plant diversity for 118 units of contiguous forest

- **Lowest importance**
  - below thresholds for both soil erosion and flood hazard, **and**
  - negligible interception of water from fog (i.e. located below 1,500 m), **and**
  - not part of a minimum network of contiguous forests for woody plant species or selected groups of animal species.

In the case of contiguous forests of highest importance, a further distinction was made to prioritise those important for endemic species over and above those important for non-endemic species. Thus, contiguous forests exceeding both soil erosion and flood hazard thresholds, or intercepting fog or part of a minimum network for **endemic** species were considered top priority for conservation.

Units of contiguous forest are listed according to these criteria in Table 7.2. By far the majority (104) are of highest importance for conservation. The distribution of these contiguous forests is mapped in Figure 7.4. With the exception of a few small fragments, all contiguous forests in the wet zone are included within this minimum network, together with the extensive Ruhuna/Yala unit in the south-east and several small units to the north. This minimum network covers 516,795 ha, or 7.8% of total land area. Although this equates to only half of the existing protected areas system, much of it is located within the wet zone where pressures on land for agriculture and other purposes are enormous.

Options to further reduce this minimum network are limited, particularly if the integrity of adjacent forests is to be maintained. One option would be to focus on endemic species, possibly at the risk of some non-endemic species becoming extinct, perhaps within the next half-century. A network of top priority contiguous forests for watershed protection and conservation of endemic species comprises a total of 70 contiguous forests (Table 7.2), which are mapped in Figure 7.5. Although the number of contiguous forests is reduced by about one-third, the network is still very expansive and covers 490,193 ha, or 7.4% of total land area. In fact, differences between Figures 7.4 and 7.5 are minor. For example, only a few of the small forests in the south of the wet zone are not part of the minimum network for endemic species.

Table 7.2 Importance of units of contiguous forest for watershed protection and species conservation. Top priority forests in the highest importance category are listed in capitals.

Highest importance (N=104)/TOP PRIORITY (N=70)

EMD No.	Name
7	AMANAWALA-AMPANE
636	Aruwewa
509	AUWEGALAKANDA
24	BADULLAKELE
-28	BAMBARABOTUWA (N=5)
511	BAMBARAWANA
589	Begahapatana
37	BERALIYA (AKURESSA)
38	BERALIYA (KUDAGALA)
-39	BIBILEHELA (N=2)
44	Bundala
552	BUTAWELLA
-140	CENTRAL HIGHLANDS (N=16)
556	CHILAW LAKE
57	DAMBULUWANA
60	DANDENIYA-APAREKKA
515	DEDUGALLA-NANGALA
575	Dewagiriya
78	DOLUWAKANDA
80	Dunkanda
660	Elagamuwa
96	GAL OYA
101	Galgiriyakanda
534	GALLELETOTA
112	GILIMALE-ERATNE
544	GORANGALA
536	Hapugala
128	HARASBEDDA
539	Hataramune
-129	HAYCOCK (N=2)
136	HINNA
507	HOMADOLA
138	HORAGALA-PARAGALA
146	INDIKADA MUKALANA
147	Ingiriya
-161	KALAHALLA-PALLEKELE (N=2)
497	KALUBOWITIYANA
655	KALUDIYAPOKUNA
166	KALUGALA
184	KARAWITA
-175	KDN (N=6)
190	Kekanadura
191	KELANI VALLEY
526	Keulakada Wewa
197	KIKILIMANA
550	KIRIBATGALA
585	Kitulhela
-522	KNUCKLES /WASGOMUWA (N=11)
-208	KOMBALA-KOTTAWA (N=2)
531	KUDAGODA
217	KUDUMIRIYA
535	Kuragala
498	Kurulugala
657	Kurulukele
222	LABUGAMA-KALATUWANA
241	MAGURUGODA
-253	MALAMBURE (N=2)
256	Manapaya
-164	Mangroves (N=3)
263	Masmullekele
502	MEDIRIGIRIYA TULANA
572	Menikdeniya
-281	Mineriya (N=2)
280	Minneriya-Giritale
279	MINNERIYA
525	Miyandagala
581	MONERAKELLE
293	MULATIYANA
306	NAMUNUKULA
537	NARANGATTAHINNA
327	OHIYA
329	OLIYAGANKELE
333	Padawiya
-343	PANILKANDA (N=2)
-362	PEDRO (N=3)
376	Potawa
-573	PUSWELLAGOLLA (N=4)
595	Radaliwinnekota
383	RAGALLA
384	Rajawaka
388	RAMMALAKANDA
390	RANWARAGALAKANDA
392	RAVANA ELLA
394	RILAGALA
395	RITIGALA
-398	RUHUNA/YALA (N=8)
407	SELLANKANDAL
514	SEMBAWATTE
-414	SINHARAJA (N=14)
532	Talawegoda
426	TANGAMALAI
432	TIBBUTUKANDA
506	TIBORUWAKOTA
570	Tottawelgola
576	ULGALA
588	Wadinahela
-455	WALANKANDA (N=8)
659	WATHURANA
463	WEDAKANDA
464	Wedasitikanda
471	Welihena
652	Wellamudawa
-487	YAGIRALA (N=3)
489	YAKDESSAKANDA

Important Forests (N=45)

EMD No.	Name
4	Alapalawala
11	Anaolundewa
527	Angamana
605	Balanagala
513	Batahena
568	Beliyakanda
516	Boralugoda
72	Demanagammana
500	Derangala
548	Dumbara
580	Dummalahela
-96	Gal Oya Valley (N=6)
540	Galbokaya
538	Gallegodahinna
566	Gosgahapatana
598	Gunner's Quoin
519	Guruyalle
543	Handuwelkanda
133	Hidellana-Weralupe
508	Hindeinattu
142	Hurulu
520	Illukkanda
157	Kadawatkele
611	Keeriyagolla
610	Kithedallakanda
169	Kumburugamuwa
221	Kurana Madakada
609	Madigala
239	Maduru Oya Block 1
565	Makulussa
504	Masimbula
269	Meegahatenna
281	Minneriya-Giritale Block 1
533	Mulgama
294	Muwagankanda
318	Neugalkanda
389	Ranwala
438	Uda Walawe
443	Ulinduwewa
583	Velihela
432	Victoria-Randenigala-Rantambe
458	Wanniyagama
465	Weerakulicholai-Elavankulam
521	Wewegalatana
510	Yakdehikanda

Lowest important forests (N=75)

EMD No.	Name
10	Ambanmukalana
567	Amsawagama
637	Andarawewa
654	Arangala
554	Aruakalu
17	Attavillu
597	Badanagala
27	Bakinigahawela
630	Bogodayagama
593	Bolhindagala
45	Campbell's Land
62	Darakulkanda
66	Degadaturawa
631	Dematawewa
579	Diggala
586	Diggalahela
642	Galmaduwa
-640	Getamalagamakanda (N=2)
594	Golupitiyahela
584	Guruhela
131	Henegedaralanda
518	Hopewell
-144	Inamaluwa (N=2)
160	Kahalla
170	Kananpella
177	Kanugollayaya
178	Kanumuldeniya
639	Katupotakanda
201	Kirinda Mahayayakele
653	Kokkebe
577	Korathalhinna
656	Kosgahakele
596	Kudagala North
601	Kumadiya Tulana
633	Labunoruwa
582	Lolehela
232	Ma Eliya
237	Madunagala
247	Mahakanda
599	Mahamorakanda
249	Mahapitakanda
635	Manawewakanda
272	Marakele
643	Marasinhagama
558	Masawa
517	Matinapatana
646	Medalassa Korale
278	Mihintale
277	Mihintale
285	Miriyagalla
591	Murutukanda
602	Mutugalla Tulana
-305	Namaneliya (N=2)
638	Pahala Mawatawewa
650	Pallankulama
600	Palliyagodella Tulana
645	Puliyamkulam
634	Puliyankulama
647	Ranawekanda
590	Randeniya
632	Ratmale Kanda
404	Sangappale
-406	Sellandkandal (N=2)
651	Semewa
603	Sinnakallu
592	Sitarama
553	Talpattekanda
644	Tambaragalawewa
629	Tambutakanda
442	Udawattakele
578	Ulgala (old)
453	Viharekele
604	Viyanahela
587	Westminster Abbey
496	Yoda Ela

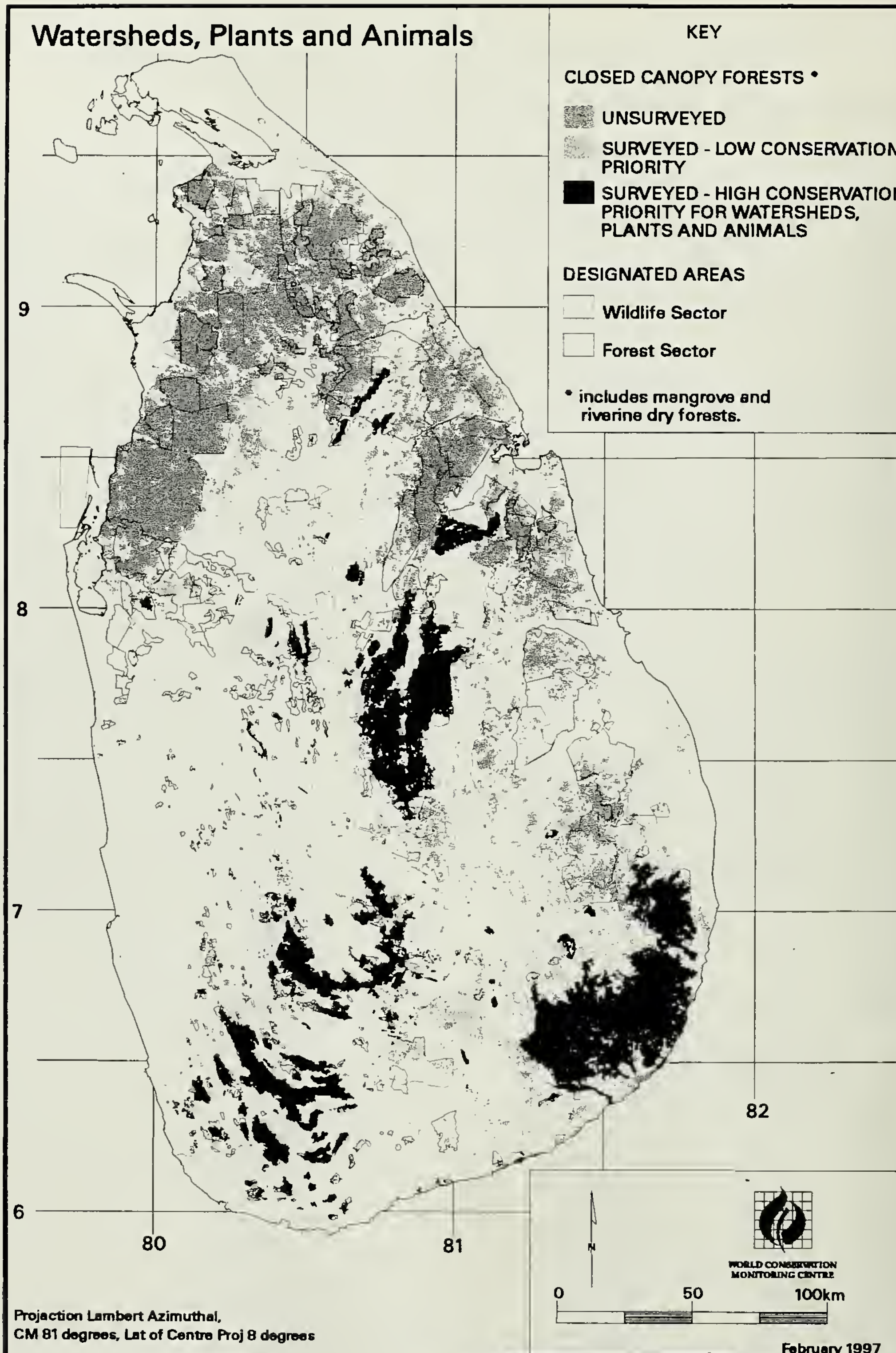


Figure 7.4 Minimum network of contiguous forests of highest importance for watershed protection and representation of all 1,153 woody plant species and 410 animal species recorded in the NCR.

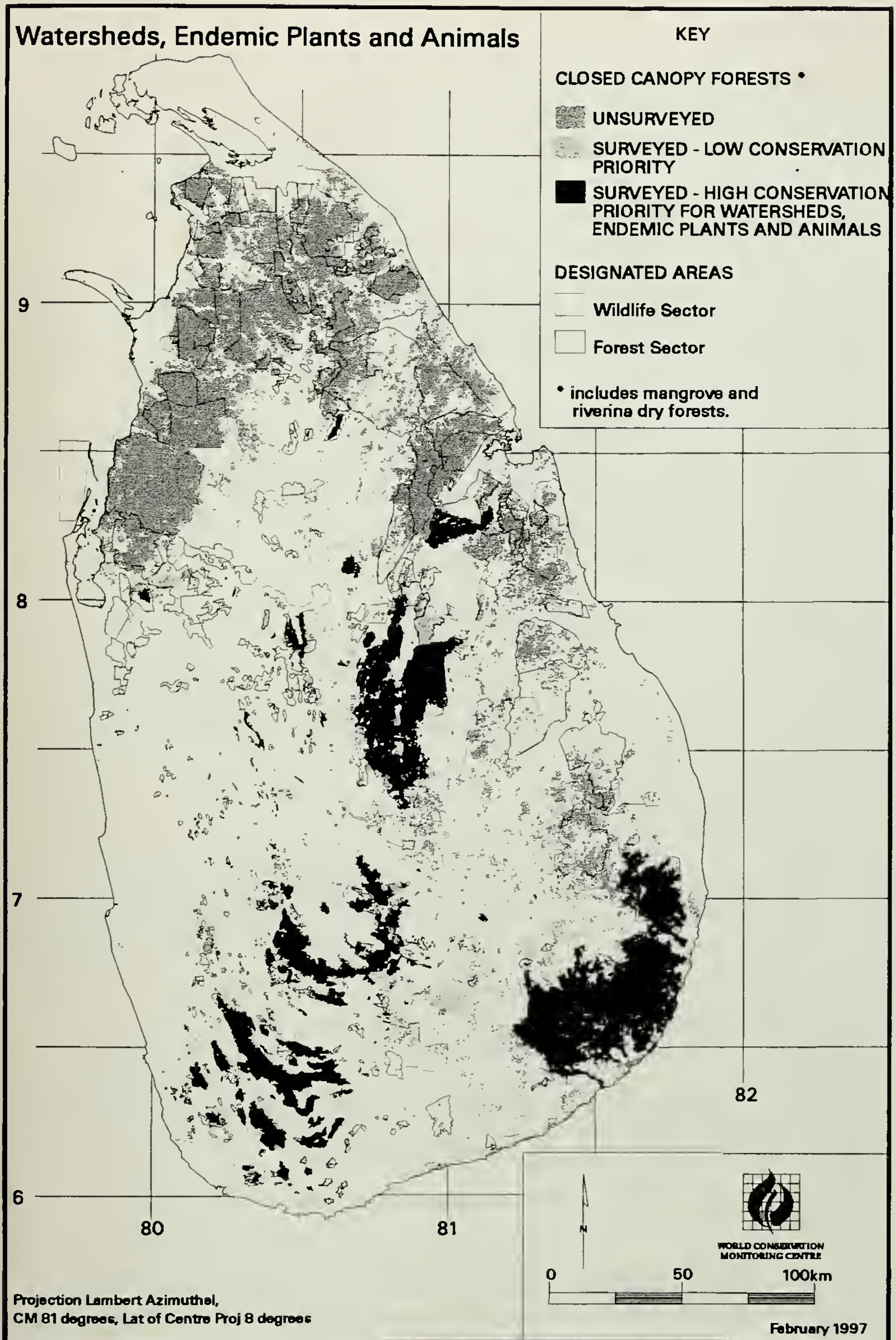


Figure 7.5 Minimum network of contiguous forests of top priority for watershed protection and representation of all 455 endemic woody plant species and 138 endemic animal species recorded in the NCR.

7.3 DISCUSSION

There has been extensive dialogue involving both the Forest Department and other governmental and non-governmental sectors to reach consensus on conservation objectives and priorities. This has been an ongoing, iterative process as evidenced from:

- the declaration of 13 conservation forests (covering some 24,000 ha) soon after the NCR commenced, based principally on recommendations from the Accelerated Conservation Review (TEAMS, 1991); and
- the subsequent declaration of Kanneliya and 17 other conservation forests (covering a total in excess of 25,000 ha) in the low country wet zone, based on the preliminary results of the NCR (Green, 1995) which were the subject of a seminar (Liyanage, 1996).

Following the completion of the field work and prior to the final analysis of the data, further meetings and seminars were held to reach a degree of consensus on the scientific criteria for defining an optimum system of conservation forests and their priority. The outcome of those discussions and their application to the results of the NCR are considered in the next two subsections, respectively.

7.3.1 Selection criteria for conservation forests

Objectives

The objectives of a national system of conservation forests for Sri Lanka are:

- to protect important watersheds,
- to conserve biodiversity, and
- to meet cultural, economic and social needs.

Given that biodiversity is defined in terms of the variability within species (genetic diversity), the variety of living organisms (species diversity) and the variety of biotic communities within the biosphere (ecosystem diversity), the most important considerations in designing a system of forests in which to conserve biodiversity are:

- maintenance of evolutionary processes, such as hydrological processes, nutrient cycles, biotic interactions and disturbance regimes;
- representation of all native forest ecosystems and seral stages across their natural range of variation; maintenance of viable populations of all native forest species in their natural patterns of abundance and distribution; and
- responsiveness to short-term and long-term environmental change (after Noss, 1991, 1992).

While the NCR does not contribute directly to identifying economic and social needs, particularly with respect to those communities living in and around natural forests, an attempt has been made to identify those forests likely to be under least pressure from human activities and, therefore, important in terms of their biological integrity and wilderness value.

Criteria

The following set of criteria should guide the selection of an optimum system of conservation forests. The order in which they are listed below does not reflect their relative importance, although the first criterion regarding existing protected areas is a pragmatic measure.

STATUS QUO

Existing protected areas will provide the foundation upon which to establish a system of conservation forests.

WATERSHED PROTECTION

Forests important for watershed protection will be selected on the basis of:

- their importance for protection of soil from erosion,
- their importance for control of flooding, and
- their importance for interception of fog.

Priorities for watershed protection, in no particular order, are:

- forests having a soil erosion value > 300 t ha^{-1} yr^{-1}
- forests having a mean annual flood value > 10 m s^{-1}.
- forests above 1,500 m because of their role in fog interception.

ECOSYSTEM DIVERSITY

In principle, the best way to represent all ecosystems is to conserve the full array of physical habitats and environmental gradients, from the highest to the lowest altitudes, the driest to the wettest sites, and across all types of soils, substrates, and topoclimates (Hunter *et al.*, 1988; Noss 1991).

In the case of Sri Lanka's forests, ecosystem diversity will be maximised by:

- ensuring that each floristic region is represented within the conservation forests system, and
- ensuring that each forest type is represented within the conservation forests system.

Priorities for ecosystem conservation, in order, are (after WCMC, 1996):

- ecosystems unique to Sri Lanka,
- ecosystems for which Sri Lanka holds a significant part of the world total, and
- species-rich ecosystems.

SPECIES DIVERSITY

Species diversity within Sri Lanka's forests will be maximised by:

- ensuring that all forest species are represented.

Priorities for species conservation, in order, are (after WCMC, 1996):

- endemic, globally threatened species,
- endemic, nationally threatened species,
- endemic, non-threatened species,
- non-endemic, globally threatened species,
  (with priority to those for which Sri Lanka holds a significant part of the world population)
- non-endemic, nationally threatened species, and
- non-endemic, non-threatened species.

GENETIC DIVERSITY

Genetic diversity within Sri Lanka's forests will be maximised by:

- ensuring that conservation forests are *as large as possible* to maintain viable populations of plants and animals; and
- linking conservation forests via *corridors* to provide for genetic exchange between geographically isolated populations, and for the movement of migratory populations.

Ideally, forests species, particularly endemics, should be represented within at least two forests as a safeguard from natural or anthropogenic catastrophes. In practice, this can only be achieved for some species. Many species, notably endemics, have restricted ranges that have become further reduced through loss of forest habitat. Thus, large size and provision of corridors provide all the more important means to counter the potential loss of genetic diversity.

OTHER CRITERIA

Other important considerations are the desirability, indeed necessity, for conservation forests to provide a wide range of other cultural and socio-economic goods (e.g. firewood, non-timber forest products) and services (e.g. research, tourism) in support of local communities and the public.

7.3.2 Optimum system of conservation forests

The results from this study clearly demonstrates the paramount importance of Sri Lanka's natural forests, both in terms of their role in maintaining ecosystem stability and functions and as a reservoir of high species diversity. It has also been possible to identify those forests of most importance for watershed protection and for biodiversity conservation at ecosystem and species levels.

Sufficient information, albeit neither always based on adequate samples with respect to species inventories nor geographically comprehensive, is now available to identify at least the most important constituents of an optimum system of conservation forests. These constituent forests are clearly evident from the results of the watershed and biodiversity analyses in Chapters 5 and 6, respectively. The close degree of complementarity between the watershed and biodiversity values of forest, as shown in Section 7.2.1, highlights the importance of such an integrated approach to conservation.

Application of the criteria presented in Section 7.3.1 to the results of this study provides a sound basis for developing an optimum system of conservation forests. General guidelines, in order of priority, are provided below.

1. As appropriate, use existing protected areas to provide the basis of a conservation forests system. A prerequisite is to upgrade the legal conservation status of the Knuckles and 31 other conservation forests.

   Based on NCR records, this will ensure that some 80% or more of species diversity, (90% in the case of woody plant species) is conserved.

2. Protect *top priority contiguous forests*, as defined in Table 7.2.

   This will ensure that the following are conserved:
   - forests of importance for soil **and** water conservation,
   - forests of importance for fog interception, and
   - forests of importance for endemic species.

3. Protect any outstanding *montane* forest that is not covered by the previous measure.

4. Protect other contiguous forests of *highest importance* for non-endemic species, as defined in Table 7.2.

5. Protect other *important* contiguous forests, as defined in Table 7.2.

   This will ensure that the following are conserved:
   - forests of importance for **either** soil **or** water conservation.

- Where opportunities exist, and in concert with the above measures, maximise representation of *mangroves, Floristic Regions III, V, VII, XI, XIII and soil zones 2, 3 and 4 of Floristic Region II* within the system of conservation forests.

Other guiding principles are as follows:

- Provide for as large conservation forests as possible, particularly in the wet zone where the role of forests in watershed protection and biodiversity conservation is crucial. Key units of contiguous forest which should be conserved in their entirety include:

  - Bambarabotuwa
  - Central Highlands
  - Gilimale-Eratne
  - KDN
  - Knuckles/Wasgomuwa
  - Pedro
  - Sinharaja

- Incorporate as much *wilderness* as possible within the conservation forests system.

- Plan for ecological corridors as a link between isolated forest fragments, particularly in the wet zone.

In conclusion, the results of the NCR show that extensive networks of conservation forests are necessary for full representation of species diversity, even for endemics.

Although there is some redundancy, in terms of forests which do not contribute any species to the optimum system, it is mostly with respect to forests in the dry zone where species diversity and levels of endemism are lower. Even small forests in the wet zone have unique species, such as the 18 ha privately-owned Wathurana forest with its several endemic and other woody plant species that have not been recorded elsewhere (Annex 6).

Given that there is very little redundancy in the wet zone, forests being important for either woody plants, animals or for protection of watersheds, every effort should be made to conserve remaining natural forest and maintain the current ban on logging in the wet zone for the foreseeable future. It is unlikely, however, that such measures will be adequate to safeguard the entire spectrum of forest biodiversity. It will be necessary, therefore, to conserve biodiversity though other measures, including private stewardship of natural forests.

7.4 FUTURE

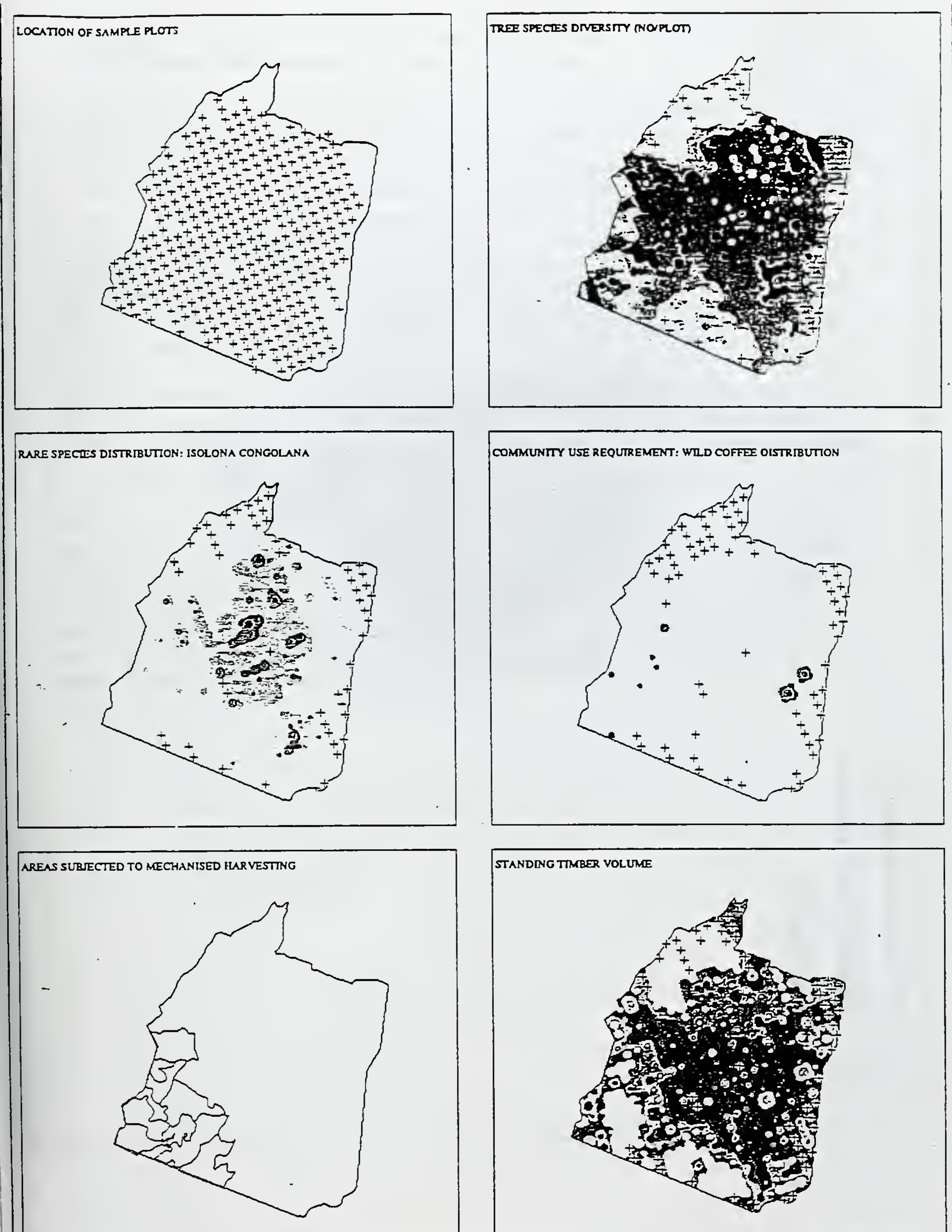
Ten years on from the first Forestry Master Plan of 1986, when provisions to safeguard Sri Lanka's rapidly dwindling natural forests were totally inadequate, future prospects are much more promising. The ban on logging in the wet zone, introduced in 1990, has essentially been enshrined within the National Forestry Policy of 1995, which gives overriding priority to the conservation of biodiversity and protection of watersheds within forest ecosystems.

In the meantime, the NCR has been completed and now provides a wealth of reliable data upon which to implement conservation provisions within the new National Forestry Policy. The results of the NCR presented in this report provide a sound basis for defining and establishing an optimum system of conservation forests to meet watershed protection and biodiversity conservation objectives. However, it is neither possible nor, indeed, entirely appropriate to precisely identify each conservation forest within this optimum system for two main reasons:

- biodiversity information on some forests is either inadequate or totally lacking; and
- cultural, economic and social considerations need to be taken into account as part of the decision-making process.

The next step, therefore, is for the Forest Department to consider with other sectors pragmatic ways of addressing the conservation priorities identified in this report, taking proper account of any socio-economic implications. Importantly, its Environmental Management Division now has the necessary skills and tools to elaborate further on the design of an optimum conservation forests system to meet other criteria that may arise during the implementation process. As demonstrated for a limited number of scenarios in this report (Section 6.2), the Environmental Information Management System (EIMS) provides a very powerful tool with which to explore alternative options for biodiversity conservation and quantify their potential benefits and costs.

In order to further optimise this system of conservation forests, it will be necessary to carry out additional surveys of forests overlooked by the NCR, as well as those inadequately inventoried for species. Moreover, any plans to convert natural forest to other forms of land use or manage it for purposes other than conservation should be preceded by more detailed biodiversity surveys in order to fully evaluate their impact.


LOCATION OF SAMPLE PLOTS
TREE SPECIES DIVERSITY (NO/PLOT)
RARE SPECIES DISTRIBUTION: ISOLONA CONGOLANA
COMMUNITY USE REQUIREMENT: WILD COFFEE DISTRIBUTION
AREAS SUBJECTED TO MECHANISED HARVESTING
STANDING TIMBER VOLUME

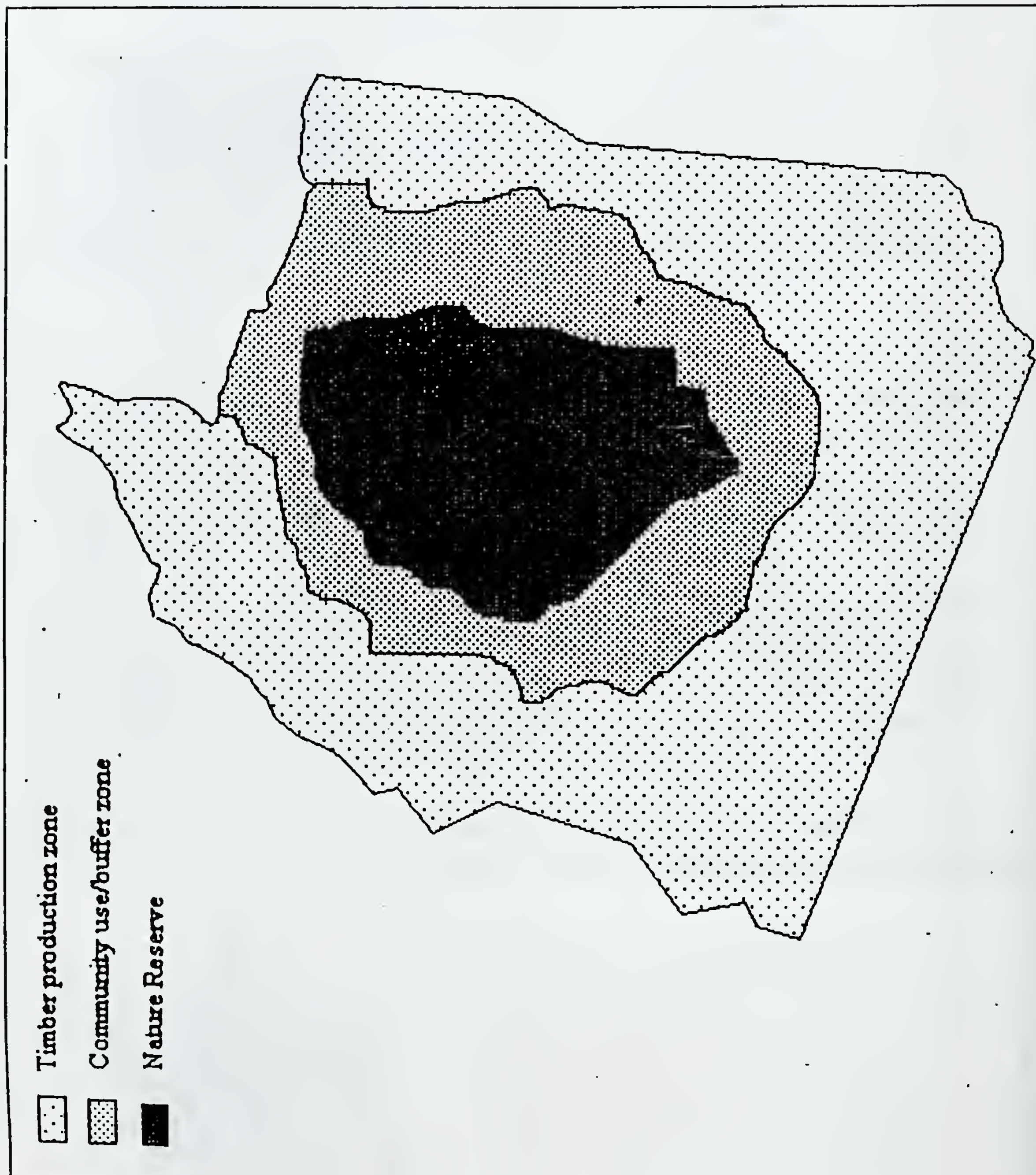


Figure 7.7 Zonation of a forest to meet biodiversity conservation, community and timber production requirements (Source: Howard, 1995)

This should be considered mandatory for any forest either not surveyed or inadequately surveyed by the NCR, particularly if it lies in the wet zone.

Despite the wealth of data generated by the NCR, it should be emphasised that they are preliminary, having been based on rapid assessment techniques. Much more detailed and wide-ranging surveys will be required to plan the management of individual conservation forests. An example of an integrated approach to management planning is illustrated in Figure 7.6. Having surveyed and mapped the distribution of land use patterns and important elements of biodiversity within a forest, it is then possible to demarcate management zones to provide a range of services (Figure 7.7). Such an integrated approach enables conservation and development objectives to be reconciled. It is crucial, however, to monitor the impact of management measures on biodiversity over the long term to ensure that they are sustainable.

Inevitably, designing an optimum system of conservation forests is an iterative process, particularly as more data become available as conservation forests are established and surveyed for management planning purposes. New data incorporated within EIMS can be used to refine conservation planning at the system level.

Finally, given the need for further biodiversity surveys, it should be noted that there are more rapid, less costly alternatives to inventorying plant species. Based on experimental fieldwork in Sri Lanka, it has been shown that taxa at the level of genera or families are reliable surrogates for species richness. Inventorying woody plant genera or families instead of species reduced survey costs by at least 60% and 85%, respectively. In the case of inventorying at the level of genera, this had little effect on the representation of the full range of woody plant species within minimum forest systems (Balmford *et al.*, 1996).

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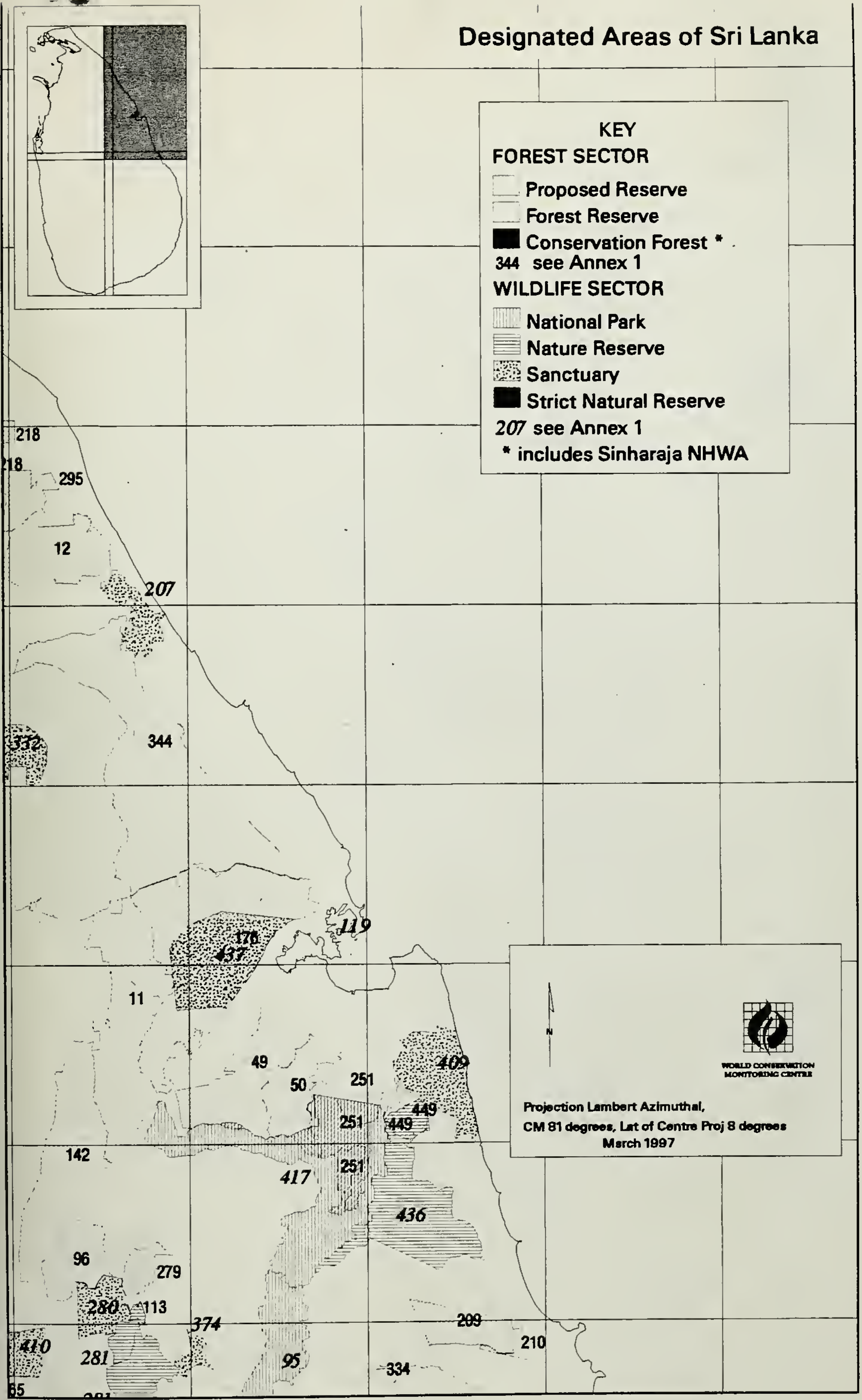
Designated Areas of Sri Lanka
KEY
FOREST SECTOR
Proposed Reserve
Forest Reserve
Conservation Forest *
344 see Annex 1
WILDLIFE SECTOR
National Park
Nature Reserve
Sanctuary
Strict Natural Reserve
207 see Annex 1
* includes Sinharaja NHWA
Projection Lambert Azimuthal,
CM 81 degrees, Lat of Centre Proj 8 degrees
March 1997
WORLD CONSERVATION MONITORING CENTRE
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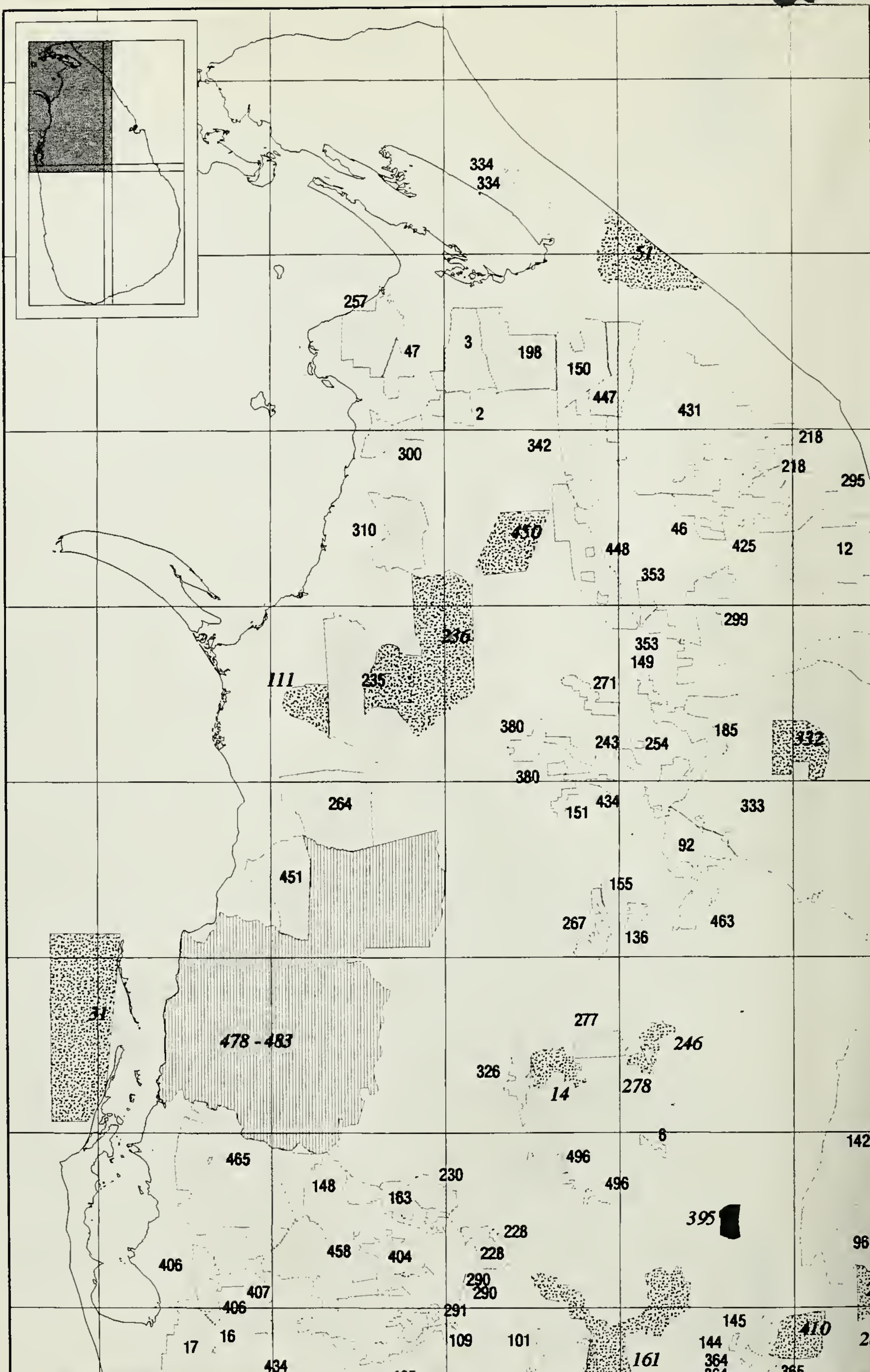
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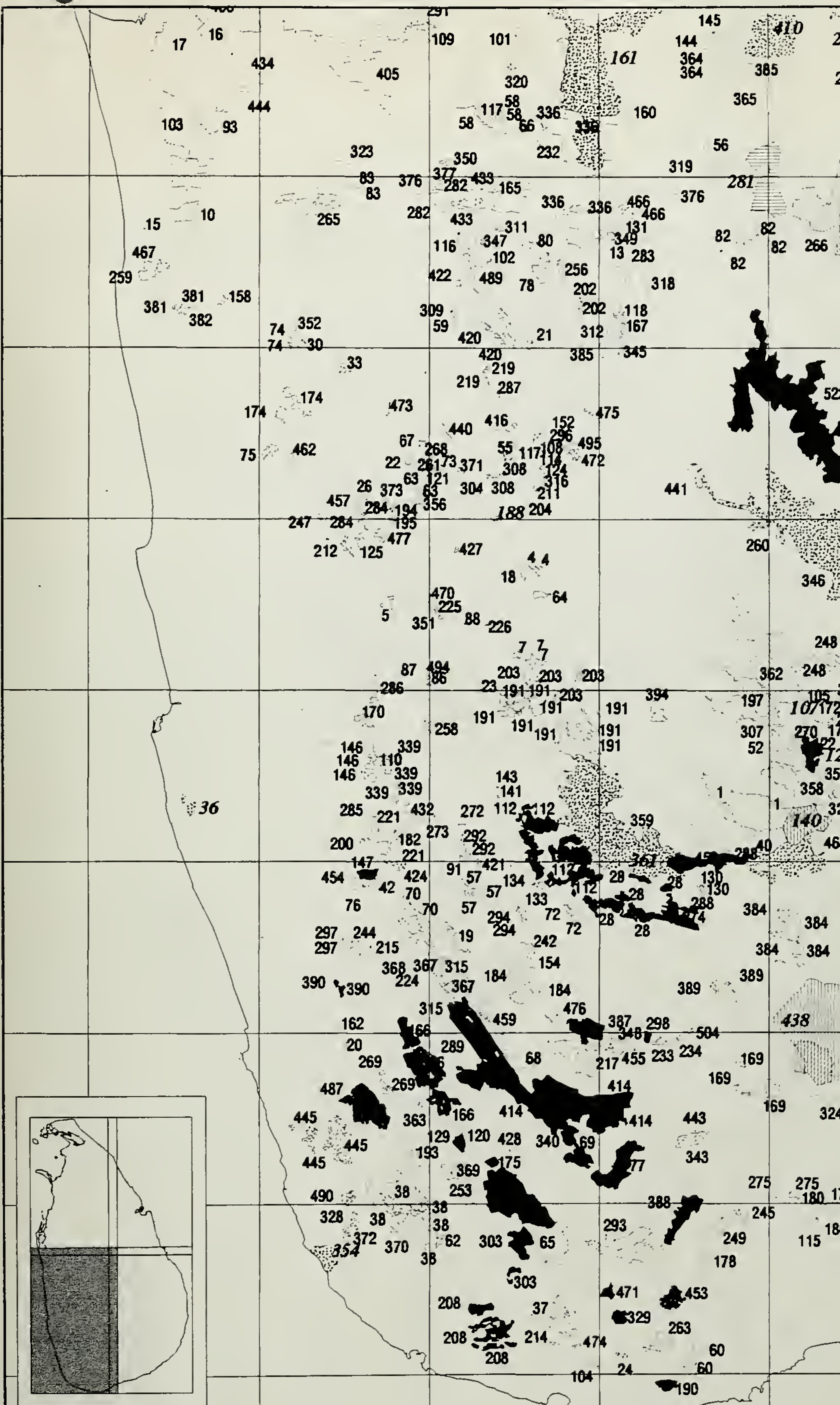

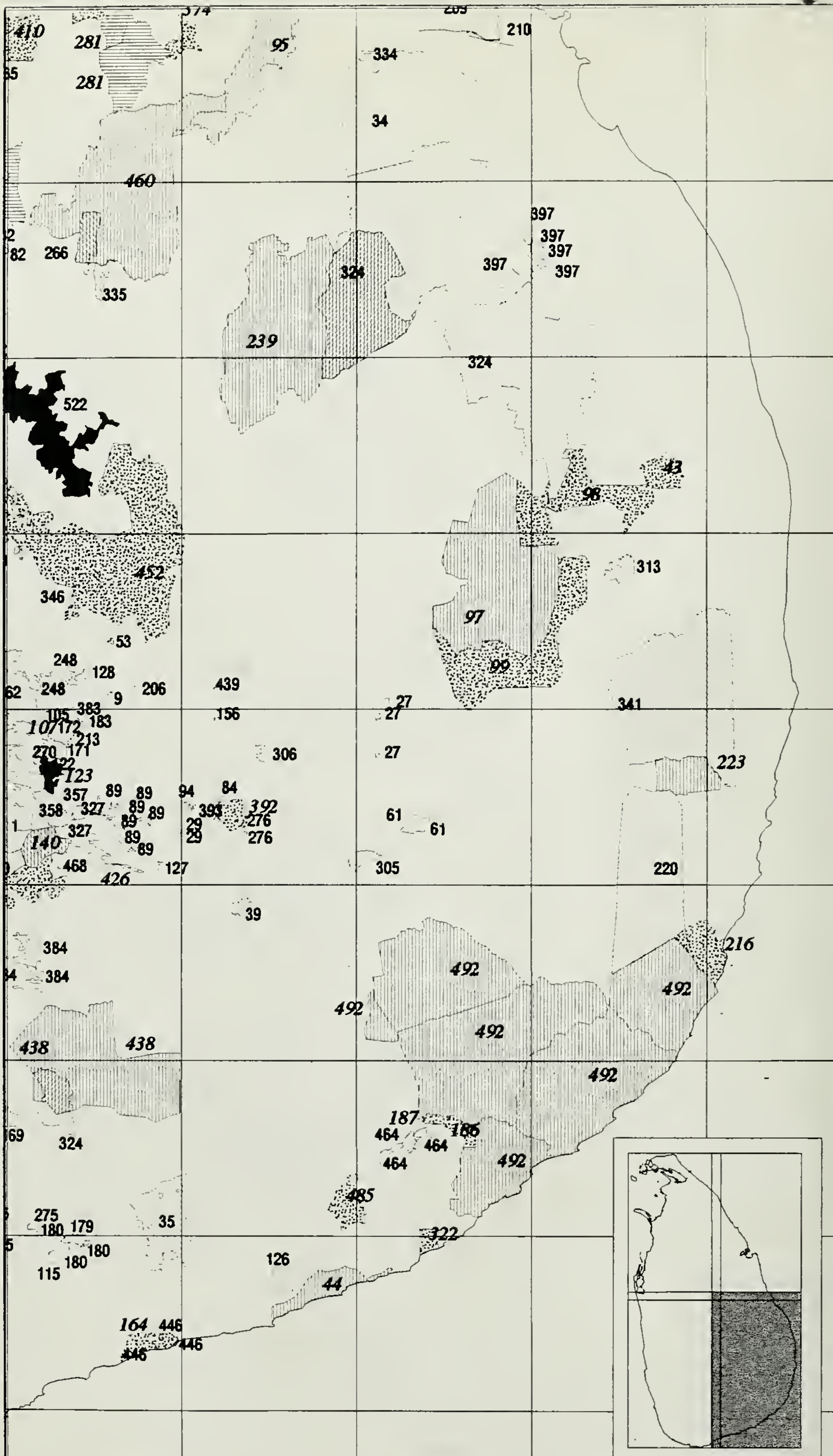
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Annex 1

LIST OF DESIGNATED AREAS

Nationally designated areas are listed alphabetically, by responsible administration. Where known, their boundaries are shown in the maps immediately preceding this annex.

Proposed reserve is an administrative rather than legal designation for forests originally intended for notification as forest reserves. Boundary demarcation, as a prelude to notification, never took place due the tide of events over recent decades when forest land was released for use outside the forestry sector at an increasingly rapid rate.

The 12 *national parks* comprise a total of 24 independently notified blocks.

Notified area is the area originally notified or, in the case of proposed reserves, declared as protected. *Present area* is the notified area corrected for land released from forest or proposed reserves subsequent to their establishment. *MAB area* is the area declared by the Forest department as a national Man and Biosphere Reserve. *GIS area* is the area computed from the digitised boundaries, using a Geographic Information System. It should provide the most accurate estimate, provided that the digitised boundaries reflect any changes following land releases. Comparison between the three estimates of area for any given site suggests that this may not always be the case for forest or proposed reserves.

EMD No.	Name and national designation		Notification date	Area (ha) Notified	Present	MAB*	GIS	District(s)	
FOREST DEPARTMENT									
1	Agra-Bopats	PR		9105.4	6933.6	0.0	619.4	NUW	
3	Akkiriyan	FR		8179.5	7684.0	0.0	8220.4	JAF	
2	Akkiriyan	PR		2681.0	2681.0	0.0	2815.1	MUL	JAF
4	Alapalawala	PR		182.1	181.7	0.0	27.8	KEG	
5	Alawala-Ataudakanda	PR		352.8	352.8	0.0	31.7	GAM	
6	Alutabendawewa	PR		440.2	384.0	0.0	487.5	ANU	
7	Amanawala-Ampane	PR		518.0	514.0	0.0	56.7	KEG	
9	Ambaliyadde	PR		61.7	61.7	0.0	107.4	NUW	
10	Ambanmukalana	FR	15/05/1896	1085.9	1004.8	0.0	1180.8	PUT	
11	Anaolundewa	PR		29640.2	28957.1	50511.7	29422.6	ANU	POL
12	Andankulam	FR	10/06/1921	15158.7	14835.0	0.0	15113.6	MUL	VAV
13	Angurukandayaya	PR		139.2	139.2	0.0	125.3	KUR	
15	Arachchikotuwa	PR		0.8	0.8	0.0	6.4	PUT	
17	Attavillu	FR	21/06/1912	9009.1	5179.4	0.0	8695.3	PUT	
16	Attavillu	PR		429.4	429.4	0.0	462.9	PUT	
18	Aturupana	FR	14/11/1941	24.8	24.8	0.0	48.0	KEG	
19	Ayagama	PR		661.7	214.3	0.0	633.3	RAT	
20	Badagama	PR		24.7	24.7	0.0	40.7	KAL	
21	Badagamuwa	FR	01/06/1894	228.7	213.9	20.2	241.0	KUR	
22	Badapeliyagoda	FR	28/10/1938	49.9	49.9	0.0	45.7	KUR	
24	Badullakele	FR	11/10/1940	182.3	147.7	0.0	179.8	MTR	
23	Badullawala	PR		42.9	41.0	0.0	52.7	KEG	
26	Bajjangoda	PR		175.9	175.9	0.0	173.7	GAM	
27	Bakinigahawela	FR	27/05/1921	200.3	200.3	0.0	90.0	MON	
28	Bambarabotuwa	FR#	04/07/1890	5440.3	5440.3	0.0	1181.4	RAT	
29	Bandarawela	PR		15.4	12.6	0.0	10.5	BAD	
30	Banhedawaka	PR		159.0	159.0	0.0	158.4	KUR	
33	Barigoda	FR	11/03/1921	78.5	78.5	0.0	147.8	KUR	

EMD No.	Name and national designation		Notification date	Area (ha) Notified	Present	MAB*	GIS	District(s)
32	Barıgoda	PR		72.7	72.7	0.0	0.0	KUR
34	Baron's Cap	PR		38121.4	37397.1	1012.1	37516.2	BAT
35	Bedigantota	PR		8093.7	7527.2	0.0	8679.4	HAM
37	Beraliya (Akuressa)	PR		1859.9	1645.5	0.0	0.0	GAL MTR
38	Beraliya (Kudagala)	PR		4241.1	2571.8	0.0	4.4	GAL
39	Bibilehela	PR		610.0	606.3	0.0	721.0	BAD MON
40	Bogawantalawa	PR		4289.7	4289.7	0.0	3781.6	NUW
42	Botale	PR		276.1	276.1	0.0	313.4	KAL
45	Campbell's Land	FR	22/03/1902	292.6	292.6	0.0	278.3	KAN MTL
46	Chamalankulam	FR	10/06/1921	3281.7	3281.7	0.0	3371.4	MUL
47	Chunavil	FR	10/06/1921	2298.6	2298.6	0.0	2110.4	JAF
49	Chundankadu	FR	01/03/1940	16746.3	5690.3	0.0	17599.4	TRI
50	Chundankadu	PR		11051.5	8443.7	0.0	10417.4	TRI
52	Conical Hill	PR		1569.5	707.5	0.0	1721.3	NUW
53	Dambakele	FR		71.2	71.2	0.0	60.4	NUW
54	Dambukanda	PR		41.7	41.7	0.0	0.0	GAM
55	Dambulla	FR	29/01/1937	172.3	169.5	0.0	82.3	KEG
56	Dambulla Oya	PR		104.4	103.2	0.0	75.8	MTL
57	Dambuluwana	FR	12/04/1943	485.2	401.1	0.0	292.4	RAT
58	Dambuwa	PR		1062.3	1062.3	0.0	74.3	KUR
59	Dampitiya	PR		97.1	11.1	0.0	62.1	KUR
60	Dandeniya-Aparekka	FR	02/12/1938	560.0	348.3	0.0	588.2	MTR
61	Daragoda	FR	07/01/1921	748.9	748.9	374.4	658.7	MON
62	Darakulkanda	PR		457.6	141.7	0.0	235.2	GAL
63	Dawatagolla	FR	05/03/1937	43.2	34.7	0.0	56.1	KUR
64	Debetgama Bossella	PR		103.2	103.2	0.0	215.1	KEG
65	Dediyagala	FR	06/09/1940	3789.9	3789.9	0.0	3866.0	GAL MTR
66	Degadaturawa	PR		161.9	161.9	0.0	268.3	KUR
67	Dehelgamuwa	FR	03/05/1940	58.0	4.1	0.0	66.4	KUR
68	Delgoda	PR		998.0	998.0	0.0	1013.5	RAT
69	Dellawa	PR#		2034.0	2236.3	0.0	1250.5	GAL MTR
70	Delmella Yatagampitiya	PR		2033.7	1413.3	0.0	55.8	KAL
71	Delwela	PR#		1560.9	1560.1	0.0	1531.9	RAT
72	Demanagammana	PR		114.9	114.1	0.0	53.5	RAT
73	Dewalakanda	FR	04/08/1939	112.5	112.5	0.0	111.0	KUR
74	Digalla	FR	18/06/1948	90.3	87.0	0.0	60.9	KUR
75	Dikkele Mukalana	FR	22/07/1921	336.4	308.1	0.0	324.5	KUR
76	Diwalakada	PR		281.1	144.3	0.0	313.5	KAL
77	Diyadawa	FR#	21/08/1936	2578.2	2447.7	404.8	2504.9	MTR
78	Doluwakanda	PR		400.6	400.6	400.8	499.1	KUR
79	Dotalugala	PR		1871.7	1871.7	1619.4	86.0	KAN MTL
80	Dunkanda	PR		301.1	301.1	0.0	488.4	KUR
82	Elagomuwa	PR		870.1	870.1	0.0	15.2	MTL
83	Elawaka	PR		168.3	168.3	0.0	67.6	KUR
84	Ella	PR		52.2	52.2	0.0	75.1	BAD
86	Eluwana	FR	02/12/1892	85.6	85.6	0.0	150.9	KEG
85	Eluwana	PR		28.3	28.3	0.0	0.0	KEG
87	Epilagala	PR		42.5	42.5	0.0	52.3	KEG
88	Erabaduwala	PR		17.4	17.4	0.0	6.0	KEG
89	Erabedda	PR		1538.9	1538.8	0.0	13.8	BAD
91	Etabedda	FR	08/05/1875	91.1	70.8	0.0	63.5	RAT
92	Etakaduwa	PR		7689.0	7689.0	0.0	6318.0	ANU
93	Etaritiya	PR		1558.0	1428.5	0.0	1482.8	PUT
94	Ettalapitiya	PR		269.1	269.1	0.0	236.5	BAD
96	Gal Oya	PR		9036.6	8897.4	0.0	8493.4	POL
100	Galaha	PR		242.8	242.8	0.0	0.0	KAN
101	Galgiriyakanda	PR		1182.5	1182.5	0.0	1208.7	KUR
102	Galketiyagama	PR		40.5	40.5	0.0	122.3	KUR
103	Galkuliya	PR		4775.3	4127.8	0.0	4723.6	PUT
104	Gallendakuttiya	FR	21/02/1936	89.3	89.1	0.0	20.3	MTR
105	Galpalama	PR		73.6	68.0	0.0	70.6	NUW
106	Galway's Land	PR		56.7	56.7	0.0	0.0	NUW
108	Gangekumbura	FR	11/11/1938	156.4	156.3	0.0	19.7	KEG
109	Getadivula	PR		581.5	581.5	0.0	573.3	KUR
110	Getamarawa-Dunkolahena	PR		129.7	129.7	0.0	87.4	COL
112	Gilimale-Eratne	PR#		5832.7	4838.8	40.4	61.5	RAT
113	Giritale	PR		1077.3	1063.1	0.0	574.2	POL
114	Godagandenikanda	PR		55.8	55.8	0.0	21.3	KEG
115	Gonadeniya	FR	16/12/1921	414.4	414.4	0.0	339.8	HAM
116	Gonagama	PR		457.7	235.1	0.0	467.1	KUR
117	Gondenikanda	FR	04/07/1941	73.0	72.4	0.0	61.4	KEG
118	Gorakadola	FR	23/09/1938	191.9	191.1	0.0	230.0	KUR
120	Habarakada	PR		209.6	209.6	202.4	271.4	GAL

EMD No.	Name and national designation		Notification date	Area (ha) Notified	Present	MAB*	GIS	District(s)	
121	Habilikanda	PR		180.9	180.9	0.0	198.1	KUR	
122	Hakgala	FR		423.2	423.2	0.0	22.6	NEW	BAD
124	Halagiriya	FR	20/12/1940	40.5	18.1	0.0	40.4	KEG	
125	Halpankanda	PR		159.3	158.5	0.0	22.8	GAM	
126	Hambantota	PR		1165.5	1125.0	0.0	1170.8	HAM	
127	Haputale	FR	08/07/1921	141.3	141.1	0.0	119.7	BAD	
128	Harasbedda	PR		364.2	364.2	0.0	279.1	NUW	
129	Haycock	FR#		362.0	362.0	364.3	380.8	KAL	
130	Helapandeniya	PR		136.0	21.4	0.0	83.8	RAT	
131	Henegedaralanda	PR		731.7	729.6	0.0	671.2	KUR	
132	Heraliyawala	PR		13.8	13.8	0.0	0.0	KUR	
134	Hidellana	FR	08/05/1875	48.6	48.6	0.0	27.3	RAT	
133	Hidellana-Weralupe	PR		136.8	128.1	0.0	181.6	RAT	
136	Hinna	PR		1021.8	1021.8	0.0	1088.4	ANU	
141	Humpitikanda	PR		36.4	19.4	0.0	28.8	KEG	
142	Hurulu	FR	20/11/1942	25511.1	25217.7	0.0	25497.6	ANU	POL
143	Imbulpitiya	FR	05/09/1941	12.2	12.2	0.0	19.1	KEG	
145	Inamaluwa	FR	03/03/1944	1896.9	1863.6	0.0	2013.0	MTL	
144	Inamaluwa	PR		309.6	309.6	0.0	263.4	MTL	
146	Indikada Mukalana	PR		786.1	747.5	0.0	176.6	COL	
147	Ingiriya	FR#	07/08/1929	407.0	282.6	0.0	449.3	KAL	
148	Ipolagama	PR		4451.5	4203.7	0.0	4805.1	PUT	
149	Irampaikulam	FR	10/06/1921	944.9	944.9	0.0	969.7	MUL	VAV
150	Iranaimadu	FR	16/05/1930	8321.8	7541.8	1417.0	8083.0	JAF	MUL
151	Irasenthirankulam	FR	10/06/1921	1458.4	1116.5	0.0	1477.6	VAV	
152	Iriminna	FR	03/05/1940	25.8	25.8	0.0	16.7	KUR	
153	Iriyagahahena	PR		44.5	44.5	0.0	0.0	RAT	
154	Iriyagahahena Mukalana	FR	24/06/1927	74.5	44.1	0.0	172.5	RAT	
155	Issenbessawewa	FR	07/06/1901	441.9	441.9	300.0	455.7	ANU	
156	Judges Hill	PR		10.9	10.7	0.0	50.1	BAD	
157	Kadawatkele	PR		283.3	267.1	0.0	258.0	KUR	
158	Kaduruwewa	PR		120.2	120.2	0.0	102.0	KUR	
160	Kahalla	FR	11/10/1935	3397.7	3292.5	0.0	3337.9	ANU	
159	Kahalla	PR		34.0	34.0	0.0	0.0	ANU	
162	Kaharagala	PR		31.8	31.8	0.0	32.7	KAL	
163	Kala Oya	PR		4949.7	4949.7	0.0	5127.5	KUR	
165	Kalugala	PR		3365.0	2705.9	0.0	3149.3	KUR	
166	Kalugala	PR#		4630.1	4288.0	0.0	1087.1	KAL	
168	Kalugalkanda	FR	10/11/1933	62.5	62.5	0.0	0.0	MTR	
167	Kalugalkanda	PR		153.0	152.9	0.0	197.3	KUR	
170	Kananpella	FR		295.2	263.5	0.0	298.6	COL	
172	Kandapola Sita Eliya	FR	20/05/1892	2721.2	2615.9	20.2	1819.1	NUW	
171	Kandapola Sita Eliya	PR		109.6	97.9	0.0	1067.1	NUW	
173	Kandawattegoda	PR#		404.7	358.6	0.0	0.0	GAL	
174	Kankaniyamulla	FR	20/12/1940	1108.0	1047.9	161.9	310.5	KUR	
175	Kanneliya	FR#	06/07/1934	6114.4	6024.5	40.4	249.6	GAL	
176	Kantalai	FR	31/01/1902	40007.7	37479.3	0.0	46663.5	TRI	
177	Kanugollayaya	PR		211.7	119.5	0.0	254.1	KUR	
178	Kanumuldeniya	FR	13/09/1940	678.7	678.7	20.2	674.2	HAM	MTR
179	Kaparella Uswewa	FR	16/12/1921	564.4	564.4	0.0	558.4	HAM	
180	Kaparella Uswewa	PR		214.5	214.5	0.0	3.1	HAM	
181	Karagahatenna	PR		55.4	55.4	0.0	0.0	GAM	
182	Karandana	FR	30/06/1899	77.8	77.8	0.0	86.0	RAT	
183	Karandekumbura	PR		72.8	72.8	0.0	52.0	BAD	
184	Karawita	PR		1375.9	1211.8	0.0	269.7	RAT	
185	Karunkalikulam	FR		8037.1	6398.9	0.0	8432.0	VAV	
189	Kebalawita	PR		114.9	114.9	0.0	6.2	GAM	
190	Kekanadura	FR#	15/11/1935	401.7	379.9	0.0	453.5	MTR	
191	Kelani Valley	FR	11/09/1903	1155.1	1155.1	0.0	152.3	KEG	
192	Kelani Valley	PR		2944.9	2906.2	0.0	3.1	KAN	
193	Kelunkanda	FR	16/06/1939	249.0	196.3	0.0	270.7	GAL	
194	Kendahena	FR	29/07/1932	69.2	69.2	0.0	77.2	KUR	
195	Kendahena	PR		0.2	0.2	0.0	109.2	KUR	
196	Ketangilla	PR		86.2	86.2	0.0	0.0	KEG	
197	Kikilimana	PR		4868.4	4580.6	809.7	4879.2	NUW	
198	Kilinochchi	FR		11190.7	10784.7	1417.0	11144.5	JAF	
503	Kinniya	PR		14.2	14.2	0.0	0.0	TRI	
200	Kirigala Mukalana	PR		18.8	18.8	0.0	35.4	KAL	
201	Kirinda Mahayayakele	FR	19/07/1940	374.1	252.7	0.0	0.0	MTR	
202	Kirindigolla	FR	05/03/1937	171.0	171.0	0.0	26.6	KUR	
203	Kitulgala	PR		265.9	263.0	0.0	48.7	KEG	
204	Kivulpona	FR	21/08/1936	21.6	21.6	0.0	22.9	KEG	
205	Kobahadunkanda	PR		890.3	890.3	0.0	0.0	RAT	

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206	Kohile	PR		12.1	12.1	0.0	112.6	BAD
208	Kombala-Kottawa	PR#		2289.7	1624.6	202.4	121.9	GAL
209	Koralai	FR	04/01/1929	7774.0	3664.0	0.0	7564.6	BAT
210	Koralai	PR		1165.5	1102.4	0.0	1181.3	BAT
211	Kotagama	FR	01/11/1935	29.5	29.5	0.0	39.3	KEG
212	Kotakanda	PR		254.8	242.7	0.0	212.4	GAM
213	Kotakitulakanda	PR		60.7	60.7	0.0	55.2	BAD
214	Kudagalkanda	FR		151.8	25.7	0.0	236.2	MTR
215	Kudaganga	FR		141.3	137.4	0.0	139.7	KAL
217	Kudumiriya	PR		2144.8	2144.8	0.0	2153.0	RAT
218	Kulamiruppu A & B	FR	10/06/1921	5036.1	4277.3	0.0	1714.2	MUL
219	Kumbalpola	PR		102.8	96.3	0.0	79.0	KUR
220	Kumbukkan	PR	08/04/1927	37635.8	37635.8	0.0	26332.7	AMP
169	Kumburugamuwa	FR	03/03/1893	1523.2	1480.7	0.0	6.8	RAT
221	Kurana Madakada	PR		1391.2	1161.4	0.0	31.9	KAL
222	Labugama-Kalatuwana	FR	16/03/1992	2150.1	2150.1	0.0	0.0	COL KAL RAT
224	Latpandura	PR		42.1	42.1	0.0	41.8	KAL
225	Lenagala	FR	23/12/1897	33.8	30.0	0.0	38.1	KEG
226	Lewala	FR	13/01/1893	31.7	30.0	0.0	27.0	KEG
227	Likolawewa	FR	24/07/1936	3462.2	3462.2	0.0	0.0	KUR
228	Likolawewa	FR	19/07/1940	325.7	325.7	0.0	3382.3	ANU
230	Lunu Oya	FR	01/09/1939	3647.4	3647.4	0.0	3945.2	ANU
232	Ma Eliya	FR	02/08/1935	383.6	381.2	0.0	261.1	KUR
234	Madampe	FR#	10/02/1893	237.3	224.8	0.0	248.5	RAT
233	Madampe	PR#		40.5	40.5	0.0	33.8	RAT
235	Madhu	PR		22547.2	22346.4	1417.0	22307.8	MAN
237	Madunagala	FR	06/04/1992	975.2	975.2	0.0	0.0	HAM
241	Magurugoda	FR	25/05/1934	275.4	241.0	0.0	0.0	RAT
242	Magurugoda	PR		45.7	24.7	0.0	267.8	RAT
243	Maha Irampaikulam	FR		804.8	416.3	0.0	801.0	VAV
244	Mahagama	FR		368.7	227.1	0.0	406.6	KAL
245	Mahakaluweragoda	FR	21/07/1922	238.6	238.6	0.0	283.8	HAM
247	Mahakanda	PR		170.6	103.0	0.0	164.2	GAM
248	Mahakudagala	PR		1762.5	1638.7	0.0	317.4	NUW
249	Mahapitakanda	FR	16/12/1921	797.4	722.3	0.0	745.8	HAM
250	Mahaweliganga	PR		6475.0	6475.0	0.0	2639.6	TRI
251	Mahaweliganga North and South	FR	22/12/1939	9209.5	8642.1	0.0	5968.3	TRI
253	Malambure	FR	19/07/1935	1012.3	929.8	0.0	1109.2	GAL
254	Mamadu	FR		230.2	230.2	0.0	222.3	VAV
256	Manapaya	PR		314.0	314.0	0.0	318.9	KUR
257	Mandakalar	FR		8387.1	7577.7	0.0	8355.9	JAF
258	Maniyangama-Timbiripola	FR	04/11/1892	209.0	209.0	0.0	212.1	KEG
259	Manuwangama-Nariyagama	FR	07/12/1894	537.6	244.2	0.0	385.7	PUT
260	Maoye Ella	FR	24/02/1888	48.6	48.6	0.0	82.1	KAN
261	Maragalkanda	FR	14/07/1939	117.1	20.0	0.0	125.4	KUR
273	Marakele	FR	08/05/1875	76.9	76.9	0.0	99.8	RAT
272	Marakele	PR		131.5	106.2	0.0	138.7	RAT
262	Masimbula	FR	13/12/1889	20.2	20.2	0.0	0.0	RAT
504	Masimbula	PR		255.0	255.0	0.0	299.2	RAT
263	Masmullekele	FR	21/07/1939	805.4	618.0	20.2	715.2	MTR
264	Mavillu	FR	10/06/1921	14601.1	14601.1	0.0	14574.6	MAN
265	Mawattagama	PR		2152.9	1512.6	0.0	2178.8	KUR
266	Medaulpota	PR		2340.2	2340.2	0.0	2374.5	MTL POL
267	Medawachchiya	PR		2892.5	2878.4	0.0	2933.0	ANU
268	Meeambakanda	FR	01/09/1939	124.6	124.6	0.0	160.4	KUR
269	Meegahatenna	PR		282.8	277.4	0.0	80.2	KAL
270	Meepilimana	FR	02/11/1906	981.8	771.5	0.0	362.0	NUW
271	Melkulam	FR	10/06/1921	2197.2	1931.6	0.0	2166.0	MUL VAV
274	Messana	PR#		724.4	433.8	0.0	705.8	RAT
275	Middeniya	FR	03/10/1941	372.7	372.5	0.0	103.5	HAM
276	Migollegama	PR		141.2	141.2	0.0	80.0	BAD
277	Mihintale	FR	14/11/1924	3308.2	2462.9	0.0	3270.3	ANU
279	Minneriya	PR		2444.3	828.0	809.7	3392.8	POL
282	Minuwangeta	PR		746.2	139.2	0.0	22.1	KUR
283	Mipitikanda	PR		235.9	235.9	0.0	284.4	KUR
284	Mirigamkanda	PR		139.3	139.2	0.0	13.6	GAM
285	Miriyagalla	FR		123.7	123.1	0.0	124.3	COL
286	Mitirigala	FR		511.5	353.7	0.0	500.1	GAM
287	Moragolla	FR	22/11/1895	21.3	19.9	0.0	24.2	KUR
288	Morahela	FR#	31/03/1893	930.5	846.9	0.0	545.5	RAT
289	Morapitiya-Runakanda	PR#		7012.5	6732.5	0.0	7108.1	KAL
290	Moturampatana	PR		319.3	235.9	0.0	110.2	KUR
291	Mudungoda	PR		774.2	774.2	0.0	832.1	KUR

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292	Mudunkotuwa	PR		78.1	78.1	0.0	89.4	RAT
293	Mulatiyana	FR	25/08/1944	3277.5	3148.9	404.8	3603.5	MTR
294	Muwagankanda	FR	20/03/1931	164.8	132.1	0.0	134.8	RAT
295	Nagancholai	FR	01/07/1932	6771.3	6447.5	1417.0	6824.8	MUL
296	Nagolla	FR	03/05/1940	123.1	123.1	0.0	38.3	KUR
297	Nahalla	PR		35.1	35.1	0.0	51.4	KAL
298	Nahiti Mukalana	FR#	13/12/1889	195.7	195.7	0.0	186.1	RAT
299	Nainamadu	FR	10/06/1921	9817.4	9740.5	0.0	9436.9	MUL VAV
300	Nakapaduwan	FR	10/06/1921	4149.7	2931.6	0.0	4026.0	JAF
301	Nakele	PR		80.9	80.9	0.0	93.1	PUT
302	Nakele Mukalana	FR	14/11/1924	39.8	29.3	0.0	0.0	KUR
303	Nakiyadeniya	PR#		2292.1	2235.5	0.0	1267.2	GAL
304	Namalgomuwa	PR		72.8	72.8	0.0	18.1	KEG
305	Namandiya	FR	22/04/1921	861.4	790.6	0.0	963.3	MON
306	Namunukula	PR		279.3	279.3	0.0	416.9	BAD
307	Nanu Oya	PR		420.8	415.9	0.0	269.5	NUW
308	Naranbedda	FR	16/06/1939	51.7	51.7	0.0	15.2	KEG
309	Nawagatta	PR		62.7	54.6	0.0	54.3	KUR
310	Neenthavil	FR	10/06/1921	8125.1	7720.5	0.0	8296.7	MAN
311	Nelawa	FR	13/02/1942	48.0	48.0	0.0	57.9	KUR
312	Nelligalkanda	FR	12/08/1938	50.0	50.0	0.0	77.5	KUR
313	Nellikele	PR		1152.5	1152.5	1133.6	1238.2	AMP
315	Neluketiya Mukalana	PR		2625.2	2384.4	0.0	2020.1	KAL
316	Netiyapana	FR	13/02/1942	18.0	2.2	0.0	25.1	KEG
317	Nettipolagama	FR	14/04/1944	1.0	1.0	0.0	0.0	KUR
318	Neugalkanda	PR		376.0	376.0	0.0	417.5	KUR
319	Nikawehera	PR		33.2	33.2	0.0	5.9	MTL
320	Nikawekanda	PR		151.8	151.8	0.0	140.9	KUR
323	Nugampola	PR		339.9	339.9	0.0	486.6	KUR
324	Nuwaragala	FR	28/06/1929	42150.8	33943.8	6072.8	4273.3	AMP BAT
325	Nuwaragala	PR		154.6	154.6	0.0	0.0	BAT
326	Nuwaragam	FR	24/05/1935	2584.8	2314.6	2100.0	2757.5	ANU
327	Ohiya	PR		1925.5	1769.1	4251.0	2068.9	BAD NUW
328	Olabedda	FR	28/04/1933	153.6	73.0	0.0	41.8	GAL
329	Oliyagankele	FR#	08/09/1939	488.6	486.0	20.2	437.0	MTR
330	Omunugala	FR	18/03/1927	54221.8	53666.6	2024.2	0.0	AMP BAT
331	Ottery-Queenswood	PR		52.6	52.6	0.0	0.0	NUW
333	Padawiya	PR		97901.7	97664.3	0.0	99284.9	ANU
334	Pallai	FR	10/06/1921	460.9	460.9	0.0	744.7	JAF
335	Pallegama-Himbiliyakada	PR		4547.2	4547.2	0.0	968.7	MTL
336	Pallekele	FR	04/02/1896	14513.8	12721.4	0.0	74.3	KUR
339	Pallepattu	FR	23/09/1892	680.9	657.9	0.0	49.9	RAT
340	Panagoda	PR		266.3	266.3	0.0	127.6	GAL
341	Panama	PR		37635.8	36907.4	0.0	38119.5	AMP
342	Panikkankulam	FR		7303.8	6534.9	1417.0	6828.3	MUL
343	Panilkanda	FR	18/03/1927	588.1	588.1	0.0	630.1	MTR
344	Pankulam-Northern Block	PR		53871.8	52355.9	0.0	57170.1	TRI
345	Pannagama	PR		165.9	164.9	0.0	193.5	KUR
348	Pannala	FR	12/05/1893	129.9	129.0	0.0	135.5	RAT
346	Pannala	PR		1173.7	769.1	0.0	1191.2	NUW
347	Pannawa-Geppalawa	PR		316.5	314.4	0.0	389.8	KUR
349	Pansalhinna	PR		123.4	123.4	0.0	131.9	KUR
350	Panwewa	Fk	01/03/1940	241.7	241.7	0.0	247.9	KUR
351	Paradeniya	FR	08/10/1897	31.2	31.2	0.0	38.9	KEG
352	Paragaharuppe	FR	01/03/1940	54.0	54 0	0.0	51.0	KUR
353	Parantan	FR	22/09/1946	2897.1	2897.1	0.0	1544.3	MUL VAV
356	Paspolakanda	PR		112.5	107.4	0.0	24.4	KEG
357	Pattipola	FR	23/09/1938	394.9	393.3	1214.6	430.6	BAD
358	Pattipola-Ambawela	PR		1498.0	1480.3	0.0	1954.5	NUW
359	Peak Wilderness	PR		5665.7	5665.7	0.0	4381.5	KEG NUW
362	Pedro	PR		6879.7	6757.0	6882.5	7554.8	NUW
363	Pelawatta	FR		110.0	110.0	0.0	104.0	KAL
365	Pelwehera	FR	27/03/1936	1925.9	1925.9	0.0	1962.3	MTL
364	Pelwehera	PR		240.0	240.0	0.0	117.0	MTL
367	Plenda West	PR		145.3	145.3	0.0	153.6	KAL
368	Polawattakanda	FR		29.4	0.3	0.0	29.4	KAL
369	Polgahakanda	FR	18/09/1942	862.3	577.4	0 0	887.6	GAL
370	Polgahawila	PR		304.7	286.6	0.0	237.5	GAL
371	Polgolla	FR	02/03/1888	53.6	51.5	0.0	68.2	KUR
372	Polhunnawa	FR	06/01/1933	193.0	193.0	0.0	23.9	GAL
373	Polkatukanda	FR	01/03/1940	151.5	151.5	0.0	155.3	KUR
375	Pomparippu	FR		7021.3	7021.3	0.0	0.0	PUT
376	Potawa	PR		77.2	77.2	0.0	52.2	MTL

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377	Potuwewa	PR		241.6	99.6	0.0	219.9	KUR
378	Preston-Elsmere	PR		60.7	60.7	0.0	0.0	NUW
380	Puwarasankulam	FR		4377.6	4292.6	0.0	3649.8	VAV
382	Pyrendawa	FR	24/10/1890	361.3	360.4	0.0	285.1	PUT
381	Pyrendawa	PR		125.5	110.6	0.0	60.1	PUT
383	Ragalla	PR		268.1	268.1	0.0	279.1	NUW
384	Rajawaka	PR		2387.6	2387.6	0.0	77.4	RAT
385	Rambodagalla	PR		202.3	202.3	0.0	124.8	KUR
388	Rammalakanda	FR#	21/05/1926	1698.1	1406.7	404.8	1724 6	HAM MTR
386	Rammalakanda	PR		453.7	453.7	0.0	0.0	RAT
387	Rammalakanda	PR		4.8	4.8	0.0	385.5	MTR
389	Ranwala	PR		1117.7	867.5	0.0	1186.2	RAT
390	Ranwaragalakanda	PR#		192.1	192.1	0.0	125.5	KAL
391	Rathkarawwa	PR		4050.5	4021.4	0.0	0.0	RAT
393	Rawanella	PR		331.8	331.8	0.0	376.6	BAD
394	Rilagala	PR		566.6	566.6	0.0	507.2	KAN NUW
397	Rugam	PR		2143.6	2139.6	0.0	117.4	BAT
404	Sangappale	PR		4694.8	4505.8	0.0	4536.5	KUR
405	Sawarangalawa	PR		6309.5	5530.0	0.0	7096.1	KUR PUT
406	Sellankandal	FR	02/09/1892	4268.6	4265.8	0.0	3779.5	PUT
407	Sellankandal	PR		5526.0	4542.2	0.0	5738.3	PUT
412	Sinharaja	FR	21/05/1926	3724.6	3663.9	0.0	0.0	GAL MTR
413	Sinharaja	FR	08/05/1875	2428.1	2428.1	0.0	2694.8	RAT
414	Sinharaja	NHWA	21/10/1988	11187.0	11187.0	0.0	0.0	GAL MTR RAT
411	Sinharaja	PR		2772.1	2772.1	0.0	3054.3	RAT
416	Siyambalangamuwa	FR	19/08/1938	63.7	63.3	0.0	56.5	KEG
420	Sundapola	FR		306.9	121.6	10.1	60.0	KUR
421	Talagahakanda	FR	30/09/1949	60.4	60.4	0.0	72.9	RAT
422	Talagomuwa	FR	04/12/1936	81.3	81.3	0.0	58.3	KUR
424	Tandikele	PR		370.3	290.2	0.0	46.6	RAT
425	Tanduwan	FR	10/06/1921	1115.3	791.6	0.0	1146.3	MUL
427	Taranagala	FR	05/09/1941	28.3	28.3	0.0	38.7	KEG
428	Tawalama	PR		167.5	167.5	0.0	197.5	GAL
431	Teravil Oddusuddan	FR	10/06/1921	38595.8	36552.1	2024.2	38042.6	MUL
432	Tibbutukanda	PR		233.9	233.9	0.0	255.3	RAT
433	Timbiriwewa	PR		1274.0	56.8	0.0	1043.6	KUR
434	Tonigala	PR		1486.8	937.3	0.0	1546.2	PUT
435	Tonikallu	PR		655.9	136.3	0.0	0.0	VAV
439	Udalelegama	FR	23/12/1921	17.9	17.9	0.0	28.8	BAD
440	Udapolakanda	PR		63.9	63.9	0.0	98.3	KUR
441	Udawattakele	FR	15/10/1897	104.0	103.0	102.0	118.7	KAN
443	Ulinduwewa	FR	17/10/1902	104.7	104.7	0.0	104.4	RAT
444	Unaliya	PR		1400.2	1096.7	0.0	1540.0	PUT
445	Uragaha	PR		1567.3	1567.3	0.0	98.8	GAL
446	Usangoda	PR		277.2	252.9	0.0	25.4	HAM
447	Vaddakachchi	FR		7109.5	7109.5	0.0	6953.3	JAF VAV
448	Vannivilankulam	FR	10/06/1921	10953.9	10529.0	0.0	10879.6	MAN MUL VAV
449	Vappiah-Verugal	FR	03/10/1941	4372.6	4344.7	0.0	3655.5	TRI
451	Veppal	PR		10518.7	10114.0	0.0	10495.0	MAN
453	Viharekele	FR#	26/04/1935	825.1	625.1	0.0	861.6	MTR
454	Wagawatta	PR		143.3	113.0	0.0	105.7	KAL
455	Walankanda	FR	03/04/1890	832.9	711.5	0.0	938.9	RAT
456	Walawe Basin	FR#	08/09/1893	3237.5	3229.7	0.0	1739.3	RAT
457	Walbotalekanda	PR		41.7	41.7	0.0	49.6	GAM
458	Wanniyagama	PR		15596.6	14417.8	0.0	15843.6	PUT
459	Waratalgoda	PR		1889.9	1889.9	0.0	1940.0	RAT
462	Waulkele	FR	25/08/1944	20.7	20.7	0.0	22.1	KUR
463	Wedakanda	PR		5180.0	5180.0	0.0	4248.4	ANU
464	Wedasitikanda	FR	07/09/1978	1343.4	1343.4	1344.1	541.7	HAM MON
465	Weerakulicholai-Elavankulam	PR		30128.9	29192.4	0.0	30664.7	PUT
466	Wegodapola	PR		418.5	398.2	0.0	492.3	MTL
467	Weherabendikele	PR		285.7	275.0	0.0	334.2	PUT
468	Welegama	PR		639.0	639.0	0.0	747.2	BAD
470	Welhella-Ketangilla	FR	13/04/1896	128.8	114.6	0.0	164.6	KEG
471	Welihena	FR#	15/11/1935	333.1	296.8	0.0	337.4	MTR
472	Welikanda	PR		242.0	43.1	0.0	421.7	KAN
473	Welikumbura	FR	12/02/1937	80.9	80.9	0.0	64.8	KUR
474	Wellana	FR	23/12/1932	85.4	85.4	0.0	99.1	MTR
475	Weuda Mukalana	FR	14/06/1918	152.1	152.1	0.0	144.7	KUR
476	Wewelkandura	PR		429.0	429.0	0.0	459.1	RAT
477	Wilikulakanda	PR		352.2	310.0	0.0	274.4	GAM
484	Wilpotha	PR		2665.3	2547.5	0.0	2683.6	PUT
487	Yagirala	FR		3014.7	2390.2	0.0	2999.8	KAL

EMD No.	Name and national designation		Notification date	Area (ha) Notified	Present	MAB*	GIS	District(s)
486	Yagirala	PR#		34.1	34.1	0.0	0.0	KAL
489	Yakdessakanda	PR		1011.7	1010.9	0.0	1464.9	KUR
490	Yakkatuwa	FR	26/06/1931	296.2	296.2	0.0	75.4	GAL
494	Yalapitiya	PR		43.3	43.3	0.0	58.7	KEG
495	Yatale	PR		56.9	56.9	0.0	61.5	KAN KUR
496	Yoda Ela	FR	10/02/1950	2288.2	1585.6	0.0	1733.7	ANU

DEPARTMENT OF WILDLIFE CONSERVATION

EMD No.	Name and national designation		Notification date	Notified	Present	MAB*	GIS	District(s)
8	Ambalangoda-Hikkaduwa Rocky Islets	S	25/10/1940	1.3	1.3	0.0	0.0	GAL
14	Anuradhapura	S	27/05/1938	3500.7	3500.7	0.0	3525.7	ANU
31	Bar Reef Marine	S	03/04/1992	30670.0	30670.0	0.0	28036.0	PUT
36	Bellanwila-Attidiya	S	25/07/1990	60.0	60.0	0.0	400.6	COL
43	Buddhangala	S	01/11/1974	1841.3	1841.3	0.0	2821.5	AMP
44	Bundala	NP	31/12/1992	6215.9	6215.9	0.0	4664.6	HAM
51	Chundikulam	S	01/03/1938	11149.1	11149.1	0.0	11107.5	JAF MUL
95	Flood Plains	NP	07/08/1984	17350.7	17350.7	0.0	16989.7	POL
97	Gal Oya Valley	NP	12/02/1954	25899.9	25899.9	0.0	36043.7	MON
98	Gal Oya Valley North-East	S	12/02/1954	12432.0	12432.0	0.0	12332.7	AMP MON
99	Gal Oya Valley South-West	S	12/02/1954	15281.0	15281.0	0.0	18168.2	AMP MON
107	Galway's Land	S	01/03/1938	56.7	56.7	0.0	0.0	NUW
111	Giant's Tank	S	24/09/1954	3941.2	3941.2	0.0	4008.0	MAN
119	Great Sober Island	S	21/03/1963	64.5	64.5	0.0	65.9	TRI
123	Hakgala	SNR	01/03/1938	1141.6	1141.6	0.0	1198.4	BAD NUW
135	Hikkaduwa Marine	S	18/05/1979	44.5	44.5	0.0	0.0	GAL
137	Honduwa Island	S	19/11/1973	8.0	8.0	0.0	0.0	GAL
139	Horagolla	S	05/10/1973	13.4	13.4	0.0	0.0	GAM
140	Horton Plains	NP	16/03/1988	3159.8	3159.8	0.0	3015.2	NUW
161	Kahalla-Pallekele	S	11/07/1989	21690.0	21690.0	0.0	23172.5	ANU KUR
164	Kalametiya Kalapuwa	S	28/06/1984	712.0	712.0	0.0	2453.1	HAM
186	Katagamuwa	S	27/05/1938	1003.6	1003.6	0.0	1222.3	HAM
187	Kataragama	S	27/05/1938	837.7	837.7	0.0	594.4	MON
188	Kegalle	S	14/03/1941	113.3	113.3	0.0	107.4	KEG
199	Kimbulwan Oya	S	21/06/1963	492.1	492.1	0.0	610.0	KUR
207	Kokilai Lagoon	S	18/05/1951	2995.0	2995.0	0.0	5361.2	MUL TRI
216	Kudumbigala	S	28/09/1973	4403.0	4403.0	0.0	4409.1	AMP
223	Lahugala-Kitulana	NP	31/10/1980	1554.0	1554.0	0.0	4911.0	AMP
229	Little Sober Island	S	21/03/1963	6.5	6.5	0.0	0.0	TRI
231	Lunugamvehera	NP	Proposed	2071.8	2071.8	0.0	0.0	HAM MON
236	Madhu Road	S	28/06/1968	26676.9	26676.9	0.0	27398.6	MAN MUL
238	Madunagala	S	29/06/1993	791.0	791.0	0.0	0.0	HAM
239	Maduru Oya Block 1	NP	09/11/1983	51469.4	51469.4	0.0	58752.2	BAD AMP POL
240	Maduru Oya Block 2	NP	16/09/1985	7381.2	7381.2	0.0	0.0	AMP
246	Mahakanadarawa Wewa	S	09/12/1966	0.0	0.0	0.0	1679.7	ANU
252	Maimbulkande-Nittambuwa	S	31/10/1972	21.8	21.8	0.0	0.0	GAM
278	Mihintale	S	27/05/1938	999.6	999.6	0.0	0.0	ANU
280	Minneriya-Giritale	S	28/07/1938	6693.5	6693.5	0.0	5914.3	POL
281	Minneriya-Giritale Block 1	NR	12/02/1988	7529.1	7529.1	0.0	8674.8	POL
999	Muthurajawella	S	Proposed	0.0	0.0	0.0	0.0	COL
314	Nelugala	JC	16/01/1970	10360.0	10360.0	0.0	0.0	BAT POL
321	Nilgala	JC	Proposed	0.0	0.0	0.0	0.0	AMP POL
322	Nimalawa	S	03/02/1993	1065.9	1065.9	0.0	985.0	HAM
332	Padaviya Tank	S	21/06/1963	6475.0	6475.0	0.0	6486.4	ANU
337	Pallemalala	S	23/10/1942	13.8	13.8	0.0	0.0	HAM
354	Parapuduw Nun's Island	S	17/08/1988	189.8	189.8	0.0	1517.9	GAL
355	Parittiivu Island	S	18/05/1973	97.1	97.1	0.0	0.0	JAF
361	Peak Wilderness	S	01/11/1940	22379.2	22379.2	0.0	0.0	KEG NUW RAT
366	Pigeon Island	S	01/11/1974	4.7	4.7	0.0	0.0	TRI
374	Polonnaruwa	S	27/05/1938	1521.6	1521.6	0.0	1750.0	POL
392	Ravana Ella	S	18/05/1979	1932.0	1932.0	0.0	1910.1	BAD
395	Ritigala	SNR	07/11/1941	1528.2	1528.2	0.0	1521.3	ANU
396	Riverine	NR	23/07/1991	824.2	824.2	0.0	0.0	AMP POL
398	Ruhuna Block 1	NP	25/02/1938	13679.2	13679.2	0.0	14462.4	HAM
399	Ruhuna Block 2	NP	03/09/1954	9931.0	9931.0	0.0	33389.2	MON
400	Ruhuna Block 3	NP	28/04/1967	40775.4	40775.4	0.0	41254.3	MON
401	Ruhuna Block 4	NP	09/10/1969	26417.7	26417.7	0.0	26314.3	MON
402	Ruhuna Block 5	NP	05/10/1973	6656.2	6656.2	0.0	2238.9	MON
403	Sagamam	S	21/06/1963	616.4	616.4	0.0	0.0	AMP
408	Senanayake Samudra	S	12/02/1954	9323.9	9323.9	0.0	0.0	MON
409	Seruwila-Allai	S	09/10/1970	15540.0	15540.0	0.0	12908.4	TRI
410	Sigiriya	S	26/01/1990	5099.0	5099.0	0.0	5163.7	POL MTL
417	Somawathiya Block 1	NP	02/09/1986	21056.5	21056.5	0.0}	38984.8	POL TRI
418	Somawathiya Block 2	NP	12/05/1987	16589.2	16589.2	0.0}		POL TRI
419	Sri Jayawardenapura Bird	S	09/01/1985	449.2	449.2	0.0	0.0	COL
426	Tangamalai	S	01/03/1938	131.5	131.5	0.0	194.1	BAD
430	Telwatta	S	25/02/1938	1424.5	1424.5	0.0	0.0	GAL
436	Trikonamadu	NR	24/10/1986	25019.2	25019.2	0.0	24125.7	POL BAT
437	Trinconmalee Naval Headworks	S	21/06/1963	18130.3	18130.3	0.0	18021.6	TRI
438	Uda Walawe	NP	30/06/1972	30821.0	30821.0	0.0	31666.0	MON RAT
442	Udawattakele	S	01/03/1938	104.0	104.0	0.0	0.0	KAN

EMD No.	Name and national designation		Notification date	Area (ha) Notified	Present	MAB*	GIS	District(s)	
450	Vavunikulam	S	21/06/1963	4856.3	4856.3	0.0	7721.6	MAN	MUL
452	Victoria-Randenigala-Rantambe	S	30/01/1987	42087.1	42087.1	0.0	43236.0	KAN	NUW
460	Wasgomuwa Lot 1	NP	07/08/1984	29036.0	29036.0	0.0}	42698.6	POL	MTL
461	Wasgomuwa Lot 2	NP	07/08/1984	4612.7	4612.7	0.0}		POL	
469	Welhella-Ketagille	S	18/02/1949	134.2	134.2	0.0	0.0	KEG	
478	Wilpattu Block 1	NP	25/02/1938	54953.2	54953.2	0.0}		ANU	PUT
479	Wilpattu Block 2	NP	28/04/1967	7021.4	7021 4	0.0}		PUT	
480	Wilpattu Block 3	NP	27/08/1969	22981.4	22981.4	0.0}	132255.0	ANU	
481	Wilpattu Block 4	NP	05/12/1969	25252.9	25252.9	0.0}		ANU	
482	Wilpattu Block 5	NP	07/12/1973	21484.8	21484.8	0.0}		PUT	
483	Wilpattu North	S	25/02/1938	1877.7	1877.7	0.0}		MAN	
485	Wirawila-Tissa	S	27/05/1938	4164.2	4164.2	0.0	3034.2	HAM	
491	Yala	SNR	25/02/1938	28904.7	28904.7			HAM	
492	Yala East Block 1	NP	05/12/1969	17863.4	17863.4	0.0}	18372.4	AMP	
493	Yala East Block 2	NP	25/12/1969	285.2	285.2	0.0}		AMP	

* Area designated as a national Man and Biosphere Reserve by the Forest Department.
# Recently designated as a Conservation Forest by the Forest Department, but not in law.

Annex 2

IMPORTANCE OF NATURAL FORESTS FOR CONTROLLING SOIL EROSION

District	EMD No.	Forest name	Rainfall (mm yr^{-1})	Erosivity (J m^{-2} yr^{-1})	Slope (mm^{-1})	Erodibility	Erosion (t ha^{-1} yr^{-1})	Erosion rank
MAT	497	Kalubowitiyana	4189	42653	0.48	0.22	2669 1	1
GAL	120	Habarakada	4397	44723	0.41	0.22	2041.9	2
GAL	509	Auwegalakanda	4500	45748	0.38	0.22	1794.2	3
KEG NUW RAT	361	Peak Wilderness	4320	43957	0.36	0.22	1547.3	4
RAT	274	Messana	3753	38315	0.38	0.22	1502.7	5
KEG	191	Kelani Valley	4933	50056	0.32	0.22	1392.2	6
GAL	506	Tiboruwakota	4350	44255	0.34	0.22	1389.5	7
RAT	529	Dotalugala	4075	41519	0.33	0.22	1228.0	8
RAT	386	Rammalakanda	3440	35201	0.35	0.22	1171.2	9
RAT	476	Wewelkandura	4036	41131	0.32	0.22	1143.9	10
KEG	515	Dedugalla-Nangala	4900	49728	0.29	0.22	1135.9	11
RAT	432	Tibbutukanda	2500	25848	0.36	0.27	1116.6	12
MAT	501	Aninkanda	3250	33310	0.35	0.22	1108.3	13
GAL	511	Bambarawana	4150	42265	0.31	0.22	1103.2	14
KAL	129	Haycock	4263	43390	0.30	0.22	1060.6	15
MAT	77	Diyadawa	3410	34902	0.33	0.22	1032.3	16
GAL	510	Yakdehikanda	3600	36793	0.32	0.22	1023.3	17
GAL	508	Hindeinattu	3083	31649	0.34	0.22	993.7	18
KEG	551	Usgala	5295	53658	0.26	0.22	985.2	19
RAT	530	Appalagala	2610	26942	0.36	0.22	948.4	20
MAT	500	Derangala	3500	35798	0.30	0.22	875.1	21
MTL	565	Makulussa	2428	25131	0.32	0.27	857.8	22
GAL	253	Malambure	3937	40146	0.28	0.22	854.9	23
KAN	522	Knuckles	3184	32654	0.31	0.22	852.3	24
KEG	7	Amanawala-Ampane	5371	54414	0.24	0.22	851.3	25
GAL	69	Dellawa	3759	38375	0.28	0.22	817.1	26
RAT	549	Alutwelawisahena	4050	41270	0.27	0.22	817.1	26
BAD	306	Namunukula	2314	23997	0.35	0.22	798.4	28
RAT	184	Karawita	4184	42604	0.26	0.22	782.2	29
RAT	205	Kobahadunkanda	3801	38793	0.27	0.22	768.1	30
RAT	527	Angamana	3800	38783	0.27	0.22	767.9	31
RAT	455	Walankanda	3455	35350	0.28	0.22	752.7	32
RAT	348	Pannala	3448	35280	0.28	0.22	751.3	33
RAT	543	Handuwelkanda	3950	40275	0.26	0.22	739.5	34
RAT	456	Walawe Basin	3121	32027	0.29	0.22	731.6	35
KAN	192	Kelani Valley	5260	53310	0.22	0.22	700.8	36
RAT	544	Gorangala	4400	44753	0.24	0.22	700.1	37
RAT	528	Asantanakanda	3400	34803	0.27	0.22	689.1	38
RAT	68	Delgoda	3939	40166	0.25	0.22	681.8	39
RAT	133	Hidellana-Weralupe	4100	41768	0.24	0.22	653.4	40
KEG	514	Sembawatte	4891	49638	0.22	0.22	652.5	41
KEG	513	Batahena	5368	54384	0.21	0.22	651.4	42
MAT	343	Panilkanda	3133	32146	0.27	0.22	636.5	43
MAT	499	Silverkanda	3380	34604	0.26	0.22	635.3	44
MTL	572	Menikdeniya	1750	18385	0.32	0.27	627.5	45
MTL	562	Sacombe	2313	23987	0.28	0.27	626.9	46
RAT	294	Muwagankanda	3854	39320	0.24	0.22	615.1	47
KAN	100	Galaha	2788	28713	0.28	0.22	611.4	48
KAN	521	Wewegalatana	2408	24932	0.30	0.22	609.5	49
KAL	269	Meegahatenna	4480	45549	0.22	0.22	598.8	50
NUW	197	Kikilimana	2729	28126	0.28	0.22	598.9	50
RAT	548	Dumbara	4400	44753	0.22	0.22	588.3	51
BAD	610	Kithedallakanda	2299	23848	0.30	0.22	582.9	52
KUR	78	Doluwakanda	1850	19380	0.30	0.27	581.4	53
RAT	288	Morahela	3600	36793	0.24	0.22	575.6	54
KAL	516	Boralugoda	4250	43260	0.22	0.22	568.7	55
MTL	561	Opalagala	2867	29499	0.24	0.27	566.4	56
RAT	241	Magurugoda	4188	42643	0.22	0.22	560.6	57
RAT	545	Handapan Ella	3475	35549	0.24	0.22	556.1	58
RAT	459	Waratalgoda	4564	46385	0.21	0.22	555.6	59
KUR	318	Neugalkanda	1902	19898	0.32	0.22	553.4	60
RAT	443	Ulinduwewa	3100	31818	0.25	0.22	540.1	61
RAT	217	Kudumiriya	3603	36823	0.23	0.22	529.1	62
RAT	71	Delwela	3587	36663	0.23	0.22	526.8	63
RAT	535	Kuragala	2200	22863	0.26	0.27	515.2	64

District	EMD No.	Forest name	Rainfall (mm yr^{-1})	Erosivity (J m^{-2} yr^{-1})	Slope (mm^{-1})	Erodibility	Erosion (t ha^{-1} yr^{-1})	Erosion rank
RAT	112	Gilimale-Eratne	4652	47260	0.20	0.22	513.4	65
KUR	489	Yakdessakanda	1872	19599	0.31	0.22	511.6	66
GAL	507	Homadola	3800	38783	0.22	0.22	509.8	67
BAD	468	Welegama	2665	27489	0.26	0.22	504.7	68
BAD NUW	327	Ohiya	2252	23380	0.28	0.22	497.9	69
RAT	546	Gongala	3100	31818	0.24	0.22	497.8	70
KUR	80	Dunkanda	1796	18843	0.28	0.27	492.4	71
ANU	395	Ritigala	1550	16395	0.30	0.27	491.9	72
KAL	512	Vellihallure	4400	44753	0.20	0.22	486.2	73
RAT	540	Galbokaya	2220	23062	0.25	0.27	480.5	74
GAL	328	Tawalama	4340	44156	0.20	0.22	479.7	75
KUR	552	Butawella	2103	21898	0.28	0.22	466.3	77
KUR	256	Manapaya	1850	19380	0.30	0.22	473.7	78
RAT	538	Gallegodahinna	2300	23858	0.24	0.27	458.1	79
BAD	392	Ravana Ella	1900	19878	0.29	0.22	454.0	80
KAL	289	Morapitiya-Runakanda	4466	45409	0.19	0.22	445.2	81
RAT	28	Bambarabotuwa	3979	40564	0.20	0.22	440.7	82
KAN	519	Guruyalle	2636	27201	0.22	0.27	438.8	83
COL	222	Labugama-Kalatuwana	3950	40275	0.20	0.22	437.6	84
GALMTRRAT	414	Sinharaja	3946	40235	0.20	0.22	437.1	85
KUR	157	Kadawatkele	1850	19380	0.26	0.27	436.7	86
MON	583	Velihela	1450	15400	0.29	0.27	431.7	87
RAT	537	Narangattahinna	2350	24355	0.23	0.27	429.5	88
MON	580	Dummalahela	1550	16395	0.28	0.27	428.5	89
BAD	611	Keeriyagolla	2654	27380	0.24	0.22	428.3	90
HAM	388	Rammalekanda	2837	29201	0.23	0.22	419.6	91
MTL	571	Gederagalpatana	1769	18574	0.26	0.27	418.5	92
MTL	566	Gosgahapatana	1914	20017	0.25	0.27	417.0	93
MAT	498	Kurulugala	3400	34803	0.21	0.22	416.9	94
POL	598	Gunner's Quoin	1450	15400	0.28	0.27	402.5	95
KUR	101	Galgiriyakanda	1450	15400	0.28	0.27	402.5	96
RAT	550	Kiribatgala	3263	33440	0.21	0.22	400.5	97
GAL	175	Kanneliya	3984	40614	0.19	0.22	398.2	98
KAL	166	Kalugala	4450	45250	0.18	0.22	398.2	98
KAL	390	Ranwaragalakanda	3950	40275	0.19	0.22	394.9	100
MAT	138	Horagala-Paragala	3209	32902	0.21	0.22	394.1	101
MTL	568	Beliyakanda	1650	17390	0.26	0.27	391.9	102
KAN NUW	394	Rilagala	4373	44484	0.18	0.22	391.5	103
NUW	362	Pedro	2523	26077	0.23	0.22	374.7	104
GAL	38	Beraliya (Kudagala)	3660	37390	0.19	0.22	366.6	105
NUW	40	Bogawantalawa	2699	27828	0.22	0.22	365.8	106
RAT	547	Paragala	4500	45748	0.17	0.22	359.1	107
NUW	1	Agra-Bopats	2398	24833	0.23	0.22	356.8	108
BAD NUW	123	Hakgala	2176	22624	0.24	0.22	353.9	109
RAT	19	Ayagama	4421	44962	0.17	0.22	352.9	110
NUW	172	Kandapola Sita Eliya	2157	22435	0.24	0.22	351.0	111
GAL	65	Dediyagala	3437	35171	0.19	0.22	344.8	112
KEG	4	Alapalawala	2789	28723	0.21	0.22	344.0	113
RAT	72	Demanagammana	3813	38912	0.18	0.22	342.4	114
RAT	541	Kabarakalapatana	3400	34803	0.19	0.22	341.2	115
MAT	293	Mulatiyana	3034	31161	0.20	0.22	338.5	116
RAT	532	Talawegoda	4200	42763	0.17	0.22	335.7	117
MTL	570	Tottawelgola	1627	17161	0.24	0.27	329.5	118
GAL	303	Nakiyadeniya	3561	36405	0.18	0.22	320.4	119
BAD	426	Tangamalai	2348	24335	0.22	0.22	319.9	120
RAT	57	Dambuluwana	4479	45539	0.16	0.22	316.6	121
MON	588	Wadinahela	1853	19410	0.22	0.27	313.1	122
RAT	504	Masimbula	3084	31659	0.19	0.22	310.4	123
MON	581	Monerakelle	1524	16137	0.24	0.27	309.8	124
RAT	169	Kumburugamuwa	2225	23111	0.20	0.27	308.2	125
RAT	533	Mulgama	2450	25350	0.19	0.27	305.0	126
COL	146	Indikada Mukalana	3800	38783	0.17	0.22	304.4	127
BAD	609	Madigala	1850	19380	0.24	0.22	303.2	128
GAL	37	Beraliya (Akuressa)	2671	27549	0.20	0.22	299.3	129
MON	604	Viyanahela	1750	18385	0.22	0.27	296.6	130
GAL	369	Polgahakanda	4051	41280	0.16	0.22	287.0	131
HAM	464	Wedasitikanda	1062	11540	0.27	0.27	280.4	132
MTL	567	Amsawagama	2186	22723	0.19	0.27	273.4	133
MON	582	Lolehela	1450	15400	0.23	0.27	271.6	134
KUR	553	Talpattekanda	1550	16395	0.22	0.27	264.5	135
MON	585	Kitulhela	1550	16395	0.22	0.27	264.5	135
MTL	560	Galboda	2316	24017	0.18	0.27	259.4	137
RAT	389	Ranwala	2496	25808	0.19	0.22	253.0	138
MTL	563	Talabugahaela	2250	23360	0.18	0.27	252.3	139
GAM	247	Mahakanda	3115	31967	0.17	0.22	250.9	140

District	EMD No.	Forest name	Rainfall (mm yr^{-1})	Erosivity (J m^{-2} yr^{-1})	Slope (mm^{-1})	Erodibility	Erosion (t ha^{-1} yr^{-1})	Erosion rank
NUW	383	Ragalla	2205	22912	0.20	0.22	248.9	141
MON	577	Korathalhinna	1450	15400	0.22	0.27	248.5	142
MON	578	Ulgala (old)	1450	15400	0.22	0.27	248.5	142
KAL	221	Kurana Madakada	3988	40653	0.15	0.22	248.4	144
KAL	487	Yagirala	4464	45390	0.14	0.22	241.6	145
KAL	315	Neluketiya Mukalana	4458	45330	0.14	0.22	241.3	146
KAN	518	Hopewell	2250	23360	0.22	0.17	237.3	147
KAL	70	Delmella Yatagampitiya	4339	44146	0.14	0.22	235.0	148
MON	591	Murutukanda	1672	17609	0.20	0.27	234.8	149
ANU	639	Katupotakanda	1350	14405	0.22	0.27	232.4	150
RAT	234	Madampe	3233	33141	0.16	0.22	230.4	151
MON	584	Guruhela	1450	15400	0.21	0.27	226.4	152
MON	605	Balanagala	1750	18385	0.19	0.27	221.2	153
NUW	128	Harasbedda	2421	25062	0.18	0.22	220.5	154
MON	576	Ulgala	1515	16047	0.20	0.27	214.0	155
RAT	272	Marakele	4550	46245	0.13	0.22	212.3	156
KAN NUW	452	Victoria-Randenigala-Rantambe	1963	20505	0.22	0.17	208.3	157
MTL	564	Heratgedara	2062	21490	0.17	0.27	207.0	158
GAL	173	Kandawattegoda	2550	26345	0.17	0.22	206.8	159
RAT	298	Nahiti Mukalana	3303	33838	0.15	0.22	206.8	159
RAT	542	Digandala	3300	33808	0.15	0.22	206.6	161
NUW	140	Horton Plains	2534	26186	0.17	0.22	205.5	162
ANU	635	Manawewakanda	1449	15390	0.20	0.27	205.2	163
MON	589	Begahapatana	1805	18932	0.18	0.27	204.5	164
NUW	248	Mahakudagala	2171	22574	0.18	0.22	198.7	165
MON	606	Dyabodahela	1750	18385	0.18	0.27	198.6	166
COL	170	Kananpella	3650	37290	0.14	0.22	198.5	167
MTL	573	Puswellagolla	1699	17878	0.18	0.27	193.1	168
KUR	66	Degadaturawa	1500	15898	0.19	0.27	191.3	169
MON	579	Diggala	1668	17569	0.18	0.27	189.7	170
NUW	52	Conical Hill	2292	23778	0.17	0.22	186.6	171
KAN	520	Illukkanda	2594	26783	0.16	0.22	186.2	172
KAL	147	Ingiriya	3917	39947	0.13	0.22	183.4	173
BAD	608	Welanwita	2119	22057	0.17	0.22	173.1	174
COL	285	Miriyagalla	3655	37340	0.13	0.22	171.4	175
MTL	82	Elagomuwa	2146	22325	0.15	0.27	167.4	176
MON	586	Diggalahela	1450	15400	0.18	0.27	166.3	177
KAN MTL	45	Campbell's Land	2626	27101	0.15	0.22	165.6	178
KAN	517	Matinapatana	2070	21569	0.19	0.17	163.4	179
BAD MON	39	Bibilehela	2050	21370	0.15	0.27	160.3	181
MTL	335	Pallegama-Himbiliyakada	2320	24057	0.14	0.27	157.2	182
MON	607	Rediketiya	1750	18385	0.16	0.27	156.9	183
RAT	384	Rajawaka	2295	23808	0.14	0.27	155.5	184
MAT	453	Viharakele	2444	25291	0.15	0.22	154.6	185
MAT	471	Welihena	2723	28067	0.14	0.22	149.4	186
MAT	329	Oliyagankele	2465	25499	0.14	0.22	135.7	187
HAM	178	Kanumuldeniya	2432	25171	0.14	0.22	134.0	188
RAT	536	Hapugala	2275	23609	0.13	0.27	133.0	189
NUW	307	Nanu Oya	2335	24206	0.14	0.22	128.9	190
RAT	534	Galleletota	2400	24853	0.14	0.27	162.4	190
ANU	633	Labunoruwa	1430	15201	0.15	0.27	114.0	191
GAL	208	Kombala-Kottawa	2680	27639	0.12	0.22	108.1	192
MON	587	Westminster Abbey	1550	16395	0.14	0.27	107.1	193
NUW	270	Meepilimana	2173	22594	0.13	0.22	103.7	194
KUR	131	Henegedaralanda	1750	18385	0.13	0.27	103.6	195
MTL	558	Masawa	1750	18385	0.13	0.27	103.6	195
MON	305	Namandiya	1671	17599	0.13	0.27	99.1	197
MON	590	Randeniya	1950	20375	0.12	0.27	97.8	198
KAN	442	Udawattakele	1950	20375	0.15	0.17	96.2	199
GAL	62	Darakulkanda	3457	35370	0.10	0.22	96.1	200
RAT	539	Hataramune	2260	23460	0.11	0.27	94.6	201
NUW	358	Pattipola-Ambawela	2229	23151	0.12	0.22	90.5	202
MON	595	Radaliwinnekota	1750	18385	0.12	0.27	88.2	203
MAT	263	Masmullekele	2076	21629	0.12	0.22	84.6	204
KUR	177	Kanugollayaya	1950	20375	0.12	0.22	79.7	205
ANU	640	Getalagamakanda	1300	13908	0.12	0.27	66.8	206
ANU	645	Puliyamkulam	1350	14405	0.11	0.27	58.1	207
MON	27	Bakinigahawela	1650	17390	0.10	0.27	58.0	208
ANU	634	Puliyankulama	1500	15898	0.10	0.27	53.0	209
POL	596	Kudagala North	1850	19380	0.09	0.27	52.3	210
MON	575	Dewagiriya	1713	18017	0.09	0.27	48.6	211
ANU	636	Aruwewa	1350	14405	0.10	0.27	48.0	212
RAT	531	Kudagoda	2625	27091	0.07	0.27	44.2	213
HAM	249	Mahapitakanda	2368	24534	0.08	0.22	42.6	214
MON	594	Golupitiyahela	1750	18385	0.08	0.27	39.2	215

District	EMD No.	Forest name	Rainfall (mm yr^{-1})	Erosivity (J m^{-2} yr^{-1})	Slope (mm^{-1})	Erodibility	Erosion (t ha^{-1} yr^{-1})	Erosion rank
MAT	201	Kirinda-Mahayayakele	1940	20276	0.08	0.22	35.2	216
KUR	232	Ma Eliya	1550	16395	0.08	0.27	35.0	217
KUR	629	Tambutakanda	1150	12415	0.09	0.27	33.5	218
AMP MON	98	Gal Oya Valley North-East	1750	18385	0.07	0.27	30.0	219
AMP MON	99	Gal Oya Valley South-West	1600	16893	0.07	0.27	27.6	220
POL	96	Gal Oya	1600	16893	0.07	0.27	27.6	220
MAT	60	Dandeniya-Aparekke	1839	19271	0.07	0.22	25.6	222
MON	97	Gal Oya Valley	1700	17888	0.06	0.27	21.5	223
MTL	569	Etabendiwela	1650	17390	0.06	0.27	20.9	224
ANU	647	Ranawekanda	1550	16395	0.06	0.27	19.7	225
MTL	144	Inamaluwa	1550	16395	0.06	0.27	19.7	225
POL	597	Badanagala	1750	18385	0.05	0.27	15.3	227
POL MTL	460	Wasgomuwa Lot 1	1700	17888	0.05	0.27	14.9	228
MAT	24	Badullakele	2070	21569	0.05	0.22	14.6	229
MON	592	Sitarama	1072	11639	0.06	0.27	14.0	230
POL	281	Minneriya-Giritale Block 1	1489	15788	0.05	0.27	13.2	231
POL	279	Minneriya	1690	17788	0.04	0.27	9.5	232
HAM	237	Madunagala	1150	12415	0.04	0.27	9.1	233
ANU KUR	161	Kahalla-Pallekele	1600	16893	0.04	0.27	9.0	234
POL	280	Minneriya-Giritale	1568	16574	0.04	0.27	8.8	235
MAT	190	Kekanadura	1721	18097	0.03	0.22	4.4	236
ANU	632	Ratmale Kanda	1550	16395	0.02	0.27	2.2	237
ANU	463	Wedakanda	1350	14405	0.02	0.27	1.9	238
HAM	526	Keulakada Wewa	1300	13908	0.02	0.27	1.9	238
MON	593	Bolhindagala	1186	12773	0.02	0.27	1.7	240
POL	600	Palliyagodella Tulana	1738	18266	0.01	0.33	0.7	241
POL	602	Mutugalla Tulana	1750	18385	0.01	0.33	0.7	241
PUT	10	Ambanmukalana	1625	17141	0.01	0.33	0.7	241
BAD AMP POL	239	Maduru Oya Block 1	1850	19380	0.01	0.27	0.6	244
HAM	44	Bundala	878	9709	0.01	0.48	0.6	244
MON RAT	438	Uda Walawe	1600	16893	0.01	0.27	0.6	244
POL	502	Medirigiriya Tulana	1735	18236	0.01	0.27	0.6	244
POL	599	Mahamorakanda	1600	16893	0.01	0.27	0.6	244
POL	601	Kumadiya Tulana	1750	18385	0.01	0.27	0.6	244
POL	603	Sinnakallu	1750	18385	0.01	0.27	0.6	244
POL MTL	410	Sigiriya	1600	16893	0.01	0.27	0.6	244
PUT	17	Attavillu	1334	14246	0.01	0.33	0.6	244
ANU	278	Mihintale	1350	14405	0.01	0.27	0.5	253
ANU	496	Yoda Ela	1363	14535	0.01	0.27	0.5	253
ANU	631	Dematawewa	1550	16395	0.01	0.27	0.5	253
ANU	637	Andarawewa	1350	14405	0.01	0.27	0.5	253
ANU	638	Pahala Mawatawewa	1350	14405	0.01	0.27	0.5	253
ANU	641	Galkulama Tirrapane	1312	14027	0.01	0.27	0.5	253
ANU	642	Galmaduwa	1350	14405	0.01	0.27	0.5	253
ANU	643	Marasinhagama	1350	14405	0.01	0.27	0.5	253
ANU	644	Tambaragalawewa	1350	14405	0.01	0.27	0.5	253
ANU	646	Medalassa Korale	1450	15400	0.01	0.27	0.5	253
ANU POL	11	Anaolundewa	1450	15400	0.01	0.27	0.5	253
ANU POL	142	Hurulu	1450	15400	0.01	0.27	0.5	253
KUR	165	Kalugala	1533	16226	0.01	0.27	0.5	253
KUR	630	Bogodayagama	1350	14405	0.01	0.27	0.5	253
MTL	574	Hiriwaduna	1550	16395	0.01	0.27	0.5	253
PUT	406	Sellankandal	1179	12704	0.01	0.33	0.5	253
PUT	407	Sellankandal	1209	13002	0.01	0.33	0.5	253
PUT	554	Aruakalu	1150	12415	0.01	0.33	0.5	253
HAM	186	Katagamuwa	1100	11918	0.01	0.27	0.4	271
HAM	491	Yala	1000	10923	0.01	0.27	0.4	271
HAM	525	Miyandagala	1050	11420	0.01	0.27	0.4	271
KUR	404	Sangappale	1150	12415	0.01	0.27	0.4	271
MON	187	Kataragama	1050	11420	0.01	0.27	0.4	271
MON	399	Ruhuna Block 2	1050	11420	0.01	0.27	0.4	271
MON	400	Ruhuna Block 3	1100	11918	0.01	0.27	0.4	271
MON	401	Ruhuna Block 4	1250	13410	0.01	0.27	0.4	271
MON	402	Ruhuna Block 5	1150	12415	0.01	0.27	0.4	271
PUT	458	Wanniyagama	1250	13410	0.01	0.27	0.4	271
PUT	465	Weerakulicholai-Elavankulam	1110	12017	0.01	0.27	0.4	271

Table 3 of hydrology report. [re-ranked and ordered by Rank, District, Number]

Annex 3

IMPORTANCE OF NATURAL FORESTS FOR PROTECTION OF HEADWATERS

District	EMD No.	Forest name	Stream number	Stream rank	Catchment number	Catchment rank	Distance (km)	Distance rank	Sum of ranks	Headwaters rank
KEG NUW RAT	361	Peak Wilderness	295	5	3	3	355	4	12	1
NUW	40	Bogawantalawa	175	9	3	3	591	2	14	2
NUW	140	Horton Plains	73	23	3	3	607	1	27	3
GAL MTR RAT	414	Sinharaja	337	3	2	13	298	15	31	4
ANU KUR	161	Kahalla-Pallekele	52	34	3	3	343	5	42	5
ANU POL	142	Hurulu	51	37	3	3	255	19	59	6
NUW	1	Agra-Bopats	179	8	1	47	337	6	61	7
NUW	362	Pedro	354	2	1	47	308	14	63	8
NUW	197	Kikilimana	255	6	1	47	312	11	64	9
ANU POL	11	Anaolundewa	38	50	4	1	260	18	69	10
MTL	573	Puswellagolla	47	40	2	13	282	17	70	11
RAT	545	Handapan Ella	75	20	2	13	188	40	73	12
KAN	522	Knuckles	510	1	1	47	232	28	76	13
NUW	172	Kandapola Sita Eliya	153	10	1	47	254	21	78	14
BAD	608	Welanwita	62	27	2	13	172	42	82	15
KAN NUW	452	Victoria-Randenigala-Rantambe	318	4	1	47	204	36	87	16
BAD NUW	327	Ohiya	74	22	1	47	255	19	88	17
MAT	77	Diyadawa	73	23	2	13	158	53	89	18
NUW	52	Conical Hill	48	39	1	47	333	8	94	19
GAL	69	Dellawa	77	18	2	13	145	66	97	20
NUW	248	Mahakudagala	76	19	1	47	221	31	97	20
BAD	306	Namunukula	20	83	2	13	333	8	104	22
MTL	571	Gederagalpatana	22	78	2	13	309	13	104	22
NUW	358	Pattipola-Ambawela	37	55	1	47	337	6	108	24
POL MTL	410	Sigiriya	14	103	3	3	431	3	109	25
KAN	520	Illukkanda	79	17	1	47	161	51	115	26
MON	607	Rediketiya	63	26	2	13	134	78	117	27
BAD NUW	123	Hakgala	38	50	1	47	252	22	119	28
GAL	175	Kanneliya	245	7	2	13	109	103	123	29
RAT	546	Gongala	38	50	2	13	147	64	127	30
GAL	303	Nakiyadeniya	46	41	3	3	131	84	128	31
MTL	335	Pallegama-Himbiliyakada	58	29	1	47	151	61	137	32
KAN	100	Galaha	22	78	1	47	287	16	141	33
AMP MON	99	Gal Oya Valley South-West	45	42	2	13	124	88	143	34
GAL	65	Dediyagala	111	12	2	13	102	118	143	34
POL MTL	460	Wasgomuwa Lot 1	113	11	1	47	120	90	148	36
RAT	456	Walawe Basin	53	32	1	47	132	81	160	37
MTL	565	Makulussa	23	75	1	47	191	39	161	38
KAN NUW	394	Rilagala	14	103	1	47	310	12	162	39
KAN	517	Matinapatana	16	93	1	47	252	22	162	39
MTL	561	Opalagala	24	73	1	47	172	42	162	39
GAL	328	Tawalama	33	59	2	13	118	92	164	42
NUW	307	Nanu Oya	12	112	1	47	330	10	169	43
MON	589	Begahapatana	14	103	2	13	157	54	170	44
MON	579	Diggala	12	112	2	13	169	45	170	44
MON	606	Dyabodahela	22	78	2	13	133	79	170	44
MTL	560	Galboda	24	73	1	47	161	51	171	47
BAD AMP POL	239	Maduru Oya Block 1	25	71	1	47	157	54	172	48
HAM	388	Rammalekanda	43	45	2	13	103	115	173	49
NUW	270	Meepilimana	13	107	1	47	253	22	176	50
GAL	506	Tiboruwakota	12	112	2	13	154	58	183	51
KAN	518	Hopewell	12	112	1	47	236	27	186	52
MON	595	Radaliwinnekota	9	133	2	13	172	42	188	53
MON	305	Namandiya	10	124	2	13	155	55	192	54
GAL	509	Auwegalakanda	10	124	2	13	149	62	199	55
KAN	519	Guruyalle	13	107	1	47	169	45	199	55
KUR	165	Kalugala	8	146	2	13	188	40	199	55
RAT	384	Rajawaka	62	27	1	47	100	125	199	55
KAN MTL	45	Campbell's Land	10	124	1	47	231	29	200	59
NUW	383	Ragalla	10	124	1	47	224	30	201	60
RAT	112	Gilimale-Eratne	94	15	1	47	94	139	201	60
KAL	289	Morapitiya-Runakanda	52	34	1	47	101	122	203	62
KAN	192	Kelani Valley	52	34	1	47	101	122	203	62
MTL	562	Sacombe	13	107	1	47	164	49	203	62
RAT	28	Bambarabotuwa	45	42	1	47	103	115	204	65

District	EMD No.	Forest name	Stream number	Stream rank	Catchment number	Catchment rank	Distance (km)	Distance rank	Sum of ranks	Headwaters rank
RAT	288	Morahela	31	63	1	47	114	96	206	66
BAD	392	Ravana Ella	81	16	1	47	92	144	207	67
MTL	564	Heratgedara	15	98	1	47	148	63	208	68
ANU	463	Wedakanda	42	47	1	47	103	115	209	69
ANU	496	Yoda Ela	14	103	1	47	152	60	210	70
BAD	610	Kithedallakanda	9	133	1	47	212	34	214	71
KUR	552	Butawella	16	93	1	47	136	74	214	71
MTL	566	Gosgahapatana	11	118	1	47	164	49	214	71
BAD	426	Tangamalai	8	146	1	47	253	22	215	74
RAT	528	Asamanakanda	23	75	1	47	116	93	215	74
RAT	217	Kudumiriya	56	30	1	47	94	139	216	76
POL	281	Minneriya-Giritale Block 1	18	89	1	47	124	88	224	77
GAL	369	Polgahakanda	20	83	2	13	99	129	225	78
RAT	71	Delwela	31	63	1	47	102	118	228	79
KAN	521	Wewegalatana	7	153	1	47	216	32	232	80
NUW	128	Harasbedda	7	153	1	47	214	33	233	81
BAD	468	Welegama	21	81	1	47	108	107	235	82
KEG	551	Usgala	36	57	1	47	97	132	236	83
POL	96	Gal Oya	20	83	1	47	107	110	240	84
BAD	609	Madigala	3	195	2	13	214	33	241	85
GAL	38	Beraliya (Kudagala)	43	45	2	13	71	183	241	85
KUR	101	Galgiriyakanda	3	195	2	13	210	35	243	87
BAD	611	Keeriyagolla	6	162	1	47	204	36	245	88
ANU	395	Ritigala	9	133	1	47	145	66	246	89
HAM	491	Yala	41	48	4	1	61	197	246	89
KEG	514	Sembawatte	27	67	1	47	97	132	246	89
MON	576	Ulgala	6	162	2	13	136	74	249	92
KUR	78	Doluwakanda	9	133	1	47	136	74	254	93
KUR	318	Neugalkanda	9	133	1	47	136	74	254	93
RAT	205	Kobahadunkanda	32	61	1	47	90	146	254	93
RAT	68	Delgoda	26	69	1	47	94	139	255	96
KUR	489	Yakdessakanda	17	91	1	47	102	118	256	97
KEG	191	Kelani Valley	30	65	1	47	91	145	257	98
GAL	37	Beraliya (Akuressa)	37	55	2	13	64	190	258	99
KAL	166	Kalugala	51	37	1	47	76	174	258	99
MAT	497	Kalubowitiyana	5	174	2	13	140	72	259	101
RAT	184	Karawita	30	65	1	47	89	147	259	101
PUT	465	Weerakulicholai-Elavankulam	26	69	3	3	66	188	260	103
RAT	455	Walankanda	19	88	1	47	100	125	260	103
MTL	563	Talabugahaela	6	162	1	47	157	54	263	105
MON RAT	438	Uda Walawe	64	25	1	47	62	193	265	106
MON	97	Gal Oya Valley	104	13	1	47	58	205	265	106
RAT	459	Waratalgoda	33	59	1	47	83	159	265	106
MON	605	Balanagala	38	50	1	47	78	169	266	109
MTL	572	Menikdeniya	7	153	1	47	145	66	266	109
ANU	635	Manawewakanda	5	174	1	47	165	47	268	111
RAT	549	Alutwelawisahena	11	118	1	47	109	103	268	111
RAT	432	Tibbutukanda	15	98	1	47	100	125	270	113
MAT	499	Silverkanda	11	118	1	47	108	107	272	114
POL	279	Minneriya	7	153	1	47	137	73	273	115
RAT	386	Rammalakanda	12	112	1	47	105	114	273	115
MAT	293	Mulatiyana	96	14	1	47	52	214	275	117
AMP MON	98	Gal Oya Valley North-East	75	20	1	47	56	209	276	118
RAT	389	Ranwala	27	67	1	47	82	162	276	118
KUR	131	Henegedaralanda	9	133	1	47	113	97	277	120
MON	575	Dewagiriya	3	195	2	13	142	70	278	121
MTL	82	Elagomuwa	5	174	1	47	154	58	279	122
POL	280	Minneriya-Giritale	6	162	1	47	141	71	280	123
POL	502	Medirigiriya Tulana	53	32	1	47	59	202	281	124
MON	591	Murutukanda	21	81	1	47	87	154	282	125
RAT	531	Kudagoda	10	124	1	47	106	112	283	126
RAT	534	Galleletota	13	107	1	47	97	132	286	127
COL	222	Labugama-Kalatuwana	54	31	1	47	55	210	288	128
KAL	315	Neluketiya Mukalana	38	50	1	47	62	193	290	129
KAN	442	Udawattakele	1	218	1	47	239	26	291	130
MAT	138	Horagala-Paragala	41	48	1	47	61	197	292	131
RAT	274	Messana	8	146	1	47	112	99	292	131
RAT	530	Appalagala	9	133	1	47	106	112	292	131
GAL	208	Kombala-Kottawa	17	91	3	3	59	202	296	134
MON	581	Monerakelle	25	71	1	47	74	178	296	134
RAT	544	Gorangala	16	93	1	47	85	156	296	134
RAT	542	Digandala	8	146	1	47	109	103	296	134
HAM	249	Mahapitakanda	13	107	2	13	72	181	301	138
MTL	567	Amsawagama	2	207	1	47	165	47	301	138

District	EMD No.	Forest name	Stream number	Stream rank	Catchment number	Catchment rank	Distance (km)	Distance rank	Sum of ranks	Headwaters rank
RAT	541	Kabarakalapatana	7	153	1	47	109	103	303	140
MON	590	Randeniya	16	93	1	47	80	165	305	141
ANU	633	Labunoruwa	3	195	1	47	147	64	306	142
ANU	640	Getalagamakanda	5	174	1	47	127	87	308	143
KUR	157	Kadawatkele	9	133	1	47	97	132	312	144
MTL	570	Tottawelgola	4	184	1	47	132	81	312	144
KAL	221	Kurana Madakada	32	61	1	47	58	205	313	146
ANU	278	Mihintale	6	162	1	47	108	107	316	147
GAL	253	Malambure	36	57	1	47	52	214	318	148
KEG	515	Dedugalla-Nangala	10	124	1	47	89	147	318	148
RAT	476	Wewelkandura	9	133	1	47	88	147	327	150
KAL	487	Yagırala	45	42	1	47	27	240	329	151
KEG	4	Alapalawala	7	153	1	47	99	129	329	151
RAT	529	Dotalugala	5	174	1	47	107	110	331	153
ANU	632	Ratmale Kanda	3	195	1	47	119	91	333	154
MTL	558	Masawa	1	218	1	47	143	69	334	155
KEG	7	Amanawala-Ampane	8	146	1	47	93	142	335	156
KAL	70	Delmella Yatagampitiya	15	98	1	47	63	191	336	157
KUR	80	Dunkanda	7	153	1	47	96	136	336	157
KUR	177	Kanugollayaya	2	207	1	47	131	84	338	159
MAT	498	Kurulugala	6	162	1	47	99	129	338	159
GAL	120	Habarakada	18	89	1	47	58	205	341	161
MON	604	Viyanahela	9	133	1	47	81	164	344	162
MTL	144	Inamaluwa	1	218	1	47	133	79	344	162
MON	402	Ruhuna Block 5	15	98	3	3	23	244	345	164
KUR	256	Manapaya	1	218	1	47	132	81	346	165
RAT	234	Madampe	2	207	1	47	115	94	348	166
POL	598	Gunner's Quoın	4	184	1	47	102	118	349	167
RAT	19	Ayagama	10	124	1	47	74	178	349	167
COL	146	Indikada Mukalana	20	83	1	47	48	220	350	169
RAT	57	Dambuluwana	11	118	1	47	69	185	350	169
MTL	569	Etabendiwela	1	218	1	47	128	86	351	171
RAT	550	Kiribatgala	4	184	1	47	101	122	353	172
RAT	348	Pannala	2	207	1	47	112	99	353	172
RAT	547	Paragala	11	118	1	47	66	188	353	172
BAD MON	39	Bibilehela	9	133	1	47	75	176	356	175
MON	400	Ruhuna Block 3	23	75	1	47	31	235	357	176
MON	401	Ruhuna Block 4	16	93	1	47	51	218	358	177
ANU	641	Galkulama Tirrapane	1	218	1	47	115	94	359	178
MON	27	Bakinigahawela	5	174	1	47	95	138	359	178
ANU	639	Katupotakanda	1	218	1	47	113	97	362	180
RAT	535	Kuragala	8	146	1	47	78	169	362	180
ANU	647	Ranawekanda	1	218	1	47	112	99	364	181
PUT	458	Wanniyagama	20	83	1	47	30	236	366	183
RAT	241	Magurugoda	6	162	1	47	84	157	366	183
GAL	507	Homadola	15	98	1	47	47	222	367	185
RAT	298	Nahıtı Mukalana	1	218	1	47	111	102	367	185
MON	588	Wadinahela	8	146	1	47	72	181	374	187
RAT	536	Hapugala	7	153	1	47	76	174	374	187
KAL	129	Haycock	6	162	1	47	78	169	378	189
KUR	66	Degadaturawa	2	207	1	47	100	125	379	190
GAL	508	Hindeınattu	4	184	2	13	69	185	382	191
MAT	343	Panilkanda	6	162	1	47	77	173	382	191
RAT	169	Kumburugamuwa	9	133	1	47	59	202	382	191
KEG	513	Batahena	3	195	1	47	93	142	384	194
RAT	539	Hataramune	5	174	1	47	80	165	386	195
KAL	147	Ingiriya	11	118	1	47	44	224	389	196
RAT	543	Handuwelkanda	3	195	1	47	88	147	389	196
RAT	533	Mulgama	2	207	1	47	96	136	390	198
COL	285	Mıriyagalla	9	133	1	47	54	211	391	199
MON	399	Ruhuna Block 2	6	162	2	13	48	220	395	200
RAT	527	Angamana	3	195	1	47	84	157	399	201
POL	602	Mutugalla Tulana	2	207	1	47	88	147	401	202
KAL	512	Vellihallure	12	112	1	47	23	244	403	203
MAT	453	Viharakele	10	124	1	47	33	232	403	203
MAT	501	Aninkanda	4	184	1	47	74	178	409	205
KAL	516	Boralugoda	1	218	1	47	88	147	412	206
RAT	72	Demanagammana	1	218	1	47	89	147	412	206
MON	577	Korathalhinna	5	174	1	47	62	193	414	208
RAT	443	Ulinduwewa	4	184	1	47	70	184	415	209
KUR	404	Sangappale	7	153	1	47	51	218	418	210
ANU	646	Medalassa Korale	1	218	1	47	87	154	419	211
PUT	17	Attavillu	10	124	1	47	6	250	421	212
RAT	537	Narangattahinna	1	218	1	47	83	159	424	213

District	EMD No.	Forest name	Stream number	Stream rank	Catchment number	Catchment rank	Distance (km)	Distance rank	Sum of ranks	Headwaters rank
RAT	538	Gallegodahinna	1	218	1	47	83	159	424	213
MON	594	Golupitiyahela	3	195	1	47	69	185	427	215
RAT	133	Hidellana-Weralupe	1	218	1	47	82	162	427	215
RAT	504	Masimbula	1	218	1	47	79	167	432	217
RAT	272	Marakele	1	218	1	47	79	167	432	217
GAL	511	Bambarawana	6	162	1	47	44	224	433	218
COL	170	Kananpella	5	174	1	47	53	213	434	219
RAT	294	Muwagankanda	1	218	1	47	78	169	434	219
RAT	548	Dumbara	3	195	1	47	62	193	435	222
GAL	510	Yakdehikanda	4	184	1	47	57	208	439	223
RAT	532	Talawegoda	1	218	1	47	75	176	441	224
RAT	540	Galbokaya	2	207	1	47	60	199	453	225
MAT	60	Dandeniya-Aparekke	6	162	1	47	22	246	455	226
POL	600	Palliyagodella Tulana	3	195	1	47	52	214	456	227
POL	601	Kumadiya Tulana	1	218	1	47	63	191	456	227
HAM	178	Kanumuldeniya	5	174	1	47	30	236	457	229
GAL	62	Darakulkanda	4	184	1	47	33	232	463	230
MON	585	Kitulhela	1	218	1	47	60	199	464	231
MON	583	Velihela	1	218	1	47	60	199	464	231
MAT	201	Kirinda-Mahayayakele	4	184	1	47	27	240	471	233
MAT	471	Welihena	3	195	1	47	34	230	472	234
PUT	407	Sellankandal	4	184	1	47	26	242	473	235
MON	584	Guruhela	1	218	1	47	54	211	476	236
GAM	247	Mahakanda	1	218	1	47	52	214	479	237
GAL	173	Kandawattegoda	4	184	1	47	7	249	480	238
KAL	269	Meegahatenna	2	207	1	47	34	230	484	239
MON	592	Sitarama	2	207	1	47	33	232	486	240
MAT	500	Derangala	1	218	1	47	45	223	488	241
HAM	464	Wedasitikanda	2	207	1	47	30	236	490	242
HAM	526	Keulakada Wewa	1	218	1	47	41	226	491	243
MON	587	Westminster Abbey	1	218	1	47	41	226	491	243
MON	593	Bolhindagala	1	218	1	47	38	228	493	245
MON	586	Diggalahela	1	218	1	47	37	229	494	246
KAL	390	Ranwaragalakanda	1	218	1	47	29	239	504	247
MON	187	Kataragama	1	218	1	47	25	243	508	248
MAT	263	Masmullekele	1	218	1	47	17	247	512	249
PUT	406	Sellankandal	1	218	1	47	13	248	513	250
ANU	634	Puliyankulama	0	251	0	251	0	251	753	251
ANU	644	Tambaragalawewa	0	251	0	251	0	251	753	251
ANU	638	Pahala Mawatawewa	0	251	0	251	0	251	753	251
ANU	645	Puliyamkulam	0	251	0	251	0	251	753	251
ANU	636	Aruwewa	0	251	0	251	0	251	753	251
ANU	637	Andarawewa	0	251	0	251	0	251	753	251
ANU	643	Marasinhagama	0	251	0	251	0	251	753	251
ANU	642	Galmaduwa	0	251	0	251	0	251	753	251
ANU	631	Dematawewa	0	251	0	251	0	251	753	251
HAM	525	Miyandagala	0	251	0	251	0	251	753	251
HAM	44	Bundala	0	251	0	251	0	251	753	251
HAM	237	Madunagala	0	251	0	251	0	251	753	251
HAM	186	Katagamuwa	0	251	0	251	0	251	753	251
KUR	232	Ma Eliya	0	251	0	251	0	251	753	251
KUR	630	Bogodayagama	0	251	0	251	0	251	753	251
KUR	629	Tambutakanda	0	251	0	251	0	251	753	251
KUR	553	Talpattekanda	0	251	0	251	0	251	753	251
MAT	190	Kekanadura	0	251	0	251	0	251	753	251
MAT	24	Badullakele	0	251	0	251	0	251	753	251
MAT	329	Oliyagankele	0	251	0	251	0	251	753	251
MON	582	Lolehela	0	251	0	251	0	251	753	251
MON	580	Dummalahela	0	251	0	251	0	251	753	251
MON	578	Ulgala (old)	0	251	0	251	0	251	753	251
MTL	574	Hiriwaduna	0	251	0	251	0	251	753	251
MTL	568	Beliyakanda	0	251	0	251	0	251	753	251
POL	603	Sinnakallu	0	251	0	251	0	251	753	251
POL	599	Mahamorakanda	0	251	0	251	0	251	753	251
POL	597	Badanagala	0	251	0	251	0	251	753	251
POL	596	Kudagala North	0	251	0	251	0	251	753	251
PUT	554	Aruakalu	0	251	0	251	0	251	753	251
PUT	10	Ambanmukalana	0	251	0	251	0	251	753	251

Annex 4

IMPORTANCE OF NATURAL FORESTS FOR FLOOD CONTROL

District	EMD No.	Forest name	Rainfall (mm yr^{-1})	Area (km^2)	Steam freq. (km^{-2})	Mean flood (m^3s^{-1})	Flood rank
KEG NUW RAT	361	Peak Wilderness	4320	280.45	1.18	418.10	1
KAN	522	Knuckles	3184	300.00	1.34	312.71	2
GAL MTR RAT	414	Sinharaja	3946	111.87	2.69	260.07	3
GAL	175	Kanneliya	3984	60.25	3.77	186.05	4
KAN NUW	452	Victoria-Randenigala-Rantambe	1963	428.56	0.71	159.33	5
RAT	112	Gilimale-Eratne	4652	48.39	2.19	144.41	6
NUW	362	Pedro	2523	67.57	4.19	117.19	7
KAL	289	Morapitiya-Runakanda	4466	67.33	0.74	103.94	8
NUW	197	Kikilimana	2729	45.81	4.34	95.69	9
KAN	192	Kelani Valley	5260	29.06	1.51	91.89	10
GAL	65	Dediyagala	3437	37.9	2.7	87.22	11
RAT	28	Bambarabotuwa	3979	54.40	0.96	84.67	12
NUW	1	Agra-Bopats	2398	69.34	2.41	84.37	13
KAL	166	Kalugala	4450	42.88	1.03	83.50	14
NUW	40	Bogawantalawa	2699	42.90	3.38	78.51	15
RAT	545	Handapan Ella	3475	36.00	1.78	68.50	16
POL MTL	460	Wasgomuwa Lot 1	1700	359.89	0.34	65.72	17
GAL	69	Dellawa	3759	22.36	2.9	65.47	18
KAL	487	Yagirala	4464	23.90	1.63	65.02	19
KAL	315	Neluketiya Mukalana	4458	23.84	1.43	60.47	20
RAT	459	Waratalgoda	4564	18.90	1.80	57.80	21
MAT	77	Diyadawa	3410	24.48	2.52	57.72	22
MAT	293	Mulatiyana	3034	31.49	2.25	57.55	23
COL	222	Labugama-Kalatuwana	3950	21.50	1.91	54.67	24
MON	97	Gal Oya Valley	1700	259.00	0.29	54.65	25
ANU KUR	161	Kahalla-Pallekele	1600	377.40	0.17	52.77	26
RAT	217	Kudumiriya	3603	21.45	2.19	51.78	27
GAL	38	Beraliya (Kudagala)	3660	25.72	1.48	50.42	28
RAT	456	Walawe Basin	3121	32.30	1.52	49.94	29
GAL	303	Nakiyadeniya	3561	22.36	1.74	46.93	30
KEG	191	Kelani Valley	4933	11.55	2.16	46.61	31
KAN	520	Illukkanda	2594	39.00	1.41	44.00	32
KEG	514	Sembawatte	4891	12.00	1.83	43.72	33
MON RAT	438	Uda Walawe	1600	308.21	0.16	43.39	34
AMP MON	98	Gal Oya Valley North-East	1750	124.32	0.56	43.05	35
NUW	172	Kandapola Sita Eliya	2157	26.16	4.21	42.89	36
KEG	551	Usgala	5295	7.00	3.43	42.55	37
GAL	328	Tawalama	4340	10	3.2	42.46	38
BAD	608	Welanwita	2119	85.00	0.58	40.91	39
RAT	184	Karawita	4184	12.12	2.31	40.24	40
NUW	140	Horton Plains	2534	31.60	1.74	39.78	41
MAT	138	Horagala-Paragala	3209	18.12	2.15	38.11	42
BAD AMP POL	239	Maduru Oya Block 1	1850	514.69	0.04	38.11	42
KAL	221	Kurana Madakada	3988	11.61	2.32	36.52	44
MTL	335	Pallegama-Himbiliyakada	2320	45.47	0.99	35.98	45
RAT	71	Delwela	3587	15.60	1.79	35.58	46
GAL	253	Malambure	3937	9.3	3.12	34.61	47
KAL	70	Delmella Yatagampitiya	4339	14.13	1.13	33.41	48
ANU POL	142	Hurulu	1450	252.18	0.17	33.35	49
RAT	205	Kobahadunkanda	3801	8.90	3.37	33.10	50
RAT	546	Gongala	3100	16.00	2.19	33.06	51
RAT	68	Delgoda	3939	9.98	2.40	32.18	52
RAT	384	Rajawaka	2295	23.88	2.35	32.05	53
ANU POL	11	Anaolundewa	1450	289.57	0.12	31.06	54
POL	502	Medirigiriya Tulana	1735	80.00	0.60	30.35	55
AMP MON	99	Gal Oya Valley South-West	1600	152.81	0.24	29.52	56
MTL	573	Puswellagolla	1699	100.00	0.41	29.31	57
BAD	392	Ravana Ella	1900	20.73	3.99	28.96	58
BAD NUW	327	Ohiya	2252	17.69	3.11	28.05	59
RAT	288	Morahela	3600	8.47	2.95	27.59	60
COL	146	Indikada Mukalana	3800	7.48	3.08	27.28	61
RAT	547	Paragala	4500	9.00	1.44	27.19	62
HAM	388	Rammalekanda	2837	14.07	2.22	26.55	63
NUW	248	Mahakudagala	2171	16.39	3.36	26.04	64
MON	607	Rediketiya	1750	39.00	1.38	25.72	65

District	EMD No.	Forest name	Rainfall (mm yr^{-1})	Area (km^2)	Steam freq. (km^{-2})	Mean flood (m^{3}s^{-1})	Flood rank
GAL	37	Beraliya (Akuressa)	2671	16.46	1.8	25.11	66
GAL	369	Polgahakanda	4051	5.77	3.12	24.08	67
RAT	528	Asantanakanda	3400	8.00	2.25	21.21	68
GAL	506	Tiboruwakota	4350	6	1.83	20.85	69
KAN NUW	394	Rilagala	4373	5.67	1.94	20.63	70
RAT	455	Walankanda	3455	7.12	2.39	20.25	71
GAL	208	Kombala-Kottawa	2680	16.25	1.11	19.50	72
NUW	358	Pattipola-Ambawela	2229	14.80	2.09	19.47	73
RAT	57	Dambuluwana	4479	4.01	2.74	19.00	74
KAL	512	Vellihallure	4400	4.25	2.59	18.91	75
RAT	549	Alutwelawisahena	4050	8.00	1.13	18.83	76
RAT	544	Gorangala	4400	4.00	2.75	18.54	77
GAL	120	Habarakada	4397	2.1	8.1	18.70	78
NUW	52	Conical Hill	2292	7.08	5.94	18.49	79
MON	400	Ruhuna Block 3	1100	407.75	0.05	18.05	80
PUT	465	Weerakulicholai-Elavankulam	1110	291.92	0.08	17.96	81
KEG	7	Amanawala-Ampane	5371	5.14	0.97	17.60	82
HAM	491	Yala	1000	289.05	0.10	17.14	83
RAT	389	Ranwala	2496	8.68	2.77	16.67	84
POL	96	Gal Oya	1600	88.97	0.19	16.61	85
ANU	463	Wedakanda	1350	51.80	0.69	16.23	86
BAD NUW	123	Hakgala	2176	11.42	2.37	16.13	87
MAT	499	Silverkanda	3380	7.25	1.52	15.86	88
MON	401	Ruhuna Block 4	1250	264.18	0.05	15.48	89
KEG	515	Dedugalla-Nangala	4900	2.75	2.55	15.03	90
BAD	468	Welegama	2665	6.39	2.97	14.61	91
RAT	476	Wewelkandura	4036	4.29	1.86	14.37	92
GAL	509	Auwegalakanda	4500	2.5	3.2	13.91	93
GAL	507	Homadola	3800	3	3.67	13.86	94
RAT	386	Rammalakanda	3440	4.54	2.20	13.24	95
PUT	458	Wanniyagama	1250	144.18	0.10	13.13	96
RAT	274	Messana	3753	4.34	1.84	13.08	97
RAT	19	Ayagama	4421	2.14	3.73	12.91	98
KAL	147	Ingiriya	3917	2.83	3.18	12.77	99
MTL	561	Opalagala	2867	3.50	4.86	12.48	100
POL	281	Minneriya-Giritale Block 1	1489	75.29	0.17	12.45	101
RAT	541	Kabarakalapatana	3400	6.75	1.04	12.39	102
MAT	343	Panilkanda	3133	5.88	1.58	12.25	103
MTL	560	Galboda	2316	6.00	3.17	11.85	104
RAT	241	Magurugoda	4188	2.41	2.90	11.66	105
GAL	511	Bambarawana	4150	2.48	2.82	11.62	106
KAL	129	Haycock	4263	3.62	1.38	11.50	107
MON	605	Balanagala	1750	8.00	3.63	11.11	108
POL MTL	410	Sigiriya	1600	50.99	0.22	11.07	109
RAT	432	Tibbutukanda	2500	4.50	3.56	10.94	110
RAT	529	Dotalugala	4075	1.75	4.57	10.83	111
KAN	100	Galaha	2788	2.43	7.00	10.65	112
RAT	531	Kudagoda	2625	6.50	1.54	10.38	113
KUR	552	Butawella	2103	10.50	1.24	10.32	114
MTL	571	Gederagalpatana	1769	15.00	1.07	10.24	115
MAT	497	Kalubowitiyana	4189	2.72	1.84	10.23	116
KUR	489	Yakdessakanda	1872	10.11	1.68	10.00	117
HAM	249	Mahapitakanda	2368	7.22	1.52	9.81	118
MON	606	Dyabodahela	1750	11.00	1.64	9.67	119
MON	581	Monerakelle	1524	16.50	1.15	9.45	120
POL	280	Minneriya-Giritale	1568	66.94	0.10	9.36	121
KEG	513	Batahena	5368	3.00	0.67	9.23	122
MTL	565	Makulussa	2428	3.25	4.62	9.14	123
RAT	169	Kumburugamuwa	2225	14.81	0.47	9.09	124
RAT	536	Hapugala	2275	6.00	1.83	8.76	125
MAT	498	Kurulugala	3400	2.85	2.11	8.62	126
NUW	270	Meepilimana	2173	7.72	1.30	8.52	127
RAT	527	Angamana	3800	1.75	3.43	8.51	128
MTL	564	Heratgedara	2062	6.50	1.85	8.24	129
MON	591	Murutukanda	1672	8.00	2.25	8.19	130
MON	402	Ruhuna Block 5	1150	66.56	0.18	8.12	131
PUT	17	Attavillu	1334	51.79	0.17	7.87	132
POL	600	Palliyagodella Tulana	1738	96.00	0.03	7.86	133
COL	285	Miriyagalla	3655	1.23	5.69	7.78	134
RAT	534	Galleletota	2400	3.25	3.38	7.68	135
NUW	307	Nanu Oya	2335	4.16	2.40	7.65	136
COL	170	Kananpella	3650	2.64	1.52	7.51	137
RAT	298	Nahiti Mukalana	3303	1.96	3.07	7.32	138
BAD	306	Namunukula	2314	2.79	4.30	7.28	139
KAN MTL	45	Campbell's Land	2626	2.93	2.73	7.12	140

District	EMD No.	Forest name	Rainfall (mm yr⁻¹)	Area (km²)	Steam freq. (km⁻²)	Mean flood (m³s⁻¹)	Flood rank
MAT	453	Viharakele	2444	6.25	0.94	7.10	141
KAL	269	Meegahatenna	4480	2.77	0.72	7.06	142
RAT	548	Dumbara	4400	1.00	4.00	7.00	143
RAT	542	Digandala	3300	1.00	8.00	6.78	144
KAN	519	Guruyalle	2636	1.75	5.71	6.77	145
MTL	566	Gosgahapatana	1914	7.50	1.20	6.75	146
RAT	550	Kiribatgala	3263	3.00	1.33	6.74	147
MTL	562	Sacombe	2313	2.50	4.40	6.71	148
RAT	530	Appalagala	2610	2.00	4.00	6.23	148
HAM	178	Kanumuldeniya	2432	6.79	0.64	6.21	150
RAT	535	Kuragala	2200	3.25	2.77	6.17	151
MAT	501	Aninkanda	3250	2.23	1.79	6.08	152
BAD MON	39	Bibilehela	2050	6.06	1.15	6.07	153
ANU	496	Yoda Ela	1363	15.86	0.69	6.07	153
ANU	395	Ritigala	1550	15.28	0.52	6.06	155
RAT	234	Madampe	3233	2.25	1.78	6.05	156
KAN	517	Matinapatana	2070	2.50	4.80	6.04	157
MON	604	Viyanahela	1750	9.00	0.89	5.99	158
NUW	128	Harasbedda	2421	3.64	1.65	5.93	159
MON	590	Randeniya	1950	3.00	4.00	5.92	160
KUR	165	Kalugala	1533	27.06	0.18	5.67	151
MON	595	Radaliwinnekota	1750	9.00	0.78	5.59	162
MON	588	Wadinahela	1853	7.00	1.00	5.56	163
MON	589	Begahapatana	1805	3.25	3.69	5.48	164
RAT	443	Ulinduwewa	3100	1.05	5.73	5.47	165
GAL	508	Hindeinattu	3083	2	2	5.47	165
MTL	82	Elagomuwa	2146	8.70	0.46	5.47	165
NUW	383	Ragalla	2205	2.68	2.98	5.47	165
MON	305	Namandiya	1671	7.91	1.01	5.39	169
MAT	471	Welihena	2723	2.97	1.36	5.30	170
MON	399	Ruhuna Block 2	1050	99.31	0.05	5.25	171
KUR	131	Henegedaralanda	1750	7.30	0.96	5.22	172
KEG	4	Alapalawala	2789	1.82	2.75	5.19	173
GAL	173	Kandawattegoda	2550	3.59	1.11	5.13	174
MON	576	Ulgala	1515	15.00	0.40	5.04	175
KUR	318	Neugalkanda	1902	3.76	2.13	5.02	176
KUR	404	Sangappale	1150	45.06	0.13	5.01	177
GAL	62	Darakulkanda	3457	1.42	2.11	4.91	178
KAN	518	Hopewell	2250	1.25	8.00	4.90	179
RAT	543	Handuwelkanda	3950	1.50	1.33	4.87	180
KAN	521	Wewegalatana	2408	2.00	3.00	4.83	181
POL	279	Minneriya	1690	8.28	0.72	4.80	182
KAL	516	Boralugoda	4250	1.00	2.00	4.70	183
GAL	510	Yakdehikanda	3600	1	3	4.62	184
BAD	609	Madigala	1850	13.50	0.22	4.47	185
MTL	144	Inamaluwa	1550	9.10	0.67	4.44	186
PUT	407	Sellankandal	1209	45.42	0.09	4.37	187
MON	579	Diggala	1668	2.50	4.40	4.33	188
RAT	532	Talawegoda	4200	2.34	0.43	4.30	189
KUR	78	Doluwakanda	1850	4.01	1.50	4.26	190
RAT	504	Masimbula	3084	2.55	0.78	4.16	191
MTL	572	Menikdeniya	1750	4.50	1.33	4.11	192
BAD	426	Tangamalai	2348	1.32	4.56	4.06	193
RAT	539	Hataramune	2260	2.00	2.50	4.04	194
KUR	157	Kadawatkele	1850	2.67	2.62	4.04	194
KUR	80	Dunkanda	1796	3.01	2.32	4.03	196
RAT	533	Mulgama	2450	2.00	2.00	4.02	197
BAD	610	Kithedallakanda	2299	1.00	7.00	3.90	198
MON	577	Korathalhinna	1450	15.00	0.27	3.87	199
RAT	348	Pannala	3448	1.29	1.55	3.86	200
BAD	611	Keeriyagolla	2654	1.25	3.20	3.83	201
KAL	390	Ranwaragalakanda	3950	1.92	0.52	3.71	202
RAT	272	Marakele	4550	1.06	0.94	3.69	203
RAT	538	Gallegodahinna	2300	2.00	2.00	3.69	203
MTL	563	Talabugahaela	2250	3.00	1.00	3.54	205
ANU	278	Mihintale	1350	10.00	0.50	3.44	206
RAT	133	Hidellana-Weralupe	4100	1.28	0.78	3.41	207
RAT	294	Muwagankanda	3854	1.32	0.76	3.17	208
MTL	570	Tottawelgola	1627	8.00	0.38	3.17	208
MAT	60	Dandeniya-Aparekke	1839	3.48	1.07	3.17	208
MON	575	Dewagiriya	1713	6.00	0.50	3.09	211
RAT	72	Demanagammana	3813	1.14	0.88	2.98	212
RAT	537	Narangattahinna	2350	2.50	0.80	2.87	213
MON	27	Bakinigahawela	1650	2.00	2.50	2.65	214
POL	598	Gunner's Quoin	1450	4.50	0.89	2.60	215

District	EMD No.	Forest name	Rainfall (mm yr^{-1})	Area (km^2)	Steam freq. (km^{-2})	Mean flood (m^3s^{-1})	Flood rank
ANU	640	Getalagamakanda	1300	7.00	0.57	2.60	215
KUR	101	Galgiriyakanda	1450	11.83	0.17	2.51	217
MAT	201	Kirinda-Mahayayakele	1940	2.53	0.91	2.40	218
RAT	540	Galbokaya	2220	1.75	1.14	2.37	219
ANU	635	Manawewakanda	1449	3.25	1.23	2.33	220
MAT	500	Derangala	3500	0.75	1.33	2.31	221
ANU	632	Ratmale Kanda	1550	7.00	0.29	2.31	221
MTL	567	Amsawagama	2186	4.50	0.22	2.22	223
MON	594	Golupitiyahela	1750	2.00	1.50	2.21	224
GAM	247	Mahakanda	3115	1.03	0.97	2.20	225
MAT	263	Masmullekele	2076	6.18	0.14	2.14	226
PUT	406	Sellankandal	1179	42.66	0.02	2.04	227
ANU	633	Labunoruwa	1430	3.00	1.00	1.93	228
KUR	177	Kanugollayaya	1950	1.20	1.67	1.75	229
HAM	464	Wedasitikanda	1062	13.43	0.15	1.73	230
POL	602	Mutugalla Tulana	1750	4.25	0.24	1.62	231
POL	601	Kumadiya Tulana	1750	4.00	0.25	1.59	232
ANU	647	Ranawekanda	1550	5.75	0.17	1.52	233
KAN	442	Udawattakele	1950	2.07	0.48	1.48	234
MON	592	Sitarama	1072	8.00	0.25	1.47	235
MTL	558	Masawa	1750	3.10	0.32	1.46	236
KUR	256	Manapaya	1850	3.14	0.27	1.44	237
MON	585	Kitulhela	1550	4.50	0.22	1.40	238
MTL	569	Etabendiwela	1650	3.25	0.31	1.37	239
KUR	66	Degadaturawa	1500	1.62	1.23	1.36	230
ANU	641	Galkulama Tirrapane	1312	4.50	0.22	1.12	241
MON	584	Guruhela	1450	2.75	0.36	1.09	242
MON	187	Kataragama	1050	8.38	0.12	1.02	243
MON	586	Diggalahela	1450	2.00	0.50	0.98	244
MON	583	Velihela	1450	2.00	0.50	0.98	244
HAM	526	Keulakada Wewa	1300	3	0.33	0.96	246
ANU	646	Medalassa Korale	1450	1.75	0.57	0.94	247
MON	593	Bolhindagala	1186	3.75	0.27	0.92	248
ANU	639	Katupotakanda	1350	1.75	0.57	0.85	249
ANU	636	Aruwewa	1350	1.50	0	0	250
HAM	186	Katagamuwa	1100	10.04	0	0	250
ANU	638	Pahala Mawatawewa	1350	3.25	0	0	250
HAM	525	Miyandagala	1050	3	0	0	250
ANU	642	Galmaduwa	1350	2.50	0	0	250
HAM	237	Madunagala	1150	9.75	0	0	250
ANU	634	Puliyankulama	1500	1.50	0	0	250
ANU	643	Marasinhagama	1350	1.00	0	0	250
ANU	637	Andarawewa	1350	4.00	0	0	250
HAM	44	Bundala	878	62.16	0	0	250
ANU	645	Puliyamkulam	1350	1.25	0	0	250
MON	578	Ulgala (old)	1450	2.25	0	0	250
MON	587	Westminster Abbey	1550	8.00	0	0	250
PUT	554	Aruakalu	1150	21.00	0	0	250
MON	580	Dummalahela	1550	1.25	0	0	250
MON	582	Lolehela	1450	4.00	0	0	250
PUT	10	Ambanmukalana	1625	10.05	0	0	250
POL	603	Sinnakallu	1750	4.50	0	0	250
POL	599	Mahamorakanda	1600	1.75	0	0	250
POL	597	Badanagala	1750	2.00	0	0	250
POL	596	Kudagala North	1850	4.75	0	0	250
MTL	574	Hiriwaduna	1550	9.50	0	0	250
MAT	329	Oliyagankele	2465	4.86	0	0	250
KUR	232	Ma Eliya	1550	3.81	0	0	250
KUR	630	Bogodayagama	1350	1.00	0	0	250
ANU	644	Tambaragalawewa	1350	3.50	0	0	250
ANU	631	Dematawewa	1550	8.00	0	0	250
KUR	629	Tambutakanda	1150	2.50	0	0	250
MTL	568	Beliyakanda	1650	2.50	0	0	250
KUR	553	Talpattekanda	1550	1.50	0	0	250
MAT	190	Kekanadura	1721	3.8	0	0	250
MAT	24	Badullakele	2070	1.48	0	0	250

Annex 5

LIST OF FORESTS INVENTORIED FOR SPECIES

List of forests surveyed during the NCR, together with the number of transects and plots inventoried. Notified and present areas are given for each forest, where appropriate and known. Present area accounts for lands released subsequent to notification. The composition of units of contiguous forest, comprising two or more designated forests, is also provided.

INDIVIDUAL FORESTS

EMD		Notification		Area (ha)		No.		New Species		
No.	Forest name	date	Designation	Notified	Present	Transects	Plots	Pen.	Last	Districts
ANURADHAPURA										
636	Aruwewa		OSF	150.0	150.0	3	9	3.7	1.8	ANU
* 641	Galkulama Tirrapane		OSF	450.0	450.0	1	5	2.9	12.8	ANU
640	Getalagamakanda		OSF	700.0	700.0	1	6	0.0	0.0	ANU
* 136	Hinna		PR	1021.8	1021.8	1	4	15.4	0.0	ANU
* 160	Kahalla	11/10/1935	FR	3397.7	3292.5	1	5	8.5	3.3	ANU
161	Kahalla-Pallekele	11/07/1989	S	21690.0	21690.0	3	11	2.7	2.6	ANU KUR
653	Kokkebe		OSF	0.0	0.0	2	10	1.6	0.0	ANU
633	Labunoruwa		OSF	300.0	300.0	2	10	1.9	0.0	ANU
635	Manawewakanda		OSF	325.0	325.0	1	8	1.6	0.0	ANU
* 277	Mihintale	14/11/1924	FR	3308.2	2462.9	1	5	7.3	0.0	ANU
333	Padawiya		PR	97901.7	97664.3	6	27	0.0	0.0	ANU
* 650	Pallankulama		OSF	0.0	0.0	1	5	4.4	15.1	ANU
* 645	Puliyamkulam		OSF	125.0	125.0	1	5	13.9	10.0	ANU
634	Puliyankulama		OSF	150.0	150.0	2	10	2.0	2.0	ANU
647	Ranawekanda		OSF	575.0	575.0	1	5	4.3	4.1	ANU
395	Ritigala	07/11/1941	SNR	1528.2	1528.2	4	18	3.5	5.0	ANU
* 651	Semewa		OSF	0.0	0.0	1	3	16.1	8.8	ANU
463	Wedakanda		PR	5180.0	5180.0	3	15	1.6	0.0	ANU
* 652	Wellamudawa		OSF	0.0	0.0	1	3	25.0	12.5	ANU
BADULLA										
* 39	Bibilehela		PR	610.0	606.3	2	10	8.2	0.0	BAD MON
123	Hakgala	01/03/1938	SNR	1141.6	1141.6	1	8	0.0	2.0	BAD NUW
306	Namunukula		PR	279.3	279.3	2	7	2.8	0.0	BAD
327	Ohiya		PR	1925.5	1769.1	2	9	4.9	0.0	BAD NUW
* 392	Ravana Ella	18/05/1979	S	1932.0	1932.0	1	5	43.2	6.4	BAD
* 426	Tangamalai	01/03/1938	S	131.5	131.5	1	5	6.8	2.2	BAD
608	Welanwita		OSF	8500.0	8500.0	2	10	2.0	1.9	BAD
GALLE										
* 509	Auwegalakanda		OSF	250.0	250.0	1	4	10.9	3.7	GAL
* 511	Bambarawana		OSF	248.0	248.0	1	4	15.2	8.1	GAL
37	Beraliya (Akuressa)		PR	1859.9	1645.5	2	20	2.1	1.1	GAL MTR
38	Beraliya (Kudagala)		PR	4241.1	2571.8	1	8	3.1	1.8	GAL
* 62	Darakulkanda		PR	457.6	141.7	1	6	17.2	4.7	GAL
65	Dediyagala	06/09/1940	FR	3789.9	3789.9	1	17	0.0	0.0	GAL MTR
69	Dellawa		PR	2034.0	2236.3	3	15	3.5	2.5	GAL MTR
* 120	Habarakada		PR	209.6	209.6	1	4	13.4	11.2	GAL
* 508	Hindeinattu		OSF	200.0	200.0	1	4	20.8	7.4	GAL
* 507	Homadola		OSF	300.0	300.0	1	5	6.3	5.9	GAL
* 173	Kandawattegoda		PR	404.7	358.6	1	5	6.6	10.9	GAL
175	Kanneliya	06/07/1934	FR	6114.4	6024.5	1	24	0.9	0.4	GAL
208	Kombala-Kottawa		PR	2289.7	1624.6	2	14	0.0	1.6	GAL
* 253	Malambure	19/07/1935	FR	1012.3	929.8	1	7	8.6	1.2	GAL
303	Nakiyadeniya		PR	2292.1	2235.5	2	12	2.2	0.9	GAL
369	Polgahakanda	18/09/1942	FR	862.3	577.4	1	8	1.2	0.0	GAL

EMD No.	Forest name	Notification date	Designation	Area (ha) Notified	Present	No. Transects	Plots	New Species Pen.	Last	Districts
414	Sinharaja	21/10/1988	NHWA	11187.0	11187.0	7	46	0.3	0.3	GAL MTR RAT
* 505	Tawalama		OSF	1000.0	1000.0	1	5	8.0	8.0	GAL
* 506	Tiboruwakota		OSF	600.0	600.0	1	7	3.0	5.6	GAL
HAMBANTOTA										
* 44	Bundala	31/12/1992	NP	6215.9	6215.9	1	5	14.7	2.9	HAM
523	Kahanda Kalapuwa		OSF	200.0	200.0	1	3	0.0	0.0	HAM
* 164	Kalametiya Kalapuwa	28/06/1984	S	712.0	712.0	1	5	77.8	18.2	HAM
* 178	Kanumuldeniya	13/09/1940	FR	678.7	678.7	1	5	2.6	10.3	HAM MTR
* 186	Katagamuwa	27/05/1938	S	1003.6	1003.6	1	6	2.4	12.8	HAM
* 526	Keulakada Wewa		OSF	300.0	300.0	1	5	15.6	4.3	HAM
* 237	Madunagala	06/04/1992	FR	975.2	975.2	1	3	20.8	17.2	HAM
* 525	Miyandagala		OSF	300.0	300.0	1	2	100.0	22.9	HAM
388	Rammalakanda	21/05/1926	FR	1698.1	1406.7	2	16	1.1	3.6	HAM MTR
* 524	Rekawa Kalapuwa		OSF	50.0	50.0	1	3	20.0	0.0	HAM
398	Ruhuna Block 1	25/02/1938	NP	13679.2	13679.2	2	24	1.4	4.2	HAM
* 464	Wedasitikanda	07/09/1978	FR	1343.4	1343.4	1	5	0.0	15.4	HAM MON
KALUTARA										
* 70	Delmella Yatagampitiya		PR	2033.7	1413.3	1	2	100.0	23.6	KAL
* 129	Haycock		FR	362.0	362.0	1	6	10.3	3.8	KAL
* 147	Ingiriya	07/08/1929	FR	407.0	282.6	1	6	5.0	7.0	KAL
166	Kalugala		PR	4630.1	4288.0	2	15	2.3	0.5	KAL
* 269	Meegahatenna		PR	282.8	277.4	1	3	27.1	9.6	KAL
289	Morapitiya-Runakanda		PR	7012.5	6732.5	2	22	0.4	0.4	KAL
315	Neluketiya Mukalana		PR	2625.2	2384.4	3	10	4.0	4.3	KAL
* 390	Ranwaragalakanda		PR	192.1	192.1	1	4	16.1	5.3	KAL
512	Vellihallure		OSF	425.0	425.0	1	7	3.9	3.8	KAL
* 659	Wathurana		PVT	18.0	0.0	1	5	1.9	5.4	KAL
487	Yagirala		FR	3014.7	2390.2	2	11	3.6	1.8	KAL
* 486	Yagirala		PR	34.1	34.1	1	5	14.7	5.8	KAL
KANDY										
* 79	Dotalugala		PR	1871.7	1871.7	1	5	5.1	2.5	KAN MTL
522	Knuckles		OSF	30000.0	30000.0	8	40	0.7	1.0	KAN
394	Rilagala		PR	566.6	566.6	1	5	2.6	2.5	KAN NUW
* 442	Udawattakele	01/03/1938	S	104.0	104.0	1	5	20.0	2.0	KAN
KEGALLE										
* 7	Amanawala-Ampane		PR	518.0	514.0	1	6	7.5	5.1	KEG
* 513	Batahena		OSF	300.0	300.0	1	5	14.3	3.6	KEG
191	Kelani Valley	11/09/1903	FR	1155.1	1155.1	1	11	1.8	0.0	KEG
657	Kurulukele		?	0.0	0.0	1	4	2.9	4.2	KEG
361	Peak Wilderness	01/11/1940	S	22379.2	22379.2	2	22	0.4	1.2	KEG NUW RAT
* 514	Sembawatte		OSF	1200.0	1200.0	1	5	10.3	12.7	KEG
* 551	Usgala		OSF	700.0	700.0	1	6	8.5	6.6	KEG
KURUNEGALA										
* 78	Doluwakanda		PR	400.6	400.6	1	5	11.1	6.3	KUR
* 80	Dunkanda		PR	301.1	301.1	1	5	7.8	5.9	KUR
* 101	Galgiriyakanda		PR	1182.5	1182.5	1	8	2.0	9.1	KUR
* 256	Manapaya		PR	314.0	314.0	1	5	13.8	5.8	KUR
318	Neugalkanda		PR	376.0	376.0	3	14	1.1	1.1	KUR
336	Pallekele	04/02/1896	FR	14513.8	12721.4	3	13	1.3	0.0	KUR
489	Yakdessakanda		PR	1011.7	1010.9	2	10	0.0	0.0	KUR
MONARAGALA										
* 589	Begahapatana		OSF	325.0	325.0	1	5	7.0	5.0	MON
593	Bolhindagala		OSF	375.0	375.0	1	5	2.8	2.7	MON
* 575	Dewagiriya		OSF	600.0	600.0	1	4	17.9	7.1	MON
* 579	Diggala		OSF	250.0	250.0	1	5	14.5	0.0	MON
* 594	Golupitiyahela		OSF	200.0	200.0	1	6	24.6	5.5	MON
* 584	Guruhela		OSF	275.0	275.0	1	5	7.0	3.4	MON
* 187	Kataragama	27/05/1938	S	837.7	837.7	1	5	4.5	8.3	MON
* 585	Kitulhela		OSF	450.0	450.0	1	5	12.5	4.5	MON
* 577	Korathalhinna		OSF	1500.0	1500.0	1	5	10.9	4.2	MON
582	Lolehela		OSF	400.0	400.0	1	5	3.7	0.0	MON

EMD No.	Forest name	Notification date	Designation	Area (ha) Notified	Present	No. Transects	Plots	New Species Pen.	Last	Districts
* 581	Monerakelle		OSF	1650.0	1650.0	2	10	10.3	4.1	MON
* 591	Murutukanda		OSF	800.0	800.0	1	5	19.2	7.1	MON
* 595	Radaliwinnekota		OSF	900.0	900.0	1	6	75.4	9.7	MON
590	Randeniya		OSF	300.0	300.0	1	5	4.4	2.2	MON
400	Ruhuna Block 3	28/04/1967	NP	40775.4	40775.4	4	28	2.9	1.0	MON
* 401	Ruhuna Block 4	09/10/1969	NP	26417.7	26417.7	2	5	7.1	16.0	MON
* 399	Ruhuna Block 2	03/09/1954	NP	9931.0	9931.0	2	13	3.6	5.1	MON
438	Uda Walawe	30/06/1972	NP	30821.0	30821.0	3	15	0.0	0.0	MON RAT
* 576	Ulgala		OSF	1500.0	1500.0	1	5	7.1	3.4	MON
* 583	Velihela		OSF	200.0	200.0	1	5	12.8	2.1	MON
* 604	Viyanahela		OSF	900.0	900.0	1	5	9.7	1.4	MON
588	Wadinahela		OSF	700.0	700.0	1	5	0.0	2.0	MON
MATALE										
* 567	Amsawagama		OSF	450.0	450.0	1	5	9.6	8.8	MTL
* 654	Arangala		OSF	0.0	0.0	1	3	11.6	15.7	MTL
568	Beliyakanda		OSF	250.0	250.0	2	10	2.9	1.4	MTL
* 660	Elagamuwa		OSF	0.0	0.0	1	5	2.3	10.4	MTL
* 82	Elagomuwa		PR	870.1	870.1	1	4	25.0	4.5	MTL
* 569	Etabendiwela		OSF	325.0	325.0	1	3	28.9	17.4	MTL
560	Galboda		OSF	600.0	600.0	2	10	2.4	0.0	MTL
571	Gederagalpatana		OSF	1500.0	1500.0	4	19	1.6	1.6	MTL
574	Hiriwaduna		OSF	950.0	950.0	2	10	4.5	2.9	MTL
* 144	Inamaluwa		PR	309.6	309.6	1	5	12.8	4.1	MTL
* 655	Kaludiyapokuna		OSF	0.0	0.0	2	10	3.3	6.2	MTL
656	Kosgahakele		?	0.0	0.0	1	5	0.0	0.0	MTL
572	Menikdeniya		OSF	450.0	450.0	2	10	4.3	0.0	MTL
* 561	Opalagala		OSF	350.0	350.0	1	5	5.7	1.9	MTL
335	Pallegama-Himbiliyakada		PR	4547.2	4547.2	2	10	5.0	2.9	MTL
* 376	Potawa		PR	77.2	77.2	1	5	5.8	5.5	MTL
573	Puswellagolla		OSF	10000.0	10000.0	5	25	0.8	0.0	MTL
* 562	Sacombe		OSF	250.0	250.0	1	5	7.7	5.8	MTL
570	Tottawelgola		OSF	800.0	800.0	2	10	0.0	0.0	MTL
MATARA										
* 501	Aninkanda		OSF	75.0	75.0	1	5	13.8	9.2	MTR
* 24	Badullakele	11/10/1940	FR	182.3	147.7	1	5	3.9	8.3	MTR
* 60	Dandeniya-Aparekka	02/12/1938	FR	560.0	348.3	1	5	2.3	7.4	MTR
* 500	Derangala		OSF	50.0	50.0	1	4	12.4	4.3	MTR
77	Diyadawa	21/08/1936	FR	2578.2	2447.7	2	17	2.1	1.5	MTR
* 138	Horagala-Paragala		OSF	1800.0	1800.0	1	4	12.8	8.4	MTR
* 497	Kalubowitiyana		OSF	100.0	100.0	1	5	14.9	3.9	MTR
* 190	Kekanadura	15/11/1935	FR	401.7	379.9	1	5	8.8	3.6	MTR
* 201	Kirinda Mahayayakele	19/07/1940	FR	374.1	252.7	1	6	11.6	3.4	MTR
* 498	Kurulugala		OSF	175.0	175.0	1	4	12.6	5.9	MTR
* 263	Masmullekele	21/07/1939	FR	805.4	618.0	1	6	7.5	7.8	MTR
293	Mulatiyana	25/08/1944	FR	3277.5	3148.9	4	29	0.5	2.0	MTR
329	Oliyagankele	08/09/1939	FR	488.6	486.0	4	16	1.3	1.8	MTR
* 343	Panilkanda	18/03/1927	FR	588.1	588.1	1	5	6.1	6.7	MTR
* 499	Silverkanda		OSF	1000.0	1000.0	1	5	8.8	2.6	MTR
* 453	Viharekele	26/04/1935	FR	825.1	625.1	1	6	8.0	7.4	MTR
* 471	Welihena	15/11/1935	FR	333.1	296.8	1	6	8.8	4.7	MTR
NUWARA ELIYA										
* 1	Agra-Bopats		PR	9105.4	6933.6	1	9	6.7	5.1	NUW
* 40	Bogawantalawa		PR	4289.7	4289.7	1	6	18.6	11.9	NUW
* 52	Conical Hill		PR	1569.5	707.5	1	8	5.9	3.8	NUW
* 96	Gal Oya		PR	9036.6	8897.4	1	5	8.0	0.0	POL
140	Horton Plains	16/03/1988	NP	3159.8	3159.8	3	16	2.5	0.0	NUW
* 172	Kandapola Sita Eliya	20/05/1892	FR	2721.2	2615.9	1	9	7.4	3.6	NUW
192	Kelani Valley		PR	2944.9	2906.2	1	7	4.6	1.7	NUW
* 197	Kikilimana		PR	4868.4	4580.6	2	9	29.5	3.7	NUW
* 248	Mahakudagala		PR	1762.5	1638.7	1	5	6.8	4.8	NUW
* 270	Meepilimana	02/11/1906	FR	981.8	771.5	1	6	1.8	5.2	NUW
358	Pattipola-Ambawela		PR	1498.0	1480.3	1	10	3.1	3.0	NUW
362	Pedro		PR	6879.7	6757.0	3	18	1.8	1.8	NUW

EMD No.	Forest name	Notification date	Designation	Area (ha) Notified	Present	No. Transects	Plots	New Species Pen.	Last	Districts
POLONNARUWA										
* 113	Giritale		PR	1077.3	1063.1	1	4	8.0	0.0	POL
502	Medirigiriya Tulana		OSF	8000.0	8000.0	2	8	4.1	3.9	POL
* 279	Minneriya		PR	2444.3	828.0	1	5	10.7	9.7	POL
* 280	Minneriya-Giritale	28/07/1938	S	6693.5	6693.5	1	5	8.7	4.2	POL
* 281	Minneriya-Giritale Block 1	12/02/1988	NR	7529.1	7529.1	3	16	6.0	1.2	POL
410	Sigiriya	26/01/1990	S	5099.0	5099.0	2	10	2.4	1.2	POL MTL
460	Wasgomuwa Lot 1	07/08/1984	NP	29036.0	29036.0	6	49	2.0	0.7	POL MTL
PUTTALAM										
* 556	Chilaw Lake		OSF	300.0	300.0	1	5	7.7	0.0	PUT
* 407	Sellankandal		PR	5526.0	4542.2	1	5	12.8	2.1	PUT
458	Wanniyagama		PR	15596.6	14417.8	2	10	0.0	1.6	PUT
RATNAPURA										
* 549	Alutwelawisahena		OSF	800.0	800.0	1	5	8.5	4.1	RAT
* 530	Appalagala		OSF	200.0	200.0	1	5	14.0	13.6	RAT
* 528	Asantanakanda		OSF	800.0	800.0	1	4	7.8	9.4	RAT
* 19	Ayagama		PR	661.7	214.3	1	5	5.6	3.4	RAT
28	Bambarabotuwa	04/07/1890	FR	5440.3	5440.3	1	10	1.2	2.4	RAT
* 68	Delgoda		PR	998.0	998.0	1	5	6.8	2.7	RAT
71	Delwela		PR	1560.9	1560.1	1	12	1.7	0.6	RAT
* 538	Gallegodahinna		OSF	200.0	200.0	1	5	8.5	5.3	RAT
* 534	Galleletota		OSF	325.0	325.0	1	6	12.9	0.0	RAT
112	Gilimale-Eratne		PR	5832.7	4838.8	5	28	3.3	1.1	RAT
* 546	Gongala		OSF	1600.0	1600.0	1	5	10.9	7.1	RAT
* 544	Gorangala		OSF	400.0	400.0	1	3	46.2	15.2	RAT
545	Handapan Ella		OSF	3600.0	3600.0	3	12	0.6	1.7	RAT
* 536	Hapugala		OSF	600.0	600.0	1	5	11.3	8.6	RAT
539	Hataramune		OSF	200.0	200.0	1	6	0.0	3.1	RAT
* 541	Kabarakalapatana		OSF	675.0	675.0	1	3	22.5	13.6	RAT
184	Karawita		PR	1375.9	1211.8	1	9	1.5	1.4	RAT
550	Kiribatgala		OSF	300.0	300.0	1	8	3.2	4.2	RAT
* 205	Kobahadunkanda		PR	890.3	890.3	1	6	5.2	2.2	RAT
* 531	Kudagoda		OSF	650.0	650.0	1	5	19.8	8.0	RAT
217	Kudumiriya		PR	2144.8	2144.8	1	8	2.8	2.2	RAT
* 535	Kuragala		OSF	325.0	325.0	1	5	10.2	9.3	RAT
* 504	Masimbula		PR	255.0	255.0	1	5	7.7	3.3	RAT
* 274	Messana		PR	724.4	433.8	1	6	26.0	8.4	RAT
288	Morahela	31/03/1893	FR	930.5	846.9	1	7	3.4	3.3	RAT
533	Mulgama		OSF	200.0	200.0	1	5	5.0	3.2	RAT
298	Nahiti Mukalana	13/12/1889	FR	195.7	195.7	2	12	1.8	4.5	RAT
* 537	Narangattahinna		OSF	250.0	250.0	1	5	21.1	7.3	RAT
* 547	Paragala		OSF	900.0	900.0	1	5	3.7	6.9	RAT
384	Rajawaka		PR	2387.6	2387.6	2	11	0.9	3.5	RAT
* 386	Rammalakanda		PR	453.7	453.7	1	5	5.0	5.6	RAT
532	Talawegoda		OSF	450.0	450.0	1	8	1.1	1.1	RAT
* 432	Tibbutukanda		PR	233.9	233.9	1	4	13.0	4.4	RAT
455	Walankanda	03/04/1890	FR	832.9	711.5	2	10	1.7	3.9	RAT
* 456	Walawe Basin	08/09/1893	FR	3237.5	3229.7	1	8	6.3	1.4	RAT
459	Waratalgoda		PR	1889.9	1889.9	2	10	4.8	4.6	RAT
* 476	Wewelkandura		PR	429.0	429.0	1	5	14.5	7.1	RAT

* Inadequately inventoried forest (i.e. number of previously unrecorded woody plant species in penultimate or last plot < = 5% of the cumulative number of species, as shown in the 10th and 11th columns of the table).

Key to designations:

CF	Conservation Forest	NP	National Park
FR	Forest Reserve	NR	Nature Reserve
NHWA	National Heritage Wilderness Area	S	Sanctuary
OSF	Other State Forest	SNR	Strict Natural Reserve
PR	Proposed Reserve		

CONTIGUOUS FORESTS

EMD No.	Contiguous forest name	Composition (numbers of individual forests)
-414	Sinharaja (N=14)	19, 68, 69, 70, 77, 205, 289, 315, 414, 459, 499, 545, 546, 547
-522	Knuckles /Wasgomuwa (N=9)	79, 82, 335, 460, 461, 522, 560, 561, 562, 563, 564
-140	Central Highlands (N=14)	1, 40, 52, 123, 140, 172, 192, 270, 307, 358, 361, 456, 468, 530, 549, 551
-175	KDN (N=4)	65, 175, 234, 328, 303, 505
-28	Bambarabotuwa (N=4)	28, 274, 288, 528, 529
-455	Walankanda (N=6)	71, 298, 348, 386, 455, 476, 541, 542
-208	Kombala-Kottawa (N=2)	173, 208
-343	Panilkanda (N=2)	343, 501
-362	Pedro (N=2)	100, 248, 362
-487	Yagirala (N=3)	486, 487, 512
-129	Haycock (N=2)	120, 129
-253	Malambure (N=2)	253, 369
-281	Mineriya (N=2)	113, 281
-39	Bibilehela (N=2)	39, 608
-398	Ruhuna/Yala (N=8)	186, 187, 398, 399, 400, 401, 402, 491
-573	Puswellagolla (N=4)	410, 569, 571, 573
-161	Kalahalla-Pallekele (N=2)	161, 336
-144	Inamaluwa (N=2)	144, 574
-640	Getamalagamakanda (N=2)	640, 641
-164	Mangroves (N=3)	164, 523, 524

Annex 6

SUMMARY OF WOODY PLANT DIVERSITY WITHIN INDIVIDUAL FORESTS

The number of families, genera, species and endemic species are summarised for each forest, together with the number of species that are rare (i.e. recorded only within that particular forest), nationally threatened according to Wijesinghe *et al.* (1993) and globally threatened according to the WCMC Plants Database (23 December 1994).

Species recorded within individual forests can be identified from the species/forest matrix in Annex 1, Volume 2.

EMD No.	Forest name	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
* 1	Agra-Bopats	33	63	79	1	40	0	5	13
* 549	Alutwelawisahena	51	111	147	0	89	0	9	56
* 7	Amanawala-Ampane	46	85	98	1	53	1	9	29
* 567	Amsawagama	30	50	57	0	10	0	1	1
* 501	Aninkanda	50	100	120	1	64	1	6	40
* 530	Appalagala	32	60	66	1	14	1	2	3
* 654	Arangala	28	46	51	0	8	0	1	0
636	Aruwewa	27	49	55	1	7	0	2	1
* 528	Asantanakanda	45	102	128	1	75	0	4	45
* 509	Auwegalakanda	47	105	134	0	81	0	12	53
* 19	Ayagama	55	124	147	1	70	1	12	49
* 24	Badullakele	42	72	84	0	40	0	7	29
28	Bambarabotuwa	54	123	169	1	113	0	13	77
* 511	Bambarawana	51	114	136	0	68	0	7	44
* 513	Batahena	51	115	138	0	72	0	12	45
* 589	Begahapatana	28	53	60	1	8	0	1	0
568	Beliyakanda	30	56	70	0	12	0	2	0
37	Beraliya (Akuressa)	60	136	189	1	109	0	15	75
38	Beraliya (Kudagala)	55	123	163	1	96	0	12	66
* 39	Bibilehela	30	53	61	1	6	0	0	1
* 40	Bogawantalawa	25	45	67	0	42	0	8	11
593	Bolhindagala	18	32	37	0	3	0	1	0
* 44	Bundala	20	34	35	5	3	0	0	1
* 556	Chilaw Lake	10	11	13	3	1	0	0	0
* 52	Conical Hill	26	37	53	0	29	0	3	6
* 60	Dandeniya-Aparekka	41	82	95	0	51	0	8	29
* 62	Darakulkanda	52	109	128	0	63	0	8	46
65	Dediyagala	56	125	188	0	124	0	18	87
* 68	Delgoda	49	107	150	1	96	1	14	67
69	Dellawa	62	146	203	1	111	0	9	76
* 70	Delmella Yatagampitiya	46	98	110	0	55	0	8	38
71	Delwela	50	126	173	0	102	0	18	68
* 500	Derangala	39	83	93	0	40	0	4	26
* 575	Dewagiriya	19	36	42	2	4	0	4	2
* 579	Diggala	26	47	55	0	12	0	3	4
77	Diyadawa	59	139	197	1	116	0	16	75
* 78	Doluwakanda	24	42	48	2	25	1	2	14
* 79	Dotalugala	39	73	81	2	31	0	6	9
* 80	Dunkanda	34	63	68	2	16	0	4	6
* 660	Elagamuwa	29	41	48	1	5	0	0	0
* 82	Elagomuwa	35	59	67	0	8	0	2	0
* 569	Etabendiwela	23	39	46	0	6	0	1	1
* 96	Gal Oya	35	63	75	0	12	0	1	0
560	Galboda	37	70	85	0	14	0	2	2
* 101	Galgiriyakanda	29	46	55	2	9	0	0	1
* 641	Galkulama Tirrapane	21	38	39	0	5	0	1	1

EMD No.	Forest name	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Global
* 538	Gallegodahinna	32	65	75	0	14	0	2	3
* 534	Galleletota	26	54	62	3	7	1	1	1
571	Gederagalpatana	44	98	128	0	17	0	3	4
640	Getalagamakanda	23	33	39	0	1	0	1	0
112	Gilimale-Eratne	70	179	279	4	164	3	25	104
* 113	Giritale	14	23	25	1	3	0	1	2
* 594	Golupitiyahela	30	65	73	0	14	0	2	3
* 546	Gongala	40	84	99	2	47	0	8	26
* 544	Gorangala	50	101	125	1	76	0	9	47
* 584	Guruhela	29	49	59	0	9	0	1	0
* 120	Habarakada	48	103	134	0	77	0	9	55
123	Hakgala	30	44	51	2	25	1	4	5
545	Handapan Ella	53	113	174	6	95	2	16	56
* 536	Hapugala	31	49	58	1	8	0	1	1
539	Hataramune	24	55	64	2	4	0	1	0
* 129	Haycock	56	125	182	1	115	1	16	78
* 508	Hindeinattu	55	117	135	0	67	0	11	45
* 136	Hinna	14	24	26	0	5	0	0	0
574	Hiriwaduna	30	60	68	0	13	0	2	1
* 507	Homadola	49	109	153	0	93	0	11	63
* 138	Horagala-Paragala	49	100	119	0	63	0	8	46
140	Horton Plains	33	56	79	3	42	2	3	8
* 144	Inamaluwa	20	45	49	0	7	0	1	1
* 147	Ingiriya	52	109	128	1	61	0	12	40
* 541	Kabarakalapatana	50	88	103	0	50	0	5	26
* 160	Kahalla	27	53	61	0	13	0	3	2
161	Kahalla-Pallekele	32	64	77	1	16	0	4	3
523	Kahanda Kalapuwa	10	10	10	4	0	0	2	0
* 164	Kalametiya Kalapuwa	9	11	11	0	0	0	0	0
* 497	Kalubowitiyana	61	126	154	1	69	0	9	47
* 655	Kaludiyapokuna	29	56	65	0	14	0	3	2
166	Kalugala	65	157	216	0	116	0	20	77
* 172	Kandapola Sita Eliya	32	46	56	2	25	0	1	5
* 173	Kandawattegoda	44	97	119	0	62	0	7	41
175	Kanneliya	61	147	234	3	155	0	26	106
* 178	Kanumuldeniya	42	79	87	0	44	0	4	29
184	Karawita	54	104	139	1	81	0	9	55
* 186	Katagamuwa	21	40	47	0	6	0	0	1
* 187	Kataragama	14	21	24	0	1	0	0	0
* 190	Kekanadura	41	76	83	1	38	0	6	29
191	Kelani Valley	60	132	170	0	95	0	14	63
192	Kelani Valley	58	135	177	0	83	0	16	60
* 526	Keulakada Wewa	22	41	47	1	5	0	3	2
* 197	Kikilimana	30	60	81	1	46	1	5	14
550	Kiribatgala	51	121	165	1	94	1	14	55
* 201	Kirinda Mahayayakele	38	74	89	0	48	0	6	37
* 585	Kitulhela	31	60	67	1	10	0	3	1
522	Knuckles	67	183	288	12	85	3	11	25
* 205	Kobahadunkanda	46	106	137	0	84	0	10	60
653	Kokkebe	28	54	64	0	7	0	2	0
208	Kombala-Kottawa	56	130	191	2	117	0	17	81
* 577	Korathalhinna	26	40	48	0	8	0	3	1
656	Kosgahakele	24	40	45	0	7	0	1	0
* 531	Kudagoda	39	81	88	1	23	0	4	10
217	Kudumiriya	55	124	183	2	122	1	14	81
* 535	Kuragala	28	48	54	0	7	0	1	0
* 498	Kurulugala	48	90	118	1	61	0	6	35
657	Kurulukele	36	68	72	1	21	0	2	9
633	Labunoruwa	26	47	53	0	7	0	2	1
582	Lolehela	31	49	54	0	9	0	2	1
* 237	Madunagala	17	26	29	0	3	0	1	0
* 248	Mahakudagala	28	49	62	2	29	2	3	6
* 253	Malambure	56	130	165	0	95	0	13	64
* 256	Manapaya	33	58	69	1	17	0	4	2
635	Manawewakanda	27	54	63	0	7	0	1	1
* 504	Masimbula	50	103	121	0	70	0	9	48
* 263	Masmullekele	51	99	116	1	57	0	8	43

EMD No.	Forest name	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
502	Medirigiriya Tulana	29	60	76	0	13	0	1	1
* 269	Meegahatenna	44	84	94	0	46	0	4	27
* 270	Meepilimana	28	40	58	1	31	0	1	5
572	Menikdeniya	33	73	92	1	19	0	3	4
* 274	Messana	52	108	143	5	88	2	12	51
* 277	Mihintale	21	36	41	0	6	0	1	1
* 279	Minneriya	20	27	31	0	4	0	1	2
* 280	Minneriya-Giritale	32	62	72	2	9	0	3	1
* 281	Minneriya-Giritale Block 1	32	68	85	2	12	0	3	0
* 525	Miyandagala	17	27	35	2	4	0	1	1
* 581	Monerakelle	47	104	121	6	29	0	4	7
288	Morahela	56	108	152	2	85	0	8	56
289	Morapitiya-Runakanda	63	166	244	0	131	0	18	85
293	Mulatiyana	66	150	204	5	105	2	17	69
533	Mulgama	31	54	62	0	27	0	5	16
* 591	Murutukanda	30	51	56	0	6	0	2	1
298	Nahiti Mukalana	56	130	178	0	106	0	12	69
303	Nakiyadeniya	59	161	234	0	132	0	23	84
306	Namunukula	38	63	71	13	24	2	6	4
* 537	Narangattahinna	36	74	82	1	12	1	3	2
315	Neluketiya Mukalana	65	163	211	3	101	2	12	66
318	Neugalkanda	42	78	94	0	24	0	2	11
327	Ohiya	28	52	61	10	24	2	4	4
329	Oliyagankele	52	112	163	3	100	2	18	64
* 561	Opalagala	30	48	54	0	8	0	1	0
333	Padawiya	33	62	74	0	10	0	3	1
* 650	Pallankulama	26	48	53	0	6	0	1	0
335	Pallegama-Himbiliyakada	42	90	103	3	13	0	3	2
336	Pallekele	32	63	76	2	11	0	5	3
* 343	Panilkanda	50	94	105	0	48	0	3	33
* 547	Paragala	53	111	145	0	90	0	10	63
358	Pattipola-Ambawela	27	48	67	0	38	0	4	8
361	Peak Wilderness	65	155	256	6	148	3	18	72
362	Pedro	41	83	112	6	57	2	7	16
369	Polgahakanda	60	127	170	0	97	0	9	69
* 376	Potawa	27	50	55	0	6	0	1	1
* 645	Puliyamkulam	21	32	40	0	6	0	1	0
634	Puliyankulama	26	44	51	0	7	0	1	0
573	Puswellagolla	41	95	119	0	19	0	3	3
* 595	Radaliwinnekota	30	62	72	2	9	0	2	2
384	Rajawaka	40	97	115	3	34	0	7	12
* 386	Rammalakanda	47	91	126	2	76	0	10	51
388	Rammalakanda	68	146	196	2	99	0	11	64
647	Ranawekanda	26	42	49	0	7	0	2	1
590	Randeniya	25	39	46	0	5	0	2	0
* 390	Ranwaragalakanda	42	105	131	1	72	0	14	46
* 392	Ravana Ella	28	43	47	2	5	0	0	0
* 524	Rekawa Kalapuwa	7	9	10	0	1	0	0	0
394	Rilagala	33	65	80	1	46	1	6	19
395	Ritigala	40	98	119	2	23	1	4	7
398	Ruhuna Block 1	29	58	72	2	3	0	1	1
* 399	Ruhuna Block 2	28	48	59	2	4	0	2	2
400	Ruhuna Block 3	36	76	103	3	11	0	2	2
* 401	Ruhuna Block 4	28	41	50	0	10	0	1	2
* 562	Sacombe	35	60	69	0	8	0	2	1
* 407	Sellankandal	21	41	48	1	7	1	2	1
* 514	Sembawatte	60	108	134	0	64	0	7	45
* 651	Semewa	20	32	34	0	6	0	1	0
410	Sigiriya	38	72	86	1	13	0	2	1
* 499	Silverkanda	45	89	116	2	60	0	6	32
414	Sinharaja	71	191	337	10	192	2	30	116
532	Talawegoda	35	73	90	0	38	0	7	21
* 426	Tangamalai	21	41	45	5	17	0	2	6
* 505	Tawalama	50	111	150	0	102	0	15	68
* 432	Tibbutukanda	41	100	113	1	60	0	6	39
* 506	Tiboruwakota	58	130	179	3	106	0	16	73
570	Tottawelgola	28	43	50	0	7	0	0	0

EMD No.	Forest name	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Global
438	Uda Walawe	32	60	74	0	6	0	1	0
* 442	Udawattakele	31	45	51	0	14	0	1	3
* 576	Ulgala	28	51	58	1	9	0	4	2
* 551	Usgala	52	119	152	1	92	0	12	64
* 583	Velihela	26	43	48	0	9	0	1	1
512	Vellihallure	52	111	132	0	64	0	7	42
* 453	Viharekele	44	90	108	0	62	0	9	41
* 604	Viyanahela	36	63	73	0	12	0	2	2
588	Wadinahela	27	44	50	1	4	0	1	0
455	Walankanda	58	131	181	1	101	1	13	63
* 456	Walawe Basin	53	107	145	2	70	0	11	44
458	Wanniyagama	29	54	64	0	8	0	1	1
459	Waratalgoda	61	155	217	1	126	0	22	85
460	Wasgomuwa Lot 1	49	120	151	9	22	0	5	2
* 659	Wathurana	44	89	112	5	66	3	12	43
463	Wedakanda	25	50	61	0	10	0	2	1
* 464	Wedasitikanda	21	32	39	0	4	0	1	0
608	Welanwita	35	84	103	3	13	1	3	1
* 471	Welihena	41	80	107	0	74	0	13	60
* 652	Wellamudawa	18	29	32	0	2	0	0	0
* 476	Wewelkandura	52	119	156	0	89	0	13	59
* 486	Yagirala	52	109	137	1	75	1	11	50
487	Yagirala	57	130	171	1	89	0	16	64
489	Yakdessakanda	34	62	77	2	16	0	3	5

* Inadequately inventoried forest.

Annex 7

SUMMARY OF FAUNAL DIVERSITY WITHIN INDIVIDUAL FORESTS

The number of families, genera, species and endemic species are summarised for each forest, together with the number of species that are rare (i.e. recorded only within that particular forest), nationally threatened according to Wijesinghe *et al.* (1993) and globally threatened according to IUCN (1995).

Species recorded within individual forests can be identified from the species/forest matrix in Annex 2, Volume 2. It should be noted that all forests were inadequately inventoried for fauna.

Codes for higher taxa are as follows:

A = Birds, B = Amphibians, I = Butterflies, K = Molluscs, M = Mammals, P = Fishes, R = Reptiles.

EMD		Higher						Rare/	Threatened species	
No.	Forest name	taxa	Families	Genera	Species	Rare	Endemic	Endemic	National	Global
1	Agra-Bopats	A	15	18	19	0	8	0	8	1
1	Agra-Bopats	B	1	1	5	0	2	0	2	0
1	Agra-Bopats	I	0	0	0	0	0	0	0	0
1	Agra-Bopats	K	0	0	0	0	0	0	0	0
1	Agra-Bopats	M	5	7	7	0	1	0	3	0
1	Agra-Bopats	R	1	1	1	0	1	0	1	0
	Total		22	27	32	0	12	0	14	1
7	Amanawala-Ampane	A	17	19	22	0	7	0	8	1
7	Amanawala-Ampane	B	2	2	2	0	1	0	1	0
7	Amanawala-Ampane	I	3	5	5	0	1	0	0	1
7	Amanawala-Ampane	K	3	5	5	0	5	0	0	0
7	Amanawala-Ampane	M	5	6	6	0	0	0	1	0
7	Amanawala-Ampane	R	2	3	3	0	2	0	3	0
	Total		32	40	43	0	16	0	13	2
19	Ayagama	A	13	15	20	0	7	0	7	1
19	Ayagama	B	2	3	3	0	2	0	2	0
19	Ayagama	I	1	1	1	0	0	0	0	0
19	Ayagama	K	1	2	3	0	3	0	0	0
19	Ayagama	M	6	6	6	0	1	0	1	0
19	Ayagama	R	2	2	2	0	2	0	2	0
	Total		25	29	35	0	15	0	12	1
24	Badullakele	A	9	9	10	0	2	0	2	0
24	Badullakele	B	2	2	2	1	1	0	1	0
24	Badullakele	I	2	2	2	0	0	0	0	0
24	Badullakele	K	2	2	4	0	4	0	0	0
24	Badullakele	M	4	5	5	0	3	0	2	0
24	Badullakele	R	1	1	1	0	1	0	1	0
	Total		20	21	24	1	11	0	6	0
28	Bambarabotuwa	A	16	20	22	0	7	0	6	2
28	Bambarabotuwa	B	1	1	1	0	1	0	1	0
28	Bambarabotuwa	I	3	9	12	0	0	0	0	0
28	Bambarabotuwa	K	3	4	4	0	4	0	0	0
28	Bambarabotuwa	M	4	4	4	0	1	0	1	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
28	Bambarabotuwa	R	5	8	9	0	5	0	5	0
	Total		32	46	52	0	18	0	13	2
37	Beraliya (Akuressa)	A	17	25	29	0	5	0	5	0
37	Beraliya (Akuressa)	B	1	1	2	0	1	0	1	0
37	Beraliya (Akuressa)	I	0	0	0	0	0	0	0	0
37	Beraliya (Akuressa)	K	4	8	11	0	11	0	0	0
37	Beraliya (Akuressa)	M	6	8	8	0	3	0	2	0
37	Beraliya (Akuressa)	R	5	11	11	0	7	0	8	0
	Total		33	53	61	0	27	0	16	0
38	Beraliya (Kudagala)	A	18	21	24	0	3	0	3	0
38	Beraliya (Kudagala)	B	2	2	3	0	2	0	2	0
38	Beraliya (Kudagala)	I	1	2	2	0	0.	0	0	0
38	Beraliya (Kudagala)	K	5	7	7	0	6	0	0	0
38	Beraliya (Kudagala)	M	6	6	6	0	1	0	1	0
38	Beraliya (Kudagala)	R	4	6	6	0	3	0	2	0
	Total		36	44	48	0	15	0	8	0
39	Bibilehela	A	22	37	42	0	3	0	3	0
39	Bibilehela	B	0	0	0	0	0	0	0	0
39	Bibilehela	I	4	4	4	0	0	0	0	0
39	Bibilehela	K	2	2	2	0	1	0	0	0
39	Bibilehela	M	7	8	8	0	0	0	1	0
39	Bibilehela	R	3	4	5	1	3	1	2	0
	Total		38	55	61	1	7	1	6	0
40	Bogawantalawa	A	11	16	18	0	3	0	5	0
40	Bogawantalawa	B	1	1	5	0	2	0	2	0
40	Bogawantalawa	I	3	3	3	1	0	0	0	0
40	Bogawantalawa	K	3	3	3	0	3	0	0	0
40	Bogawantalawa	M	4	5	5	0	1	0	2	0
40	Bogawantalawa	R	1	2	2	0	2	0	2	0
	Total		23	30	36	1	11	0	11	0
44	Bundala	A	15	18	20	0	1	0	1	0
44	Bundala	B	0	0	0	0	0	0	0	0
44	Bundala	I	4	7	8	0	0	0	0	0
44	Bundala	K	1	1	1	0	0	0	0	0
44	Bundala	M	8	8	8	0	0	0	2	1
44	Bundala	R	1	2	2	0	0	0	0	0
	Total		29	36	39	0	1	0	3	1
52	Conical Hill	A	10	14	15	0	3	0	4	1
52	Conical Hill	B	1	2	3	0	2	0	2	0
52	Conical Hill	I	2	2	2	0	1	0	0	0
52	Conical Hill	K	4	5	5	1	4	1	0	0
52	Conical Hill	M	5	7	7	0	0	0	2	0
52	Conical Hill	R	1	2	2	0	2	0	2	0
	Total		23	32	34	1	12	1	10	1
60	Dandeniya-Aparekka	A	10	12	12	0	0	0	0	0
60	Dandeniya-Aparekka	B	0	0	0	0	0	0	0	0
60	Dandeniya-Aparekka	I	0	0	0	0	0	0	0	0
60	Dandeniya-Aparekka	K	3	4	5	0	5	0	0	0
60	Dandeniya-Aparekka	M	2	2	2	0	0	0	0	0
60	Dandeniya-Aparekka	R	2	3	3	0	2	0	2	0
	Total		17	21	22	0	7	0	2	0
62	Darakulkanda	A	10	11	12	0	2	0	2	0
62	Darakulkanda	B	1	1	1	0	0	0	0	0
62	Darakulkanda	I	1	1	1	0	1	0	0	1
62	Darakulkanda	K	3	4	4	0	4	0	0	0
62	Darakulkanda	M	6	6	6	0	1	0	1	0
62	Darakulkanda	R	3	3	3	0	2	0	1	0
	Total		24	26	27	0	10	0	4	1

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Global
65	Dediyagala	A	14	17	20	0	4	0	4	0
65	Dediyagala	B	1	1	2	0	0	0	0	0
65	Dediyagala	I	1	1	1	0	0	0	0	0
65	Dediyagala	K	4	7	8	0	7	0	0	0
65	Dediyagala	M	8	8	8	0	1	0	2	0
65	Dediyagala	R	4	8	8	0	5	0	4	0
	Total		32	42	47	0	17	0	10	0
68	Delgoda	A	12	15	17	0	6	0	7	0
68	Delgoda	B	1	2	2	0	2	0	2	0
68	Delgoda	I	0	0	0	0	0	0	0	0
68	Delgoda	K	2	3	3	0	3	0	0	0
68	Delgoda	M	6	6	6	0	1	0	1	0
68	Delgoda	R	2	3	3	0	3	0	1	0
	Total		23	29	31	0	15	0	11	0
69	Dellawa	A	20	32	37	0	12	0	13	3
69	Dellawa	B	3	5	5	1	5	1	5	0
69	Dellawa	I	3	9	12	0	1	0	0	1
69	Dellawa	K	3	4	5	0	5	0	0	0
69	Dellawa	M	7	8	8	0	2	0	3	0
69	Dellawa	R	5	11	12	0	6	0	5	0
	Total		41	69	79	1	31	1	26	4
70	Delmella Yatagampitiya	A	14	17	19	0	5	0	5	1
70	Delmella Yatagampitiya	B	0	0	0	0	0	0	0	0
70	Delmella Yatagampitiya	I	2	4	4	0	0	0	0	0
70	Delmella Yatagampitiya	K	2	2	2	0	2	0	0	0
70	Delmella Yatagampitiya	M	5	5	5	0	0	0	1	0
70	Delmella Yatagampitiya	R	0	0	0	0	0	0	0	0
	Total		23	28	30	0	7	0	6	1
71	Delwela	A	16	19	21	0	9	0	10	1
71	Delwela	B	3	5	6	0	4	0	3	0
71	Delwela	I	2	5	5	0	1	0	0	1
71	Delwela	K	2	3	3	0	3	0	0	0
71	Delwela	M	7	8	8	0	3	0	2	0
71	Delwela	R	4	7	8	0	6	0	5	0
	Total		34	47	51	0	26	0	20	2
77	Diyadawa	A	19	29	34	0	9	0	8	1
77	Diyadawa	B	1	1	1	0	1	0	1	0
77	Diyadawa	I	4	12	16	0	1	0	0	1
77	Diyadawa	K	3	5	6	0	6	0	0	0
77	Diyadawa	M	8	10	10	0	2	0	4	0
77	Diyadawa	R	5	9	12	0	6	0	5	0
	Total		40	66	79	0	25	0	18	2
78	Doluwakanda	A	9	12	14	0	0	0	1	0
78	Doluwakanda	B	0	0	0	0	0	0	0	0
78	Doluwakanda	I	0	0	0	0	0	0	0	0
78	Doluwakanda	K	2	2	2	0	2	0	0	0
78	Doluwakanda	M	1	1	1	0	0	0	0	0
78	Doluwakanda	R	2	4	4	0	3	0	4	0
	Total		14	19	21	0	5	0	5	0
79	Dotalugala	A	11	13	14	0	6	0	6	0
79	Dotalugala	B	1	1	2	0	0	0	0	0
79	Dotalugala	I	1	1	1	0	0	0	0	0
79	Dotalugala	K	0	0	0	0	0	0	0	0
79	Dotalugala	M	6	6	6	0	1	0	1	0
79	Dotalugala	R	4	4	4	1	4	1	3	1
	Total		23	25	27	1	11	1	10	1
80	Dunkanda	A	16	19	21	0	1	0	1	0
80	Dunkanda	B	0	0	0	0	0	0	0	0
80	Dunkanda	I	3	5	5	0	0	0	0	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Global
80	Dunkanda	K	2	2	2	0	2	0	0	0
80	Dunkanda	M	7	7	7	0	0	0	1	0
80	Dunkanda	R	1	1	1	0	1	0	1	0
	Total		29	34	36	0	4	0	3	0
82	Elagomuwa	A	15	15	20	0	2	0	2	0
82	Elagomuwa	B	0	0	0	0	0	0	0	0
82	Elagomuwa	I	5	9	10	0	0	0	0	0
82	Elagomuwa	K	0	0	0	0	0	0	0	0
82	Elagomuwa	M	6	6	6	0	0	0	0	0
82	Elagomuwa	R	1	1	1	0	0	0	0	0
	Total		27	31	37	0	2	0	2	0
96	Gal Oya	A	8	8	10	0	2	0	2	0
96	Gal Oya	B	0	0	0	0	0	0	0	0
96	Gal Oya	I	5	8	11	0	0	0	0	0
96	Gal Oya	K	3	3	3	1	2	1	0	0
96	Gal Oya	M	6	7	7	0	1	0	1	1
96	Gal Oya	R	1	1	1	0	1	0	1	0
	Total		23	27	32	1	6	1	4	1
101	Galgiriyakanda	A	18	21	24	0	2	0	2	0
101	Galgiriyakanda	B	0	0	0	0	0	0	0	0
101	Galgiriyakanda	I	3	5	5	0	0	0	0	0
101	Galgiriyakanda	K	3	3	3	0	2	0	0	0
101	Galgiriyakanda	M	7	9	9	0	1	0	1	0
101	Galgiriyakanda	R	2	3	4	0	2	0	2	0
	Total		33	41	45	0	7	0	5	0
112	Gilimale-Eratne	A	21	31	34	0	10	0	10	2
112	Gilimale-Eratne	B	2	4	4	0	4	0	4	0
112	Gilimale-Eratne	I	3	7	9	0	1	0	0	1
112	Gilimale-Eratne	K	4	7	12	0	10	0	0	0
112	Gilimale-Eratne	M	8	12	12	0	3	0	4	0
112	Gilimale-Eratne	R	5	9	13	0	10	0	8	0
	Total		43	70	84	0	38	0	26	3
113	Giritale	A	7	7	9	0	1	0	1	0
113	Giritale	B	0	0	0	0	0	0	0	0
113	Giritale	I	1	1	1	0	0	0	0	0
113	Giritale	K	3	5	5	0	3	0	0	0
113	Giritale	M	8	9	9	0	0	0	2	1
113	Giritale	R	1	2	2	0	0	0	0	0
	Total		20	24	26	0	4	0	3	1
120	Habarakada	A	13	16	17	0	5	0	6	0
120	Habarakada	B	2	2	2	0	1	0	1	0
120	Habarakada	I	2	2	2	0	0	0	0	0
120	Habarakada	K	4	4	5	0	5	0	0	0
120	Habarakada	M	4	4	4	0	0	0	0	0
120	Habarakada	R	4	5	5	0	3	0	1	0
	Total		29	33	35	0	14	0	8	0
123	Hakgala	A	16	21	22	0	6	0	7	0
123	Hakgala	B	1	1	2	0	1	0	1	0
123	Hakgala	I	0	0	0	0	0	0	0	0
123	Hakgala	K	1	1	2	0	1	0	0	0
123	Hakgala	M	4	5	5	0	1	0	2	0
123	Hakgala	R	1	1	1	0	1	0	1	0
	Total		23	29	32	0	10	0	11	0
129	Haycock	A	11	11	13	0	4	0	4	0
129	Haycock	B	2	2	3	0	2	0	2	0
129	Haycock	I	2	3	3	0	0	0	0	0
129	Haycock	K	5	7	9	1	9	1	0	0
129	Haycock	M	5	6	6	0	2	0	2	0
129	Haycock	R	4	7	8	0	4	0	3	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
	Total		29	36	42	1	21	1	11	0
136	Hinna	A	14	15	16	0	2	0	2	0
136	Hinna	B	1	1	1	0	0	0	0	0
136	Hinna	I	6	12	17	1	1	1	0	0
136	Hinna	K	1	1	1	0	1	0	0	0
136	Hinna	M	6	6	6	0	0	0	1	1
136	Hinna	R	2	2	2	0	1	0	1	0
	Total		30	37	43	1	5	1	4	1
138	Horagala-Paragala	A	16	18	22	0	6	0	6	0
138	Horagala-Paragala	B	0	0	0	0	0	0	0	0
138	Horagala-Paragala	I	2	2	2	0	0	0	0	0
138	Horagala-Paragala	K	3	4	4	0	4	0	0	0
138	Horagala-Paragala	M	6	6	6	0	1	0	2	0
138	Horagala-Paragala	R	2	2	2	0	1	0	0	0
	Total		29	32	36	0	12	0	8	0
140	Horton Plains	A	16	25	26	2	5	0	7	1
140	Horton Plains	B	2	2	7	0	3	0	3	0
140	Horton Plains	I	1	1	1	0	0	0	0	0
140	Horton Plains	K	2	2	2	0	1	0	0	0
140	Horton Plains	M	6	7	7	0	1	0	3	0
140	Horton Plains	R	2	4	4	0	4	0	4	0
	Total		29	41	47	2	14	0	17	1
144	Inamaluwa	A	14	17	21	0	1	0	1	0
144	Inamaluwa	B	0	0	0	0	0	0	0	0
144	Inamaluwa	I	4	6	6	0	0	0	0	0
144	Inamaluwa	K	0	0	0	0	0	0	0	0
144	Inamaluwa	M	7	7	7	0	0	0	2	1
144	Inamaluwa	R	0	0	0	0	0	0	0	0
	Total		25	30	34	0	1	0	3	1
147	Ingiriya	A	16	18	21	0	5	0	5	1
147	Ingiriya	B	1	1	1	0	1	0	1	0
147	Ingiriya	I	1	1	1	0	0	0	0	0
147	Ingiriya	K	3	4	4	0	4	0	0	0
147	Ingiriya	M	5	5	5	0	1	0	1	0
147	Ingiriya	R	3	3	3	0	2	0	1	0
	Total		29	32	35	0	13	0	8	1
160	Kahalla	A	16	21	24	0	1	0	1	0
160	Kahalla	B	0	0	0	0	0	0	0	0
160	Kahalla	I	2	3	3	0	0	0	0	0
160	Kahalla	K	0	0	0	0	0	0	0	0
160	Kahalla	M	7	7	7	0	1	0	1	1
160	Kahalla	R	0	0	0	0	0	0	0	0
	Total		25	31	34	0	2	0	2	1
161	Kahalla-Pallekele	A	24	34	39	0	2	0	2	0
161	Kahalla-Pallekele	B	1	1	2	0	1	0	1	0
161	Kahalla-Pallekele	I	5	13	20	0	0	0	0	0
161	Kahalla-Pallekele	K	0	0	0	0	0	0	0	0
161	Kahalla-Pallekele	M	7	8	8	0	0	0	2	1
161	Kahalla-Pallekele	R	2	2	2	0	2	0	2	0
	Total		39	58	71	0	5	0	7	1
164	Kalametiya Kalapuwa	A	19	22	25	0	1	0	1	0
164	Kalametiya Kalapuwa	B	0	0	0	0	0	0	0	0
164	Kalametiya Kalapuwa	I	1	1	1	0	0	0	0	0
164	Kalametiya Kalapuwa	K	0	0	0	0	0	0	0	0
164	Kalametiya Kalapuwa	M	2	2	2	0	0	0	0	0
164	Kalametiya Kalapuwa	R	0	0	0	0	0	0	0	0
	Total		22	25	28	0	1	0	1	0
166	Kalugala	A	14	18	20	0	8	0	9	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
166	Kalugala	B	2	4	5	0	3	0	3	0
166	Kalugala	I	3	6	6	0	1	0	0	1
166	Kalugala	K	3	4	5	0	5	0	0	0
166	Kalugala	M	7	9	9	0	3	0	3	0
166	Kalugala	R	4	8	8	0	4	0	5	0
	Total		33	49	53	0	24	0	20	1
172	Kandapola Sita Eliya	A	13	14	14	0	6	0	6	1
172	Kandapola Sita Eliya	B	2	4	7	0	3	0	3	0
172	Kandapola Sita Eliya	I	3	4	4	1	0	0	0	0
172	Kandapola Sita Eliya	K	3	3	5	0	4	0	0	0
172	Kandapola Sita Eliya	M	7	9	9	0	1	0	2	0
172	Kandapola Sita Eliya	R	1	2	2	0	2	0	2	0
	Total		29	36	41	1	16	0	13	1
173	Kandawattegoda	A	8	8	9	0	1	0	1	0
173	Kandawattegoda	B	1	1	1	0	1	0	1	0
173	Kandawattegoda	I	2	2	2	0	0	0	0	0
173	Kandawattegoda	K	4	7	8	0	8	0	0	0
173	Kandawattegoda	M	3	3	3	0	0	0	0	0
173	Kandawattegoda	R	3	4	4	0	2	0	1	0
	Total		21	25	27	0	12	0	3	0
175	Kanneliya	A	15	21	22	0	7	0	7	0
175	Kanneliya	B	2	4	6	0	2	0	2	0
175	Kanneliya	I	2	4	5	0	1	0	0	1
175	Kanneliya	K	6	8	12	0	10	0	0	0
175	Kanneliya	M	7	10	10	0	3	0	3	0
175	Kanneliya	R	4	5	5	0	2	0	1	0
	Total		36	52	60	0	25	0	13	1
178	Kanumuldeniya	A	9	10	11	0	1	0	1	0
178	Kanumuldeniya	B	0	0	0	0	0	0	0	0
178	Kanumuldeniya	I	0	0	0	0	0	0	0	0
178	Kanumuldeniya	K	2	2	2	0	2	0	0	0
178	Kanumuldeniya	M	5	6	6	0	2	0	1	0
178	Kanumuldeniya	R	2	2	3	0	2	0	0	0
	Total		18	20	22	0	7	0	2	0
184	Karawita	A	17	22	24	0	8	0	7	1
184	Karawita	B	1	1	1	0	1	0	1	0
184	Karawita	I	0	0	0	0	0	0	0	0
184	Karawita	K	3	5	7	0	7	0	0	0
184	Karawita	M	6	7	7	0	1	0	2	0
184	Karawita	R	4	6	6	0	4	0	4	0
	Total		31	41	45	0	21	0	14	1
186	Katagamuwa	A	16	19	23	0	0	0	0	0
186	Katagamuwa	B	2	2	2	0	1	0	1	0
186	Katagamuwa	I	6	9	9	1	0	0	0	0
186	Katagamuwa	K	2	2	2	0	1	0	0	0
186	Katagamuwa	M	6	7	7	0	0	0	2	2
186	Katagamuwa	R	1	1	1	0	1	0	1	0
	Total		33	40	44	1	3	0	4	2
187	Kataragama	A	11	13	15	0	2	0	2	0
187	Kataragama	B	0	0	0	0	0	0	0	0
187	Kataragama	I	5	6	6	0	0	0	0	0
187	Kataragama	K	3	3	3	0	1	0	0	0
187	Kataragama	M	6	6	6	0	0	0	3	2
187	Kataragama	R	3	3	3	0	1	0	2	0
	Total		28	31	33	0	4	0	7	2
190	Kekanadura	A	8	8	10	0	4	0	4	0
190	Kekanadura	B	0	0	0	0	0	0	0	0
190	Kekanadura	I	0	0	0	0	0	0	0	0
190	Kekanadura	K	3	3	4	0	4	0	0	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
190	Kekanadura	M	5	5	5	0	1	0	1	0
190	Kekanadura	R	1	1	2	0	2	0	1	0
	Total		17	17	21	0	11	0	6	0
191	Kelani Valley	A	18	22	24	0	5	0	5	0
191	Kelani Valley	B	2	2	4	0	1	0	0	0
191	Kelani Valley	I	1	1	1	0	0	0	0	0
191	Kelani Valley	K	4	6	6	0	6	0	0	0
191	Kelani Valley	M	6	6	6	0	1	0	2	0
191	Kelani Valley	R	4	7	8	0	3	0	4	0
	Total		35	44	49	0	16	0	11	0
192	Kelani Valley	A	12	12	14	0	4	0	4	0
192	Kelani Valley	B	2	2	3	0	2	0	1	0
192	Kelani Valley	I	1	2	2	0	0	0	0	0
192	Kelani Valley	K	2	3	3	0	3	0	0	0
192	Kelani Valley	M	6	6	6	0	2	0	2	0
192	Kelani Valley	R	4	10	11	0	8	0	7	0
	Total		27	35	39	0	19	0	14	0
197	Kikilimana	A	9	9	11	0	3	0	3	0
197	Kikilimana	B	2	4	6	0	4	0	4	0
197	Kikilimana	I	3	3	3	0	1	0	0	0
197	Kikilimana	K	5	5	5	2	4	2	0	0
197	Kikilimana	M	5	6	6	0	1	0	0	0
197	Kikilimana	R	1	1	1	0	1	0	1	0
	Total		25	28	32	2	14	2	8	0
201	Kirinda Mahayayakele	A	9	9	10	0	1	0	1	0
201	Kirinda Mahayayakele	B	0	0	0	0	0	0	0	0
201	Kirinda Mahayayakele	I	0	0	0	0	0	0	0	0
201	Kirinda Mahayayakele	K	3	4	6	0	6	0	0	0
201	Kirinda Mahayayakele	M	7	7	7	0	2	0	3	0
201	Kirinda Mahayayakele	R	2	3	3	0	2	0	2	0
	Total		21	23	26	0	11	0	6	0
205	Kobahadunkanda	A	16	18	20	0	5	0	5	0
205	Kobahadunkanda	B	2	2	3	0	2	0	2	0
205	Kobahadunkanda	I	2	2	2	0	1	0	0	1
205	Kobahadunkanda	K	1	1	1	0	1	0	0	0
205	Kobahadunkanda	M	6	6	6	0	2	0	2	0
205	Kobahadunkanda	R	3	5	5	0	4	0	3	0
	Total		30	34	37	0	15	0	12	1
208	Kombala-Kottawa	A	15	20	23	0	6	0	6	0
208	Kombala-Kottawa	B	2	2	3	0	2	0	2	0
208	Kombala-Kottawa	I	2	2	2	0	0	0	0	0
208	Kombala-Kottawa	K	7	11	14	1	13	1	0	0
208	Kombala-Kottawa	M	8	9	9	2	3	0	2	0
208	Kombala-Kottawa	R	3	6	6	0	3	0	3	0
	Total		37	50	57	3	27	1	13	0
217	Kudumiriya	A	12	14	17	0	8	0	7	2
217	Kudumiriya	B	2	3	5	0	4	0	4	0
217	Kudumiriya	I	1	1	1	0	0	0	0	0
217	Kudumiriya	K	1	2	3	0	3	0	0	0
217	Kudumiriya	M	3	3	3	0	0	0	0	0
217	Kudumiriya	R	2	4	4	0	3	0	3	0
	Total		21	27	33	0	18	0	14	2
237	Madunagala	A	11	14	16	0	1	0	1	0
237	Madunagala	B	0	0	0	0	0	0	0	0
237	Madunagala	I	1	1	1	0	0	0	0	0
237	Madunagala	K	0	0	0	0	0	0	0	0
237	Madunagala	M	6	6	6	0	1	0	1	1
237	Madunagala	R	1	1	1	0	1	0	1	0
	Total		19	22	24	0	3	0	3	1

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
248	Mahakudagala	A	10	12	12	0	3	0	3	0
248	Mahakudagala	B	2	2	3	0	1	0	0	0
248	Mahakudagala	I	1	2	2	0	0	0	0	0
248	Mahakudagala	K	1	1	1	0	1	0	0	0
248	Mahakudagala	M	4	5	5	0	1	0	1	0
248	Mahakudagala	R	1	1	1	0	1	0	1	0
	Total		19	23	24	0	7	0	5	0
253	Malambure	A	13	15	17	0	6	0	6	0
253	Malambure	B	2	2	2	0	1	0	1	0
253	Malambure	I	2	4	4	0	1	0	0	1
253	Malambure	K	5	7	9	0	9	0	0	0
253	Malambure	M	6	7	7	0	3	0	2	0
253	Malambure	R	4	5	5	0	3	0	2	0
	Total		32	40	44	0	23	0	11	1
256	Manapaya	A	14	15	17	0	1	0	1	0
256	Manapaya	B	0	0	0	0	0	0	0	0
256	Manapaya	I	3	4	4	0	0	0	0	0
256	Manapaya	K	1	1	1	0	1	0	0	0
256	Manapaya	M	8	8	8	0	1	0	1	0
256	Manapaya	R	1	1	1	0	0	0	0	0
	Total		27	29	31	0	3	0	2	0
263	Masmullekele	A	14	18	20	0	2	0	2	0
263	Masmullekele	B	1	1	1	0	0	0	0	0
263	Masmullekele	I	1	1	1	0	0	0	0	0
263	Masmullekele	K	3	4	4	0	4	0	0	0
263	Masmullekele	M	6	6	6	0	1	0	1	0
263	Masmullekele	R	2	2	2	0	2	0	2	0
	Total		27	32	34	0	9	0	5	0
269	Meegahatenna	A	6	6	8	0	2	0	2	0
269	Meegahatenna	B	0	0	0	0	0	0	0	0
269	Meegahatenna	I	2	2	2	0	0	0	0	0
269	Meegahatenna	K	0	0	0	0	0	0	0	0
269	Meegahatenna	M	5	5	5	0	2	0	2	0
269	Meegahatenna	R	2	3	3	0	2	0	1	0
	Total		15	16	18	0	6	0	5	0
270	Meepilimana	A	13	16	17	0	6	0	6	1
270	Meepilimana	B	1	1	3	0	0	0	0	0
270	Meepilimana	I	2	2	2	0	1	0	0	0
270	Meepilimana	K	1	1	1	0	1	0	0	0
270	Meepilimana	M	5	6	6	0	1	0	2	0
270	Meepilimana	R	2	3	3	0	3	0	3	0
	Total		24	29	32	0	12	0	11	1
274	Messana	A	14	18	21	0	7	0	8	0
274	Messana	B	3	3	3	0	2	0	2	0
274	Messana	I	4	4	5	1	1	0	0	0
274	Messana	K	1	2	2	0	2	0	0	0
274	Messana	M	5	5	5	0	1	0	1	0
274	Messana	R	3	4	4	0	4	0	4	0
	Total		30	36	40	1	17	0	15	0
277	Mihintale	A	12	14	17	0	1	0	1	0
277	Mihintale	B	0	0	0	0	0	0	0	0
277	Mihintale	I	4	6	7	0	0	0	0	0
277	Mihintale	K	2	2	2	0	1	0	0	0
277	Mihintale	M	6	8	8	0	0	0	0	0
277	Mihintale	R	2	3	3	0	2	0	2	0
	Total		26	33	37	0	4	0	3	0
279	Minneriya	A	8	8	9	0	1	0	1	0
279	Minneriya	B	0	0	0	0	0	0	0	0
279	Minneriya	I	2	2	2	0	0	0	0	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
279	Minneriya	K	3	5	5	1	3	1	0	0
279	Minneriya	M	8	10	10	0	1	0	2	1
279	Minneriya	R	1	2	2	0	2	0	2	0
	Total		22	27	28	1	7	1	5	1
280	Minneriya-Giritale	A	10	10	13	0	2	0	2	0
280	Minneriya-Giritale	B	0	0	0	0	0	0	0	0
280	Minneriya-Giritale	I	4	7	9	0	0	0	0	0
280	Minneriya-Giritale	K	2	2	2	0	1	0	0	0
280	Minneriya-Giritale	M	6	7	7	0	0	0	2	1
280	Minneriya-Giritale	R	2	2	2	0	2	0	2	0
	Total		24	28	33	0	5	0	6	1
281	Minneriya-Giritale Block 1	A	20	24	27	0	2	0	2	0
281	Minneriya-Giritale Block 1	B	2	2	3	0	2	0	1	0
281	Minneriya-Giritale Block 1	I	5	12	16	1	0	0	0	0
281	Minneriya-Giritale Block 1	K	3	3	3	0	1	0	0	0
281	Minneriya-Giritale Block 1	M	9	11	11	0	1	0	2	1
281	Minneriya-Giritale Block 1	R	2	4	4	0	3	0	3	0
	Total		41	56	64	1	9	0	8	1
288	Morahela	A	15	17	19	0	7	0	7	1
288	Morahela	B	2	4	7	0	3	0	3	0
288	Morahela	I	2	7	9	0	0	0	0	0
288	Morahela	K	3	3	3	0	3	0	0	0
288	Morahela	M	7	9	9	0	2	0	3	1
288	Morahela	R	3	6	9	0	9	0	6	0
	Total		32	46	56	0	24	0	19	2
289	Morapitiya-Runakanda	A	20	27	30	0	10	0	9	2
289	Morapitiya-Runakanda	B	3	5	6	0	5	0	5	0
289	Morapitiya-Runakanda	I	3	6	8	0	0	0	0	0
289	Morapitiya-Runakanda	K	4	5	6	0	6	0	0	0
289	Morapitiya-Runakanda	M	9	10	11	0	1	0	4	0
289	Morapitiya-Runakanda	R	3	8	9	0	4	0	4	0
	Total		42	61	70	0	26	0	22	2
293	Mulatiyana	A	22	31	37	0	6	0	6	0
293	Mulatiyana	B	2	2	4	0	2	0	2	0
293	Mulatiyana	I	2	5	6	0	1	0	0	1
293	Mulatiyana	K	5	9	12	0	11	0	0	0
293	Mulatiyana	M	8	11	11	0	3	0	4	0
293	Mulatiyana	R	5	13	14	0	7	0	7	1
	Total		44	71	84	0	30	0	19	2
298	Nahiti Mukalana	A	20	25	28	0	7	0	7	0
298	Nahiti Mukalana	B	2	2	2	0	2	0	1	0
298	Nahiti Mukalana	I	3	5	5	0	1	0	0	1
298	Nahiti Mukalana	K	1	2	2	0	2	0	0	0
298	Nahiti Mukalana	M	8	9	9	0	3	0	3	0
298	Nahiti Mukalana	R	4	8	9	0	5	0	6	1
	Total		38	51	55	0	20	0	17	2
303	Nakiyadeniya	A	17	21	26	0	8	0	8	1
303	Nakiyadeniya	B	2	4	6	0	4	0	4	0
303	Nakiyadeniya	I	3	3	3	0	1	0	0	1
303	Nakiyadeniya	K	6	10	14	1	14	1	0	0
303	Nakiyadeniya	M	5	5	5	0	0	0	0	0
303	Nakiyadeniya	R	5	8	8	1	4	0	4	0
	Total		38	51	62	2	31	1	16	2
306	Namunukula	A	15	19	20	0	5	0	5	1
306	Namunukula	B	1	1	3	0	1	0	1	0
306	Namunukula	I	2	3	3	0	0	0	0	0
306	Namunukula	K	1	1	1	0	0	0	0	0
306	Namunukula	M	4	4	4	0	1	0	2	0
306	Namunukula	R	0	0	0	0	0	0	0	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
	Total		23	28	31	0	7	0	8	1
315	Neluketiya Mukalana	A	16	18	22	0	7	0	7	1
315	Neluketiya Mukalana	B	3	3	3	0	3	0	3	0
315	Neluketiya Mukalana	I	2	5	6	0	0	0	0	0
315	Neluketiya Mukalana	K	3	6	8	0	8	0	0	0
315	Neluketiya Mukalana	M	4	4	4	0	0	0	1	0
315	Neluketiya Mukalana	R	2	4	4	0	2	0	3	0
	Total		30	40	47	0	20	0	14	1
318	Neugalkanda	A	22	37	46	0	5	0	6	0
318	Neugalkanda	B	2	2	2	0	1	0	1	0
318	Neugalkanda	I	4	5	7	0	0	0	0	0
318	Neugalkanda	K	1	1	1	0	0	0	0	0
318	Neugalkanda	M	7	9	10	0	2	0	1	0
318	Neugalkanda	R	2	3	4	0	2	0	3	0
	Total		38	57	70	0	10	0	11	0
327	Ohiya	A	15	17	19	1	5	0	5	1
327	Ohiya	B	1	1	3	0	0	0	0	0
327	Ohiya	I	1	1	1	0	0	0	0	0
327	Ohiya	K	1	1	1	0	1	0	0	0
327	Ohiya	M	5	8	8	0	2	0	3	0
327	Ohiya	R	2	2	2	0	2	0	2	0
	Total		25	30	34	1	10	0	10	1
329	Oliyagankele	A	8	9	10	0	1	0	2	0
329	Oliyagankele	B	1	1	1	0	1	0	1	0
329	Oliyagankele	I	2	4	4	0	1	0	0	1
329	Oliyagankele	K	3	4	4	1	4	1	0	0
329	Oliyagankele	M	5	5	5	0	1	0	1	0
329	Oliyagankele	R	2	2	2	0	2	0	1	0
	Total		21	25	26	1	10	1	5	1
333	Padawiya	A	23	29	33	0	2	0	2	0
333	Padawiya	B	2	4	7	0	3	0	3	0
333	Padawiya	I	5	13	18	0	0	0	0	0
333	Padawiya	K	4	5	5	0	3	0	0	0
333	Padawiya	M	9	12	13	0	2	0	3	1
333	Padawiya	R	3	5	7	1	4	0	4	0
	Total		46	68	83	1	14	0	12	1
335	Pallegama-Himbiliyakada	A	23	33	39	0	3	0	4	0
335	Pallegama-Himbiliyakada	B	1	1	1	0	0	0	0	0
335	Pallegama-Himbiliyakada	I	5	9	10	0	0	0	0	0
335	Pallegama-Himbiliyakada	K	2	2	2	0	0	0	0	0
335	Pallegama-Himbiliyakada	M	9	11	11	0	1	0	3	1
335	Pallegama-Himbiliyakada	R	3	4	4	0	3	0	3	0
	Total		43	60	67	0	7	0	10	1
336	Pallekele	A	24	34	41	0	2	0	2	0
336	Pallekele	B	0	0	0	0	0	0	0	0
336	Pallekele	I	4	6	6	0	0	0	0	0
336	Pallekele	K	3	3	3	1	2	1	0	0
336	Pallekele	M	9	12	12	0	1	0	2	1
336	Pallekele	R	2	2	2	0	0	0	1	0
	Total		42	57	64	1	5	1	5	1
343	Panilkanda	A	15	19	22	0	7	0	8	1
343	Panilkanda	B	0	0	0	0	0	0	0	0
343	Panilkanda	I	2	3	3	0	0	0	0	0
343	Panilkanda	K	2	4	4	0	4	0	0	0
343	Panilkanda	M	7	7	7	0	2	0	2	0
343	Panilkanda	R	4	7	8	0	5	0	4	0
	Total		30	40	44	0	18	0	14	1
358	Pattipola-Ambawela	A	15	17	19	0	8	0	8	3

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
358	Pattipola-Ambawela	B	1	2	4	0	1	0	1	0
358	Pattipola-Ambawela	I	2	2	2	0	1	0	0	0
358	Pattipola-Ambawela	K	0	0	0	0	0	0	0	0
358	Pattipola-Ambawela	M	5	7	7	0	2	0	1	0
358	Pattipola-Ambawela	R	1	1	1	0	1	0	1	0
	Total		24	29	33	0	13	0	11	3
361	Peak Wilderness	A	20	28	31	0	13	0	14	3
361	Peak Wilderness	B	3	5	9	0	6	0	6	0
361	Peak Wilderness	I	1	1	1	0	0	0	0	0
361	Peak Wilderness	K	5	8	11	0	9	0	0	0
361	Peak Wilderness	M	7	8	8	0	2	0	4	0
361	Peak Wilderness	R	5	7	12	0	9	0	6	0
	Total		41	57	72	0	39	0	30	3
362	Pedro	A	18	26	30	1	6	0	7	1
362	Pedro	B	1	1	5	0	1	0	1	0
362	Pedro	I	3	5	6	0	0	0	0	0
362	Pedro	K	4	5	6	0	5	0	0	0
362	Pedro	M	8	9	10	0	1	0	5	0
362	Pedro	R	1	3	3	0	3	0	3	0
	Total		35	49	60	1	16	0	16	1
369	Polgahakanda	A	12	14	16	0	3	0	4	0
369	Polgahakanda	B	2	2	2	0	1	0	1	0
369	Polgahakanda	I	3	4	4	0	1	0	0	1
369	Polgahakanda	K	5	6	8	1	8	1	0	0
369	Polgahakanda	M	8	9	10	0	1	0	4	0
369	Polgahakanda	R	3	5	6	0	4	0	3	0
	Total		33	40	46	1	18	1	12	1
376	Potawa	A	21	27	31	0	3	0	3	0
376	Potawa	B	0	0	0	0	0	0	0	0
376	Potawa	I	0	0	0	0	0	0	0	0
376	Potawa	K	0	0	0	0	0	0	0	0
376	Potawa	M	4	4	4	0	0	0	0	0
376	Potawa	R	2	2	2	0	0	0	0	0
	Total		27	33	37	0	3	0	3	0
384	Rajawaka	A	20	29	33	1	4	0	4	0
384	Rajawaka	B	1	1	1	0	1	0	1	0
384	Rajawaka	I	4	6	7	0	0	0	0	0
384	Rajawaka	K	2	2	2	0	2	0	0	0
384	Rajawaka	M	7	8	8	0	0	0	1	0
384	Rajawaka	R	0	0	0	0	0	0	0	0
	Total		34	46	51	1	7	0	6	0
386	Rammalakanda	A	10	11	15	0	4	0	4	0
386	Rammalakanda	B	1	1	1	0	1	0	1	0
386	Rammalakanda	I	3	4	4	0	1	0	0	1
386	Rammalakanda	K	3	3	3	0	3	0	0	0
386	Rammalakanda	M	5	5	5	0	2	0	2	0
386	Rammalakanda	R	3	3	3	0	3	0	2	0
	Total		25	27	31	0	14	0	9	1
388	Rammalakanda	A	16	25	30	1	7	0	8	0
388	Rammalakanda	B	2	5	6	0	5	0	5	0
388	Rammalakanda	I	4	8	8	0	1	0	0	1
388	Rammalakanda	K	3	6	6	0	5	0	0	0
388	Rammalakanda	M	7	8	8	0	3	0	2	0
388	Rammalakanda	R	4	9	9	0	6	0	5	0
	Total		36	61	67	1	27	0	20	1
390	Ranwaragalakanda	A	9	12	15	0	2	0	2	0
390	Ranwaragalakanda	B	0	0	0	0	0	0	0	0
390	Ranwaragalakanda	I	4	5	5	0	0	0	0	0
390	Ranwaragalakanda	K	3	3	4	1	4	1	0	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
390	Ranwaragalakanda	M	4	4	4	0	1	0	1	0
390	Ranwaragalakanda	R	1	1	1	0	0	0	0	0
	Total		21	25	29	1	7	1	3	0
392	Ravana Ella	A	20	26	29	0	2	0	3	0
392	Ravana Ella	B	0	0	0	0	0	0	0	0
392	Ravana Ella	I	2	3	3	0	0	0	0	0
392	Ravana Ella	K	1	1	1	0	0	0	0	0
392	Ravana Ella	M	5	5	5	0	0	0	0	0
392	Ravana Ella	R	1	1	1	0	0	0	0	0
	Total		29	36	39	0	2	0	3	0
394	Rilagala	A	10	11	12	0	4	0	4	0
394	Rilagala	B	1	1	3	0	1	0	1	0
394	Rilagala	I	2	3	3	0	0	0	0	0
394	Rilagala	K	3	3	4	0	3	0	0	0
394	Rilagala	M	0	0	0	0	0	0	0	0
394	Rilagala	R	2	2	2	0	1	0	1	0
	Total		18	20	24	0	9	0	6	0
395	Ritigala	A	23	33	39	0	2	0	2	0
395	Ritigala	B	2	2	2	0	1	0	1	0
395	Ritigala	I	5	8	11	0	0	0	0	0
395	Ritigala	K	1	1	1	0	0	0	0	0
395	Ritigala	M	7	9	10	0	2	0	4	1
395	Ritigala	R	4	6	7	0	4	0	4	0
	Total		42	59	70	0	9	0	11	1
398	Ruhuna Block 1	A	23	31	36	0	1	0	1	0
398	Ruhuna Block 1	B	3	3	3	0	0	0	0	0
398	Ruhuna Block 1	I	3	4	4	0	0	0	0	0
398	Ruhuna Block 1	K	3	4	4	0	1	0	0	0
398	Ruhuna Block 1	M	13	15	16	0	1	0	5	2
398	Ruhuna Block 1	R	7	12	13	2	5	1	7	1
	Total		52	69	76	2	8	1	13	3
399	Ruhuna Block 2	A	17	22	25	0	0	0	0	0
399	Ruhuna Block 2	B	0	0	0	0	0	0	0	0
399	Ruhuna Block 2	I	2	2	2	0	0	0	0	0
399	Ruhuna Block 2	K	3	3	3	0	1	0	0	0
399	Ruhuna Block 2	M	12	14	14	0	0	0	3	2
399	Ruhuna Block 2	R	3	5	6	0	3	0	3	0
	Total		37	46	50	0	4	0	6	2
400	Ruhuna Block 3	A	22	31	34	0	2	0	2	0
400	Ruhuna Block 3	B	0	0	0	0	0	0	0	0
400	Ruhuna Block 3	I	5	6	8	0	0	0	0	0
400	Ruhuna Block 3	K	4	5	10	1	6	1	0	0
400	Ruhuna Block 3	M	14	19	19	1	0	0	6	2
400	Ruhuna Block 3	R	3	7	10	1	4	0	4	0
	Total		48	68	81	3	12	1	12	2
401	Ruhuna Block 4	A	11	12	13	0	1	0	1	0
401	Ruhuna Block 4	B	0	0	0	0	0	0	0	0
401	Ruhuna Block 4	I	5	6	8	0	0	0	0	0
401	Ruhuna Block 4	K	3	3	5	0	4	0	0	0
401	Ruhuna Block 4	M	7	8	8	0	0	0	4	2
401	Ruhuna Block 4	R	3	4	4	0	3	0	3	0
	Total		29	33	38	0	8	0	8	2
407	Sellankandal	A	11	11	12	0	1	0	1	0
407	Sellankandal	B	0	0	0	0	0	0	0	0
407	Sellankandal	I	4	5	6	0	0	0	0	0
407	Sellankandal	K	3	3	3	0	1	0	0	0
407	Sellankandal	M	5	6	6	0	0	0	1	1
407	Sellankandal	R	1	1	1	0	0	0	0	0
	Total		24	26	28	0	2	0	2	1

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
410	Sigiriya	A	15	18	23	0	2	0	3	0
410	Sigiriya	B	1	2	2	0	1	0	1	0
410	Sigiriya	I	5	9	13	1	0	0	0	0
410	Sigiriya	K	2	2	2	0	1	0	0	0
410	Sigiriya	M	7	7	7	0	0	0	2	1
410	Sigiriya	R	2	3	3	0	3	0	3	0
	Total		32	41	50	1	7	0	9	1
414	Sinharaja	A	25	37	44	1	16	0	18	2
414	Sinharaja	B	4	8	11	1	8	0	8	0
414	Sinharaja	I	6	9	11	1	1	0	0	1
414	Sinharaja	K	5	8	15	0	14	0	0	0
414	Sinharaja	M	10	13	13	0	2	0	6	0
414	Sinharaja	R	5	9	13	0	9	0	5	0
	Total		55	84	107	3	50	0	37	3
426	Tangamalai	A	16	20	21	0	4	0	5	1
426	Tangamalai	B	1	1	4	0	2	0	2	0
426	Tangamalai	I	2	3	3	0	0	0	0	0
426	Tangamalai	K	1	1	1	0	0	0	0	0
426	Tangamalai	M	4	5	5	0	1	0	1	0
426	Tangamalai	R	1	2	2	0	2	0	2	0
	Total		25	32	36	0	9	0	10	1
432	Tibbutukanda	A	14	16	21	0	3	0	3	0
432	Tibbutukanda	B	2	3	3	0	2	0	2	0
432	Tibbutukanda	I	1	1	1	0	0	0	0	0
432	Tibbutukanda	K	3	4	4	0	4	0	0	0
432	Tibbutukanda	M	2	2	2	0	0	0	0	0
432	Tibbutukanda	R	3	4	4	0	2	0	3	0
	Total		25	30	35	0	11	0	8	0
438	Uda Walawe	A	24	29	34	0	2	0	2	0
438	Uda Walawe	B	1	1	1	0	0	0	0	0
438	Uda Walawe	I	4	6	10	0	0	0	0	0
438	Uda Walawe	K	0	0	0	0	0	0	0	0
438	Uda Walawe	M	12	14	14	0	0	0	3	1
438	Uda Walawe	R	1	1	1	0	0	0	1	1
	Total		42	51	60	0	2	0	6	2
442	Udawattakele	A	13	17	22	0	3	0	3	0
442	Udawattakele	B	1	1	1	0	1	0	1	0
442	Udawattakele	I	3	3	3	0	0	0	0	0
442	Udawattakele	K	0	0	0	0	0	0	0	0
442	Udawattakele	M	4	4	4	0	1	0	1	0
442	Udawattakele	R	1	1	1	0	1	0	1	0
	Total		22	26	31	0	6	0	6	0
453	Viharekele	A	9	10	13	0	4	0	4	0
453	Viharekele	B	0	0	0	0	0	0	0	0
453	Viharekele	I	0	0	0	0	0	0	0	0
453	Viharekele	K	4	6	6	0	6	0	0	0
453	Viharekele	M	3	3	3	0	0	0	0	0
453	Viharekele	R	5	8	8	0	4	0	5	1
	Total		21	27	30	0	14	0	9	1
455	Walankanda	A	16	19	23	0	6	0	7	0
455	Walankanda	B	1	2	4	0	2	0	2	0
455	Walankanda	I	3	5	5	0	0	0	0	0
455	Walankanda	K	3	4	5	0	5	0	0	0
455	Walankanda	M	5	5	5	0	2	0	2	0
455	Walankanda	R	3	4	4	0	3	0	4	0
	Total		31	39	46	0	18	0	15	0
456	Walawe Basin	A	17	21	23	0	7	0	6	1
456	Walawe Basin	B	1	1	1	0	0	0	0	0
456	Walawe Basin	I	3	5	6	0	0	0	0	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
456	Walawe Basin	K	2	2	2	0	1	0	0	0
456	Walawe Basin	M	6	6	6	0	2	0	3	0
456	Walawe Basin	R	3	3	3	0	3	0	2	0
	Total		32	38	41	0	13	0	11	1
458	Wanniyagama	A	15	20	21	0	1	0	1	0
458	Wanniyagama	B	0	0	0	0	0	0	0	0
458	Wanniyagama	I	3	3	5	0	0	0	0	0
458	Wanniyagama	K	2	2	2	0	1	0	0	0
458	Wanniyagama	M	9	12	12	0	1	0	3	2
458	Wanniyagama	R	1	2	2	0	1	0	1	0
	Total		30	39	42	0	4	0	5	2
459	Waratalgoda	A	21	27	30	0	8	0	7	1
459	Waratalgoda	B	2	2	3	0	2	0	2	0
459	Waratalgoda	I	3	4	4	0	0	0	0	0
459	Waratalgoda	K	2	3	6	0	6	0	0	0
459	Waratalgoda	M	4	4	4	0	0	0	1	0
459	Waratalgoda	R	4	8	8	0	5	0	6	0
	Total		36	48	55	0	21	0	16	1
460	Wasgomuwa Lot 1	A	28	48	56	0	5	0	6	1
460	Wasgomuwa Lot 1	B	3	4	4	0	1	0	1	0
460	Wasgomuwa Lot 1	I	6	20	25	1	0	0	0	0
460	Wasgomuwa Lot 1	K	4	4	4	0	2	0	0	0
460	Wasgomuwa Lot 1	M	14	19	20	0	2	0	7	2
460	Wasgomuwa Lot 1	R	4	7	7	0	6	0	6	0
	Total		59	102	116	1	16	0	20	3
463	Wedakanda	A	24	31	36	0	2	0	2	0
463	Wedakanda	B	1	1	2	0	1	0	1	0
463	Wedakanda	I	5	11	17	1	0	0	0	0
463	Wedakanda	K	3	3	3	0	1	0	0	0
463	Wedakanda	M	8	10	10	0	0	0	2	1
463	Wedakanda	R	3	5	5	0	2	0	2	0
	Total		44	61	73	1	6	0	7	1
464	Wedasitikanda	A	17	20	24	1	1	0	1	0
464	Wedasitikanda	B	0	0	0	0	0	0	0	0
464	Wedasitikanda	I	4	7	7	0	0	0	0	0
464	Wedasitikanda	K	2	2	2	0	1	0	0	0
464	Wedasitikanda	M	6	6	6	0	1	0	0	0
464	Wedasitikanda	R	1	1	1	0	1	0	1	0
	Total		30	36	40	1	4	0	2	0
471	Welihena	A	12	12	13	0	3	0	3	0
471	Welihena	B	0	0	0	0	0	0	0	0
471	Welihena	I	1	1	1	0	0	0	0	0
471	Welihena	K	0	0	0	0	0	0	0	0
471	Welihena	M	3	3	3	0	0	0	0	0
471	Welihena	R	2	2	3	1	1	0	0	0
	Total		18	18	20	1	4	0	3	0
476	Wewelkandura	A	16	20	22	0	7	0	6	1
476	Wewelkandura	B	2	2	2	0	2	0	2	0
476	Wewelkandura	I	1	1	1	0	0	0	0	0
476	Wewelkandura	K	2	3	5	0	5	0	0	0
476	Wewelkandura	M	5	5	5	0	1	0	2	0
476	Wewelkandura	R	3	4	4	0	3	0	2	0
	Total		29	35	39	0	18	0	12	1
486	Yagirala	A	11	12	14	0	3	0	3	0
486	Yagirala	B	0	0	0	0	0	0	0	0
486	Yagirala	I	3	4	4	0	0	0	0	0
486	Yagirala	K	3	4	5	0	5	0	0	0
486	Yagirala	M	4	5	5	0	2	0	1	0
486	Yagirala	R	2	5	5	0	2	0	3	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
	Total		23	30	33	0	12	0	7	0
487	Yagirala	A	20	27	30	0	7	0	8	2
487	Yagirala	B	2	4	4	0	4	0	4	0
487	Yagirala	I	3	4	5	1	0	0	0	0
487	Yagirala	K	3	4	5	0	5	0	0	0
487	Yagirala	M	6	8	9	0	3	0	2	0
487	Yagirala	R	3	4	4	0	2	0	3	0
	Total		37	51	57	1	21	0	17	2
489	Yakdessakanda	A	25	38	44	0	1	0	1	0
489	Yakdessakanda	B	0	0	0	0	0	0	0	0
489	Yakdessakanda	I	2	4	4	0	0	0	0	0
489	Yakdessakanda	K	1	1	1	0	1	0	0	0
489	Yakdessakanda	M	7	7	7	0	1	0	1	0
489	Yakdessakanda	R	2	2	3	0	2	0	2	0
	Total		37	52	59	0	5	0	4	0
497	Kalubowitiyana	A	11	12	15	0	4	0	4	0
497	Kalubowitiyana	B	2	3	3	0	3	0	3	0
497	Kalubowitiyana	I	2	5	6	0	1	0	0	1
497	Kalubowitiyana	K	5	6	8	1	7	0	0	0
497	Kalubowitiyana	M	5	5	5	0	1	0	1	0
497	Kalubowitiyana	R	2	3	3	0	2	0	1	0
	Total		27	34	40	1	18	0	9	1
498	Kurulugala	A	12	13	13	0	6	0	5	1
498	Kurulugala	B	1	1	1	0	1	0	1	0
498	Kurulugala	I	2	4	5	0	0	0	0	0
498	Kurulugala	K	3	3	3	0	3	0	0	0
498	Kurulugala	M	4	5	5	0	2	0	1	0
498	Kurulugala	R	2	3	3	0	3	0	1	0
	Total		24	29	30	0	15	0	8	1
499	Silverkanda	A	11	13	16	0	5	0	6	0
499	Silverkanda	B	2	2	3	0	1	0	1	0
499	Silverkanda	I	1	1	1	0	0	0	0	0
499	Silverkanda	K	4	4	5	0	5	0	0	0
499	Silverkanda	M	6	6	6	0	1	0	2	0
499	Silverkanda	R	2	3	4	0	4	0	1	0
	Total		26	29	35	0	16	0	10	0
500	Derangala	A	10	14	17	0	3	0	3	0
500	Derangala	B	0	0	0	0	0	0	0	0
500	Derangala	I	2	3	5	0	0	0	0	0
500	Derangala	K	1	1	1	0	1	0	0	0
500	Derangala	M	7	7	7	0	1	0	2	0
500	Derangala	R	1	2	3	0	2	0	1	0
	Total		21	27	33	0	7	0	6	0
501	Aninkanda	A	14	17	18	0	9	0	9	0
501	Aninkanda	B	0	0	0	0	0	0	0	0
501	Aninkanda	I	2	4	4	0	0	0	0	0
501	Aninkanda	K	1	1	1	0	1	0	0	0
501	Aninkanda	M	7	8	8	0	2	0	3	0
501	Aninkanda	R	3	3	3	0	1	0	1	0
	Total		27	33	34	0	13	0	13	0
502	Medirigiriya Tulana	A	17	20	22	0	3	0	3	0
502	Medirigiriya Tulana	B	0	0	0	0	0	0	0	0
502	Medirigiriya Tulana	I	4	6	8	0	0	0	0	0
502	Medirigiriya Tulana	K	3	4	4	0	2	0	0	0
502	Medirigiriya Tulana	M	9	10	10	0	0	0	2	1
502	Medirigiriya Tulana	R	3	3	3	0	2	0	3	0
	Total		36	43	47	0	7	0	8	1
504	Masimbula	A	16	19	21	0	5	0	5	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
504	Masimbula	B	1	1	1	0	0	0	0	0
504	Masimbula	I	3	4	4	0	0	0	0	0
504	Masimbula	K	1	1	1	0	1	0	0	0
504	Masimbula	M	3	4	4	0	1	0	2	0
504	Masimbula	R	2	2	2	0	1	0	0	0
	Total		26	31	33	0	8	0	7	0
505	Tawalama	A	9	12	14	0	3	0	3	0
505	Tawalama	B	0	0	0	0	0	0	0	0
505	Tawalama	I	2	3	3	0	0	0	0	0
505	Tawalama	K	1	1	1	0	1	0	0	0
505	Tawalama	M	7	8	8	0	2	0	2	1
505	Tawalama	R	2	2	2	0	0	0	1	0
	Total		21	26	28	0	6	0	6	1
506	Tiboruwakota	A	11	13	16	0	5	0	5	0
506	Tiboruwakota	B	1	1	1	0	1	0	1	0
506	Tiboruwakota	I	2	2	2	0	0	0	0	0
506	Tiboruwakota	K	4	6	7	0	7	0	0	0
506	Tiboruwakota	M	5	5	5	0	1	0	2	0
506	Tiboruwakota	R	2	3	3	0	3	0	2	0
	Total		25	30	34	0	17	0	10	0
507	Homadola	A	8	11	11	0	5	0	5	0
507	Homadola	B	1	1	2	0	1	0	1	0
507	Homadola	I	1	1	1	0	1	0	0	1
507	Homadola	K	5	6	7	0	7	0	0	0
507	Homadola	M	5	5	5	0	1	0	1	0
507	Homadola	R	1	2	2	0	2	0	1	0
	Total		21	26	28	0	17	0	8	1
508	Hindeinattu	A	13	14	18	0	4	0	4	0
508	Hindeinattu	B	0	0	0	0	0	0	0	0
508	Hindeinattu	I	2	3	3	0	1	0	0	1
508	Hindeinattu	K	4	7	7	0	7	0	0	0
508	Hindeinattu	M	3	3	3	0	0	0	0	0
508	Hindeinattu	R	1	1	1	0	1	0	0	0
	Total		23	28	32	0	13	0	4	1
509	Auwegalakanda	A	5	5	7	0	2	0	2	0
509	Auwegalakanda	B	0	0	0	0	0	0	0	0
509	Auwegalakanda	I	0	0	0	0	0	0	0	0
509	Auwegalakanda	K	2	3	4	0	3	0	0	0
509	Auwegalakanda	M	5	5	5	0	0	0	0	0
509	Auwegalakanda	R	1	1	1	0	1	0	1	0
	Total		13	14	17	0	6	0	3	0
511	Bambarawana	A	4	5	8	0	1	0	1	0
511	Bambarawana	B	0	0	0	0	0	0	0	0
511	Bambarawana	I	2	2	2	0	1	0	0	1
511	Bambarawana	K	3	4	4	0	3	0	0	0
511	Bambarawana	M	3	3	3	0	0	0	0	0
511	Bambarawana	R	3	3	3	0	1	0	1	0
	Total		15	17	20	0	6	0	2	1
512	Vellihallure	A	12	13	15	0	6	0	6	1
512	Vellihallure	B	1	1	1	0	1	0	1	0
512	Vellihallure	I	1	1	1	0	1	0	0	1
512	Vellihallure	K	3	3	3	0	3	0	0	0
512	Vellihallure	M	4	5	5	0	1	0	2	0
512	Vellihallure	R	1	1	1	0	1	0	0	0
	Total		22	24	26	0	13	0	9	2
513	Batahena	A	17	20	22	0	8	0	7	1
513	Batahena	B	2	2	3	0	1	0	1	0
513	Batahena	I	0	0	0	0	0	0	0	0
513	Batahena	K	3	3	3	0	3	0	0	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
513	Batahena	M	4	4	4	0	1	0	2	0
513	Batahena	R	1	1	1	0	1	0	1	0
	Total		27	30	33	0	14	0	11	1
514	Sembawatte	A	10	11	13	0	5	0	5	0
514	Sembawatte	B	3	3	3	0	2	0	2	0
514	Sembawatte	I	1	1	1	0	0	0	0	0
514	Sembawatte	K	3	4	4	0	4	0	0	0
514	Sembawatte	M	3	3	3	0	0	0	1	0
514	Sembawatte	R	2	4	4	0	2	0	3	0
	Total		22	26	28	0	13	0	11	0
522	Knuckles	A	26	42	50	0	10	0	12	2
522	Knuckles	B	3	4	10	1	6	1	5	0
522	Knuckles	I	4	11	16	0	0	0	0	0
522	Knuckles	K	6	10	17	6	12	5	0	0
522	Knuckles	M	12	17	18	1	3	0	6	0
522	Knuckles	R	4	10	11	1	9	1	9	1
	Total		55	94	122	9	40	7	32	3
523	Kahanda Kalapuwa	A	8	8	9	0	0	0	0	0
523	Kahanda Kalapuwa	B	1	1	1	0	0	0	0	0
523	Kahanda Kalapuwa	I	2	3	4	0	0	0	0	0
523	Kahanda Kalapuwa	K	0	0	0	0	0	0	0	0
523	Kahanda Kalapuwa	M	1	1	1	0	0	0	0	0
523	Kahanda Kalapuwa	R	0	0	0	0	0	0	0	0
	Total		12	13	15	0	0	0	0	0
524	Rekawa Kalapuwa	A	9	9	10	0	0	0	0	0
524	Rekawa Kalapuwa	B	1	1	1	0	1	0	1	0
524	Rekawa Kalapuwa	I	4	4	4	0	0	0	0	0
524	Rekawa Kalapuwa	K	0	0	0	0	0	0	0	0
524	Rekawa Kalapuwa	M	0	0	0	0	0	0	0	0
524	Rekawa Kalapuwa	R	0	0	0	0	0	0	0	0
	Total		14	14	15	0	1	0	1	0
525	Miyandagala	A	11	11	12	0	0	0	0	0
525	Miyandagala	B	0	0	0	0	0	0	0	0
525	Miyandagala	I	4	6	8	0	0	0	0	0
525	Miyandagala	K	1	1	1	0	0	0	0	0
525	Miyandagala	M	3	3	3	0	0	0	0	0
525	Miyandagala	R	0	0	0	0	0	0	0	0
	Total		19	21	24	0	0	0	0	0
526	Keulakada Wewa	A	13	15	19	0	0	0	0	0
526	Keulakada Wewa	B	0	0	0	0	0	0	0	0
526	Keulakada Wewa	I	2	3	3	0	0	0	0	0
526	Keulakada Wewa	K	1	1	1	0	1	0	0	0
526	Keulakada Wewa	M	6	8	8	0	0	0	1	1
526	Keulakada Wewa	R	0	0	0	0	0	0	0	0
	Total		22	27	31	0	1	0	1	1
528	Asantanakanda	A	13	16	19	0	7	0	9	0
528	Asantanakanda	B	2	2	2	0	1	0	1	0
528	Asantanakanda	I	3	4	4	0	0	0	0	0
528	Asantanakanda	K	1	1	1	0	1	0	0	0
528	Asantanakanda	M	5	5	5	0	1	0	2	0
528	Asantanakanda	R	1	2	2	0	2	0	1	0
	Total		25	30	33	0	12	0	13	0
530	Appalagala	A	18	24	30	0	4	0	5	0
530	Appalagala	B	2	2	2	0	1	0	1	0
530	Appalagala	I	5	12	15	0	0	0	0	0
530	Appalagala	K	0	0	0	0	0	0	0	0
530	Appalagala	M	7	8	8	0	1	0	2	0
530	Appalagala	R	0	0	0	0	0	0	0	0
	Total		32	46	55	0	6	0	8	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
531	Kudagoda	A	20	24	30	0	4	0	5	0
531	Kudagoda	B	0	0	0	0	0	0	0	0
531	Kudagoda	I	2	3	5	0	0	0	0	0
531	Kudagoda	K	2	2	2	1	2	1	0	0
531	Kudagoda	M	6	7	7	0	1	0	0	0
531	Kudagoda	R	1	1	1	0	1	0	1	0
	Total		31	37	45	1	8	1	6	0
532	Talawegoda	A	22	29	32	0	4	0	4	0
532	Talawegoda	B	0	0	0	0	0	0	0	0
532	Talawegoda	I	3	3	4	0	0	0	0	0
532	Talawegoda	K	0	0	0	0	0	0	0	0
532	Talawegoda	M	7	9	9	1	2	0	1	0
532	Talawegoda	R	2	3	3	0	1	0	2	0
	Total		34	44	48	1	7	0	7	0
533	Mulgama	A	19	22	26	0	2	0	2	0
533	Mulgama	B	0	0	0	0	0	0	0	0
533	Mulgama	I	1	1	1	0	0	0	0	0
533	Mulgama	K	0	0	0	0	0	0	0	0
533	Mulgama	M	6	7	7	0	1	0	1	0
533	Mulgama	R	2	2	2	0	2	0	2	0
	Total		28	32	36	0	5	0	5	0
534	Galleletota	A	20	24	28	0	2	0	2	0
534	Galleletota	B	0	0	0	0	0	0	0	0
534	Galleletota	I	5	8	8	1	0	0	0	0
534	Galleletota	K	2	2	2	0	2	0	0	0
534	Galleletota	M	7	8	8	0	0	0	2	1
534	Galleletota	R	1	1	2	0	1	0	1	0
	Total		35	43	48	1	5	0	5	1
535	Kuragala	A	21	23	27	1	1	0	3	0
535	Kuragala	B	0	0	0	0	0	0	0	0
535	Kuragala	I	4	4	5	0	0	0	0	0
535	Kuragala	K	0	0	0	0	0	0	0	0
535	Kuragala	M	7	8	8	0	1	0	1	0
535	Kuragala	R	2	3	4	0	2	0	2	0
	Total		34	38	44	1	4	0	6	0
536	Hapugala	A	17	22	27	0	2	0	2	0
536	Hapugala	B	1	1	1	0	0	0	0	0
536	Hapugala	I	4	7	8	0	0	0	0	0
536	Hapugala	K	2	2	2	0	1	0	0	0
536	Hapugala	M	7	8	8	0	0	0	1	0
536	Hapugala	R	2	3	3	0	3	0	3	0
	Total		33	43	49	0	6	0	6	0
537	Narangattahinna	A	12	13	15	0	1	0	2	0
537	Narangattahinna	B	0	0	0	0	0	0	0	0
537	Narangattahinna	I	5	7	9	0	0	0	0	0
537	Narangattahinna	K	1	1	1	0	0	0	0	0
537	Narangattahinna	M	4	5	5	0	1	0	0	0
537	Narangattahinna	R	2	2	3	1	1	0	1	0
	Total		24	28	33	1	3	0	3	0
538	Gallegodahinna	A	19	25	30	0	4	0	4	0
538	Gallegodahinna	B	1	1	1	0	0	0	0	0
538	Gallegodahinna	I	4	5	5	0	0	0	0	0
538	Gallegodahinna	K	2	2	2	0	2	0	0	0
538	Gallegodahinna	M	5	6	6	0	0	0	1	0
538	Gallegodahinna	R	2	2	2	0	2	0	2	0
	Total		33	41	46	0	8	0	7	0
539	Hataramune	A	17	18	25	1	4	0	4	1
539	Hataramune	B	0	0	0	0	0	0	0	0
539	Hataramune	I	3	5	7	0	0	0	0	0

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539	Hataramune	K	1	1	1	0	1	0	0	0
539	Hataramune	M	4	4	4	0	0	0	0	0
539	Hataramune	R	1	1	1	0	1	0	1	0
	Total		26	29	38	1	6	0	5	1
541	Kabarakalapatana	A	8	8	8	0	4	0	3	1
541	Kabarakalapatana	B	1	2	3	0	2	0	2	0
541	Kabarakalapatana	I	3	3	3	0	0	0	0	0
541	Kabarakalapatana	K	0	0	0	0	0	0	0	0
541	Kabarakalapatana	M	3	3	3	0	1	0	2	1
541	Kabarakalapatana	R	1	2	2	0	1	0	1	0
	Total		16	18	19	0	8	0	8	2
544	Gorangala	A	6	7	7	0	2	0	3	0
544	Gorangala	B	1	1	2	0	2	0	2	0
544	Gorangala	I	0	0	0	0	0	0	0	0
544	Gorangala	K	0	0	0	0	0	0	0	0
544	Gorangala	M	5	5	5	0	1	0	0	0
544	Gorangala	R	4	4	4	0	2	0	2	0
	Total		16	17	18	0	7	0	7	0
545	Handapan Ella	A	17	22	26	0	11	0	10	1
545	Handapan Ella	B	3	5	8	0	4	0	4	0
545	Handapan Ella	I	3	4	5	0	0	0	0	0
545	Handapan Ella	K	2	4	6	0	5	0	0	0
545	Handapan Ella	M	7	7	8	0	1	0	2	1
545	Handapan Ella	R	2	2	3	0	2	0	0	0
	Total		34	44	56	0	23	0	16	2
546	Gongala	A	11	14	16	0	7	0	7	0
546	Gongala	B	2	3	5	1	2	0	2	0
546	Gongala	I	2	3	3	0	1	0	0	0
546	Gongala	K	3	3	3	0	3	0	0	0
546	Gongala	M	6	7	7	0	2	0	2	0
546	Gongala	R	1	1	2	0	2	0	0	0
	Total		25	31	36	1	17	0	11	0
547	Paragala	A	15	17	18	0	7	0	8	0
547	Paragala	B	1	1	1	0	1	0	1	0
547	Paragala	I	0	0	0	0	0	0	0	0
547	Paragala	K	1	2	2	0	2	0	0	0
547	Paragala	M	4	5	5	0	2	0	1	0
547	Paragala	R	1	3	3	0	2	0	3	0
	Total		22	28	29	0	14	0	13	0
549	Alutwelawisahena	A	12	12	13	0	7	0	6	1
549	Alutwelawisahena	B	1	1	3	0	1	0	1	0
549	Alutwelawisahena	I	3	4	5	0	0	0	0	0
549	Alutwelawisahena	K	3	4	4	0	4	0	0	0
549	Alutwelawisahena	M	5	5	5	0	1	0	1	0
549	Alutwelawisahena	R	4	5	5	0	4	0	3	0
	Total		28	31	35	0	17	0	11	1
550	Kiribatgala	A	16	21	23	0	5	0	6	0
550	Kiribatgala	B	3	5	6	0	5	0	5	0
550	Kiribatgala	I	1	2	2	0	1	0	0	1
550	Kiribatgala	K	1	1	1	0	1	0	0	0
550	Kiribatgala	M	7	7	7	0	2	0	2	0
550	Kiribatgala	R	3	4	4	0	2	0	3	0
	Total		31	40	43	0	16	0	16	1
551	Usgala	A	12	14	15	0	4	0	5	0
551	Usgala	B	2	2	3	0	0	0	0	0
551	Usgala	I	0	0	0	0	0	0	0	0
551	Usgala	K	2	3	3	0	3	0	0	0
551	Usgala	M	2	2	2	0	0	0	0	0
551	Usgala	R	3	3	3	0	2	0	2	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
	Total		21	24	26	0	9	0	7	0
556	Chilaw Lake	A	7	9	9	0	0	0	0	0
556	Chilaw Lake	B	0	0	0	0	0	0	0	0
556	Chilaw Lake	I	0	0	0	0	0	0	0	0
556	Chilaw Lake	K	0	0	0	0	0	0	0	0
556	Chilaw Lake	M	1	1	1	1	0	0	1	0
556	Chilaw Lake	R	1	1	1	0	0	0	0	0
	Total		9	11	11	1	0	0	1	0
560	Galboda	A	20	25	32	0	4	0	5	0
560	Galboda	B	0	0	0	0	0	0	0	0
560	Galboda	I	4	6	7	0	0	0	0	0
560	Galboda	K	1	1	1	0	1	0	0	0
560	Galboda	M	7	8	8	0	1	0	2	1
560	Galboda	R	2	2	2	0	1	0	1	0
	Total		34	42	50	0	7	0	8	1
561	Opalagala	A	17	19	23	0	3	0	4	0
561	Opalagala	B	0	0	0	0	0	0	0	0
561	Opalagala	I	1	2	3	0	0	0	0	0
561	Opalagala	K	2	2	2	0	2	0	0	0
561	Opalagala	M	2	2	2	0	1	0	0	0
561	Opalagala	R	1	1	1	0	1	0	1	0
	Total		23	26	31	0	7	0	5	0
562	Sacombe	A	12	12	15	0	1	0	1	0
562	Sacombe	B	1	2	2	0	1	0	1	0
562	Sacombe	I	3	4	4	0	0	0	0	0
562	Sacombe	K	1	1	1	0	1	0	0	0
562	Sacombe	M	2	2	2	0	0	0	0	0
562	Sacombe	R	2	2	2	1	2	1	2	0
	Total		21	23	26	1	5	1	4	0
567	Amsawagama	A	21	25	30	0	3	0	4	0
567	Amsawagama	B	1	1	1	0	1	0	1	0
567	Amsawagama	I	3	4	4	0	0	0	0	0
567	Amsawagama	K	0	0	0	0	0	0	0	0
567	Amsawagama	M	5	5	5	0	1	0	0	0
567	Amsawagama	R	2	2	2	0	0	0	1	0
	Total		32	37	42	0	5	0	6	0
568	Beliyakanda	A	19	29	35	0	2	0	3	0
568	Beliyakanda	B	1	1	1	0	0	0	0	0
568	Beliyakanda	I	5	7	8	0	0	0	0	0
568	Beliyakanda	K	0	0	0	0	0	0	0	0
568	Beliyakanda	M	4	4	4	0	0	0	0	0
568	Beliyakanda	R	1	1	1	0	0	0	0	0
	Total		30	42	49	0	2	0	3	0
569	Etabendiwela	A	12	14	18	0	1	0	1	0
569	Etabendiwela	B	0	0	0	0	0	0	0	0
569	Etabendiwela	I	3	4	5	0	0	0	0	0
569	Etabendiwela	K	3	3	3	0	2	0	0	0
569	Etabendiwela	M	3	3	3	0	1	0	0	0
569	Etabendiwela	R	0	0	0	0	0	0	0	0
	Total		21	24	29	0	4	0	1	0
570	Tottawelgola	A	22	29	34	0	3	0	4	0
570	Tottawelgola	B	0	0	0	0	0	0	0	0
570	Tottawelgola	I	5	10	11	0	0	0	0	0
570	Tottawelgola	K	1	1	1	0	0	0	0	0
570	Tottawelgola	M	8	11	11	1	1	0	1	0
570	Tottawelgola	R	2	3	3	0	1	0	2	0
	Total		38	54	60	1	5	0	7	0
571	Gederagalpatana	A	29	47	60	0	5	0	7	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
571	Gederagalpatana	B	2	2	2	0	1	0	1	0
571	Gederagalpatana	I	6	12	16	1	0	0	0	0
571	Gederagalpatana	K	1	1	1	0	1	0	0	0
571	Gederagalpatana	M	7	9	9	0	1	0	1	1
571	Gederagalpatana	R	1	1	1	0	0	0	0	0
	Total		46	72	89	1	8	0	9	1
572	Menikdeniya	A	21	28	32	0	2	0	2	0
572	Menikdeniya	B	1	1	1	0	1	0	1	0
572	Menikdeniya	I	5	8	10	0	0	0	0	0
572	Menikdeniya	K	1	1	1	0	0	0	0	0
572	Menikdeniya	M	8	9	10	1	2	0	2	0
572	Menikdeniya	R	2	3	3	0	1	0	2	0
	Total		38	50	57	1	6	0	7	0
573	Puswellagolla	A	25	40	48	0	4	0	5	0
573	Puswellagolla	B	1	1	1	0	0	0	0	0
573	Puswellagolla	I	5	11	14	0	0	0	0	0
573	Puswellagolla	K	4	4	4	0	2	0	0	0
573	Puswellagolla	M	11	14	15	0	3	0	5	1
573	Puswellagolla	R	4	5	6	1	4	1	4	0
	Total		50	75	88	1	13	1	14	1
574	Hiriwaduna	A	21	27	33	0	2	0	2	0
574	Hiriwaduna	B	0	0	0	0	0	0	0	0
574	Hiriwaduna	I	5	8	9	0	0	0	0	0
574	Hiriwaduna	K	0	0	0	0	0	0	0	0
574	Hiriwaduna	M	8	9	9	0	1	0	3	1
574	Hiriwaduna	R	1	1	1	0	1	0	1	0
	Total		35	45	52	0	4	0	6	1
575	Dewagiriya	A	11	14	17	0	0	0	0	0
575	Dewagiriya	B	0	0	0	0	0	0	0	0
575	Dewagiriya	I	2	4	4	0	0	0	0	0
575	Dewagiriya	K	0	0	0	0	0	0	0	0
575	Dewagiriya	M	8	10	10	0	0	0	2	2
575	Dewagiriya	R	1	2	2	0	2	0	2	0
	Total		22	30	33	0	2	0	4	2
576	Ulgala	A	14	16	18	0	0	0	0	0
576	Ulgala	B	1	2	2	0	1	0	1	0
576	Ulgala	I	2	2	2	0	0	0	0	0
576	Ulgala	K	2	2	2	0	1	0	0	0
576	Ulgala	M	7	9	9	0	1	0	0	0
576	Ulgala	R	4	4	4	0	3	0	3	0
	Total		30	35	37	0	6	0	4	0
577	Korathalhinna	A	11	11	11	0	1	0	1	0
577	Korathalhinna	B	1	1	1	0	0	0	0	0
577	Korathalhinna	I	4	6	7	0	0	0	0	0
577	Korathalhinna	K	1	2	3	0	1	0	0	0
577	Korathalhinna	M	6	6	6	0	1	0	2	0
577	Korathalhinna	R	3	3	3	0	3	0	3	0
	Total		26	29	31	0	6	0	6	0
579	Diggala	A	18	26	29	0	2	0	3	0
579	Diggala	B	0	0	0	0	0	0	0	0
579	Diggala	I	2	3	3	0	0	0	0	0
579	Diggala	K	1	1	1	0	0	0	0	0
579	Diggala	M	8	8	8	0	0	0	1	1
579	Diggala	R	2	3	4	0	3	0	3	0
	Total		31	41	45	0	5	0	7	1
581	Monerakelle	A	23	34	38	0	5	0	6	0
581	Monerakelle	B	1	1	2	0	0	0	0	0
581	Monerakelle	I	4	8	10	0	0	0	0	0
581	Monerakelle	K	1	1	1	0	0	0	0	0

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581	Monerakelle	M	8	9	9	0	2	0	1	0
581	Monerakelle	R	3	4	5	0	4	0	4	0
	Total		40	57	65	0	11	0	11	0
582	Lolehela	A	15	18	21	0	1	0	1	0
582	Lolehela	B	1	1	1	0	1	0	1	0
582	Lolehela	I	4	5	6	0	0	0	0	0
582	Lolehela	K	1	1	1	0	0	0	0	0
582	Lolehela	M	7	7	7	0	2	0	1	0
582	Lolehela	R	3	4	4	0	3	0	3	0
	Total		31	36	40	0	7	0	6	0
583	Velihela	A	14	18	20	0	2	0	2	0
583	Velihela	B	0	0	0	0	0	0	0	0
583	Velihela	I	3	7	7	0	1	0	0	1
583	Velihela	K	1	1	1	0	0	0	0	0
583	Velihela	M	3	3	3	0	1	0	0	0
583	Velihela	R	3	4	4	0	3	0	3	0
	Total		24	33	35	0	7	0	5	1
584	Guruhela	A	19	20	23	0	1	0	2	0
584	Guruhela	B	0	0	0	0	0	0	0	0
584	Guruhela	I	5	7	8	0	0	0	0	0
584	Guruhela	K	1	1	1	0	0	0	0	0
584	Guruhela	M	4	4	4	0	0	0	0	0
584	Guruhela	R	3	5	6	0	5	0	4	0
	Total		32	37	42	0	6	0	6	0
585	Kitulhela	A	19	24	27	0	2	0	2	0
585	Kitulhela	B	0	0	0	0	0	0	0	0
585	Kitulhela	I	4	8	10	0	0	0	0	0
585	Kitulhela	K	2	2	2	0	1	0	0	0
585	Kitulhela	M	3	3	3	0	0	0	0	0
585	Kitulhela	R	3	4	5	0	5	0	4	0
	Total		31	41	47	0	8	0	6	0
588	Wadinahela	A	23	34	40	0	2	0	2	0
588	Wadinahela	B	1	1	1	0	1	0	1	0
588	Wadinahela	I	4	5	6	0	0	0	0	0
588	Wadinahela	K	1	1	1	0	0	0	0	0
588	Wadinahela	M	5	8	8	0	1	0	0	0
588	Wadinahela	R	3	3	3	0	2	0	2	0
	Total		37	52	59	0	6	0	5	0
589	Begahapatana	A	16	21	23	0	0	0	0	0
589	Begahapatana	B	1	1	1	0	0	0	0	0
589	Begahapatana	I	2	2	2	0	0	0	0	0
589	Begahapatana	K	1	1	1	0	0	0	0	0
589	Begahapatana	M	5	6	6	1	0	0	0	0
589	Begahapatana	R	2	4	4	0	4	0	4	0
	Total		27	35	37	1	4	0	4	0
590	Randeniya	A	20	27	32	0	1	0	2	0
590	Randeniya	B	1	1	1	0	0	0	0	0
590	Randeniya	I	3	7	9	0	0	0	0	0
590	Randeniya	K	1	1	1	0	0	0	0	0
590	Randeniya	M	4	5	5	0	1	0	0	0
590	Randeniya	R	1	1	1	0	1	0	1	0
	Total		30	42	49	0	3	0	3	0
591	Murutukanda	A	21	25	28	0	1	0	3	0
591	Murutukanda	B	1	1	1	0	0	0	0	0
591	Murutukanda	I	2	2	3	0	0	0	0	0
591	Murutukanda	K	0	0	0	0	0	0	0	0
591	Murutukanda	M	7	8	8	0	0	0	0	0
591	Murutukanda	R	3	5	5	0	5	0	5	0
	Total		34	41	45	0	6	0	8	0

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593	Bolhindagala	A	19	28	30	0	0	0	0	0
593	Bolhindagala	B	0	0	0	0	0	0	0	0
593	Bolhindagala	I	4	4	5	0	0	0	0	0
593	Bolhindagala	K	1	1	1	0	0	0	0	0
593	Bolhindagala	M	10	11	11	0	0	0	3	1
593	Bolhindagala	R	2	2	2	0	1	0	1	0
	Total		36	46	49	0	1	0	4	1
594	Golupitiyahela	A	15	19	21	0	0	0	0	0
594	Golupitiyahela	B	0	0	0	0	0	0	0	0
594	Golupitiyahela	I	2	3	3	0	0	0	0	0
594	Golupitiyahela	K	1	1	1	0	0	0	0	0
594	Golupitiyahela	M	7	7	7	0	0	0	1	1
594	Golupitiyahela	R	3	3	3	0	1	0	1	0
	Total		28	33	35	0	1	0	2	1
595	Radaliwinnekota	A	21	29	33	0	1	0	1	0
595	Radaliwinnekota	B	1	1	1	0	1	0	1	0
595	Radaliwinnekota	I	3	4	6	0	0	0	0	0
595	Radaliwinnekota	K	1	1	1	0	0	0	0	0
595	Radaliwinnekota	M	5	5	5	0	0	0	2	1
595	Radaliwinnekota	R	2	2	2	0	1	0	1	0
	Total		33	42	48	0	3	0	5	1
604	Viyanahela	A	17	19	22	0	1	0	1	0
604	Viyanahela	B	0	0	0	0	0	0	0	0
604	Viyanahela	I	5	6	6	0	0	0	0	0
604	Viyanahela	K	1	1	1	0	0	0	0	0
604	Viyanahela	M	8	9	9	0	0	0	2	2
604	Viyanahela	R	3	4	4	0	3	0	3	0
	Total		34	39	42	0	4	0	6	2
608	Welanwita	A	27	46	57	0	7	0	7	1
608	Welanwita	B	0	0	0	0	0	0	0	0
608	Welanwita	I	5	5	6	0	0	0	0	0
608	Welanwita	K	2	2	2	0	1	0	0	0
608	Welanwita	M	10	12	12	0	0	0	3	1
608	Welanwita	R	3	3	4	0	3	0	2	0
	Total		47	68	81	0	11	0	12	2
633	Labunoruwa	A	18	22	25	0	1	0	1	0
633	Labunoruwa	B	0	0	0	0	0	0	0	0
633	Labunoruwa	I	5	7	9	0	0	0	0	0
633	Labunoruwa	K	0	0	0	0	0	0	0	0
633	Labunoruwa	M	7	9	9	0	2	0	4	2
633	Labunoruwa	R	4	4	4	0	2	0	2	0
	Total		34	42	47	0	5	0	7	2
634	Puliyankulama	A	17	19	22	0	1	0	1	0
634	Puliyankulama	B	0	0	0	0	0	0	0	0
634	Puliyankulama	I	5	12	14	0	0	0	0	0
634	Puliyankulama	K	0	0	0	0	0	0	0	0
634	Puliyankulama	M	7	7	7	0	0	0	2	1
634	Puliyankulama	R	2	3	4	0	3	0	3	0
	Total		31	41	47	0	4	0	6	1
635	Manawewakanda	A	14	17	20	0	1	0	2	0
635	Manawewakanda	B	0	0	0	0	0	0	0	0
635	Manawewakanda	I	5	10	12	0	0	0	0	0
635	Manawewakanda	K	0	0	0	0	0	0	0	0
635	Manawewakanda	M	9	9	9	0	0	0	2	1
635	Manawewakanda	R	4	5	5	0	1	0	1	0
	Total		32	41	46	0	2	0	5	1
636	Aruwewa	A	19	25	28	0	2	0	3	0
636	Aruwewa	B	0	0	0	0	0	0	0	0
636	Aruwewa	I	5	10	16	1	0	0	0	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
636	Aruwewa	K	2	3	4	0	4	0	0	0
636	Aruwewa	M	9	11	11	0	1	0	2	1
636	Aruwewa	R	3	3	3	0	2	0	2	0
	Total		38	52	62	1	9	0	7	1
640	Getalagamakanda	A	13	13	17	0	1	0	1	0
640	Getalagamakanda	B	1	1	1	0	1	0	1	0
640	Getalagamakanda	I	4	9	12	0	0	0	0	0
640	Getalagamakanda	K	2	2	2	0	2	0	0	0
640	Getalagamakanda	M	9	11	11	0	1	0	3	1
640	Getalagamakanda	R	2	2	2	0	1	0	2	0
	Total		31	38	45	0	6	0	7	1
641	Galkulama Tirrapane	A	11	11	12	0	1	0	1	0
641	Galkulama Tirrapane	B	0	0	0	0	0	0	0	0
641	Galkulama Tirrapane	I	5	9	9	0	0	0	0	0
641	Galkulama Tirrapane	K	2	2	2	0	1	0	0	0
641	Galkulama Tirrapane	M	5	7	7	0	0	0	1	0
641	Galkulama Tirrapane	R	0	0	0	0	0	0	0	0
	Total		23	29	30	0	2	0	2	0
645	Puliyamkulam	A	12	14	15	0	1	0	1	0
645	Puliyamkulam	B	0	0	0	0	0	0	0	0
645	Puliyamkulam	I	3	4	5	0	0	0	0	0
645	Puliyamkulam	K	1	1	1	0	1	0	0	0
645	Puliyamkulam	M	6	6	6	0	0	0	0	0
645	Puliyamkulam	R	1	1	1	0	0	0	0	0
	Total		23	26	28	0	2	0	1	0
647	Ranawekanda	A	21	29	34	0	2	0	2	0
647	Ranawekanda	B	0	0	0	0	0	0	0	0
647	Ranawekanda	I	3	5	6	0	0	0	0	0
647	Ranawekanda	K	1	1	1	0	1	0	0	0
647	Ranawekanda	M	5	7	7	0	2	0	2	1
647	Ranawekanda	R	0	0	0	0	0	0	0	0
	Total		30	42	48	0	5	0	4	1
650	Pallankulama	A	14	18	22	0	1	0	2	0
650	Pallankulama	B	0	0	0	0	0	0	0	0
650	Pallankulama	I	5	9	12	0	0	0	0	0
650	Pallankulama	K	1	1	1	0	1	0	0	0
650	Pallankulama	M	6	8	8	0	0	0	1	1
650	Pallankulama	R	0	0	0	0	0	0	0	0
	Total		26	36	43	0	2	0	3	1
651	Semewa	A	10	10	13	0	1	0	1	0
651	Semewa	B	3	4	4	0	1	0	1	0
651	Semewa	I	4	6	9	0	0	0	0	0
651	Semewa	K	0	0	0	0	0	0	0	0
651	Semewa	M	6	7	7	0	0	0	2	1
651	Semewa	R	3	3	3	0	2	0	2	0
	Total		26	30	36	0	4	0	6	1
652	Wellamudawa	A	14	15	16	0	1	0	1	0
652	Wellamudawa	B	1	1	2	0	1	0	1	0
652	Wellamudawa	I	4	7	11	0	0	0	0	0
652	Wellamudawa	K	2	2	3	1	2	0	0	0
652	Wellamudawa	M	3	4	4	0	0	0	1	1
652	Wellamudawa	R	0	0	0	0	0	0	0	0
	Total		24	29	36	1	4	0	3	1
653	Kokkebe	A	13	15	17	0	2	0	2	0
653	Kokkebe	B	0	0	0	0	0	0	0	0
653	Kokkebe	I	5	7	9	0	0	0	0	0
653	Kokkebe	K	3	3	3	0	2	0	0	0
653	Kokkebe	M	10	12	12	0	0	0	3	2
653	Kokkebe	R	3	4	4	0	2	0	2	0

EMD No.	Forest name	Higher taxa	Families	Genera	Species	Rare	Endemic	Rare/ Endemic	Threatened species National	Threatened species Global
	Total		34	41	45	0	6	0	7	2
654	Arangala	A	17	23	28	0	4	0	4	0
654	Arangala	B	0	0	0	0	0	0	0	0
654	Arangala	I	1	1	1	0	0	0	0	0
654	Arangala	K	1	1	1	0	1	0	0	0
654	Arangala	M	5	5	5	0	0	0	1	0
654	Arangala	R	0	0	0	0	0	0	0	0
	Total		24	30	35	0	5	0	5	0
655	Kaludıyâpokuna	A	26	39	46	0	2	0	3	0
655	Kaludiyapokuna	B	1	1	1	0	1	0	1	0
655	Kaludiyapokuna	I	5	9	10	0	0	0	0	0
655	Kaludiyapokuna	K	1	1	1	1	1	1	0	0
655	Kaludiyapokuna	M	7	9	10	0	2	0	3	1
655	Kaludiyapokuna	R	3	4	4	0	1	0	1	0
	Total		43	63	72	1	7	1	8	1
656	Kosgahakele	A	18	22	28	0	1	0	1	0
656	Kosgahakele	B	1	1	1	0	1	0	1	0
656	Kosgahakele	I	3	5	5	0	0	0	0	0
656	Kosgahakele	K	0	0	0	0	0	0	0	0
656	Kosgahakele	M	7	9	9	0	2	0	2	1
656	Kosgahakele	R	1	1	1	0	1	0	1	0
	Total		30	38	44	0	5	0	5	1
657	Kurulukele	A	17	19	21	0	2	0	2	0
657	Kurulukele	B	1	2	2	0	2	0	2	0
657	Kurulukele	I	5	7	10	1	0	0	0	0
657	Kurulukele	K	2	2	2	0	1	0	0	0
657	Kurulukele	M	4	4	4	1	0	0	0	0
657	Kurulukele	R	2	2	2	0	1	0	1	0
	Total		31	36	41	2	6	0	5	0
659	Wathurana	A	17	20	23	0	5	0	5	0
659	Wathurana	B	2	2	4	0	2	0	2	0
659	Wathurana	I	3	6	6	0	0	0	0	0
659	Wathurana	K	1	1	2	0	2	0	0	0
659	Wathurana	M	1	1	1	0	0	0	0	0
659	Wathurana	R	2	2	2	0	2	0	1	0
	Total		26	32	38	0	11	0	8	0
660	Elagamuwa	A	15	18	21	0	1	0	1	0
660	Elagamuwa	B	2	2	2	0	1	0	1	0
660	Elagamuwa	I	4	5	8	0	0	0	0	0
660	Elagamuwa	K	0	0	0	0	0	0	0	0
660	Elagamuwa	M	5	6	6	0	2	0	1	0
660	Elagamuwa	R	1	1	1	0	0	0	0	0
	Total		27	32	38	0	4	0	3	0

Annex 8

SOIL/WATER CONSERVATION AND BIODIVERSITY ASSESSMENTS

The results of the soil and water conservation assessment and species diversity survey are summarised below for units of contiguous forest. An asterisk indicates that a forest is important for that particular attribute, important meaning that it warrants inclusion within a minimum network of conservation forests with respect to that attribute. Units of contiguous forest which were not included in either the soil and water conservation assessment or species diversity survey are indicated.

Attributes are defined according to following criteria:

Soil erosion	Unit of contiguous forest exceeds threshold of 300 t ha^{-1} yr^{-1} (see Annex 2 and Table 5.8).
Flood hazard	Unit of contiguous forest exceeds threshold of 10 m^3 s^{-1} yr^{-1} (see Annex 4 and Table 5.8).
Fog interception	Unit of contiguous forest lies above 1,500 m (see Tables 5.4 and 5.8).
Woody plants	Unit of contiguous forest included within a minimum network of forests necessary to conserve all woody plant species (see Annex 7, Volume 2).
Endemic woody plants	Unit of contiguous forest included within a minimum network of forests necessary to conserve all endemic woody plant species (see Annex 9, Volume 2).
Animals	Unit of contiguous forest included within a minimum network of forests necessary to conserve all animal species (see Annex 8, Volume 2).
Endemic animals	Unit of contiguous forest included within a minimum network of forests necessary to conserve all endemic animal species (see Annex 10, Volume 2).

Forest		Soil erosion	Flood hazard	Fog interception	Woody plant species		Animal species	
No	Name				All	Endemic	All	Endemic
4	Alapalawala	*			Not surveyed			
7	Amanawala-Ampane	*	*		*	*	*	*
10	Ambanmukalana				Not surveyed			
567	Amsawagama							
11	Anaolundewa		*		Not surveyed			
637	Andarawewa				Not surveyed			
527	Angamana	*			Not surveyed			
654	Arangala	Not surveyed						
554	Aruakalu				Not surveyed			
636	Aruwewa				*		*	
17	Attavillu				Not surveyed			
509	Auwegalakanda	*	*					
597	Badanagala				Not surveyed			
24	Badullakele					*	*	*
27	Bakinigahawela				Not surveyed			
605	Balanagala		*		Not surveyed			
-28	Bambarabotuwa (N=5)	*	*		*	*	*	
511	Bambarawana	*	*					
513	Batahena	*						
589	Begahapatana				*		*	
568	Beliyakanda	*						
37	Beraliya (Akuressa)		*		*			*
38	Beraliya (Kudagala)	*	*		*			
-39	Bibilehela (N=2)		*		*	*	*	*
630	Bogodayagama				Not surveyed			
593	Bolhindagala							
516	Boralugoda	*			Not surveyed			
44	Bundala				*			
552	Butawella	*	*		Not surveyed			
45	Campbell's Land				Not surveyed			
-14	Central Highlands (N=16)	*	*	*	*	*	*	*
556	Chilaw Lake	Not surveyed			*	*	*	
57	Dambuluwana	*	*		Not surveyed			
60	Dandeniya-Aparekka					*		
62	Darakulkanda							
515	Dedugalla-Nangala	*	*		Not surveyed			
66	Degadaturawa				Not surveyed			
72	Demanagammana	*			Not surveyed			
631	Dematawewa				Not surveyed			

Forest		Soil erosion	Flood hazard	Fog interception	Woody plant species		Animal species	
No	Name				All	Endemic	All	Endemic
500	Derangala	*						
575	Dewagiriya				*			
579	Diggala	Not surveyed						
586	Diggalahela				Not surveyed			
78	Doluwakanda	*			*	*		
548	Dumbara	*			Not surveyed			
580	Dummalahela	*			Not surveyed			
80	Dunkanda	*			*			
660	Elagamuwa	Not surveyed			*			
96	Gal Oya	Not surveyed					*	*
-96	Gal Oya Valley (N=6)		*					
540	Galbokaya	*			Not surveyed			
101	Galgiriyakanda	*			*			
538	Gallegodahinna	*						
534	Galleletota				*	*	*	
642	Galmaduwa				Not surveyed			
-64	Getamalagamakanda (N=2)							
112	Gilimale-Eratne	*	*		*	*		
594	Golupitiyahela							
544	Gorangala	*	*		*			
566	Gosgahapatana	*			Not surveyed			
598	Gunner's Quoin	*			Not surveyed			
584	Guruhela							
519	Guruyalle	*			Not surveyed			
543	Handuwelkanda	*			Not surveyed			
536	Hapugala				*			
128	Harasbedda			*	Not surveyed			
539	Hataramune				*		*	
-12	Haycock (N=2)	*	*		*	*	*	*
131	Henegedaralanda				Not surveyed			
133	Hidellana-Weralupe	*			Not surveyed			
508	Hindeinattu	*						
136	Hinna	Not surveyed					*	*
507	Homadola	*	*					
518	Hopewell				Not surveyed			
138	Horagala-Paragala	*	*					
142	Hurulu		*		Not surveyed			
520	Illukkanda		*		Not surveyed			
-14	Inamaluwa (N=2)							

Forest		Soil erosion	Flood hazard	Fog interception	Woody plant species		Animal species	
No	Name				All	Endemic	All	Endemic
146	Indikada Mukalana	*	*		Not surveyed			
147	Ingiriya		*		*			
157	Kadawatkele	*			Not surveyed			
160	Kahalla	Not surveyed						
-16	Kalahalla-Pallekele (N=2)		*		*		*	*
497	Kalubowitiyana	*	*		*		*	
655	Kaludiyapokuna	Not surveyed					*	*
166	Kalugala	*	*		*			
170	Kananpella				Not surveyed			
177	Kanugollayaya				Not surveyed			
178	Kanumuldeniya							
184	Karawita	*	*		*			
639	Katupotakanda				Not surveyed			
-17	KDN (N=6)	*	*		*	*	*	*
611	Keeriyagolla	*			Not surveyed			
190	Kekanadura				*			
191	Kelani Valley	*	*		*	*		
526	Keulakada Wewa				*			
197	Kikilimana	*	*	*	*	*	*	*
550	Kiribatgala	*			*	*		
201	Kirinda Mahayayakele							
610	Kithedallakanda	*			Not surveyed			
585	Kitulhela				*		*	
-52	Knuckles /Wasgomuwa (N=11)	*	*	*	*	*	*	*
653	Kokkebe	Not surveyed						
-20	Kombala-Kottawa (N=2)		*		*		*	*
577	Korathalhinna							
656	Kosgahakele	Not surveyed						
596	Kudagala North				Not surveyed			
531	Kudagoda		*		*		*	*
217	Kudumiriya	*	*		*	*		
601	Kumadiya Tulana				Not surveyed			
169	Kumburugamuwa	*			Not surveyed			
535	Kuragala	*					*	
221	Kurana Madakada		*		Not surveyed			
498	Kurulugala	*			*			
657	Kurulukele	Not surveyed			*		*	
222	Labugama-Kalatuwana	*	*		Not surveyed			
633	Labunoruwa				Not surveyed			

Forest		Soil erosion	Flood hazard	Fog interception	Woody plant species		Animal species	
No	Name				All	Endemic	All	Endemic
582	Lolehela				Not surveyed			
232	Ma Eliya				Not surveyed			
609	Madigala	*			Not surveyed			
237	Madunagala							
239	Maduru Oya Block 1		*		Not surveyed			
241	Magurugoda	*	*		Not surveyed			
247	Mahakanda				Not surveyed			
599	Mahamorakanda				Not surveyed			
249	Mahapitakanda				Not surveyed			
565	Makulussa	*			Not surveyed			
-25	Malambure (N=2)	*	*			*	*	*
256	Manapaya	*			*			
635	Manawewakanda							
-16	Mangroves (N=3)	Not surveyed			*			
272	Marakele				Not surveyed			
643	Marasinhagama				Not surveyed			
558	Masawa				Not surveyed			
504	Masimbula	*						
263	Masmullekele				*			
517	Matinapatana				Not surveyed			
646	Medalassa Korale				Not surveyed			
502	Medirigiriya Tulana		*		*	*		
269	Meegahatenna	*						
572	Menikdeniya	*			*		*	
277	Mihintale	Not surveyed						
278	Mihintale				Not surveyed			
-28	Mineriya (N=2)	Not surveyed			*		*	
279	Minneriya						*	*
280	Minneriya-Giritale				*			
281	Minneriya-Giritale Block 1		*		Not surveyed			
285	Miriyagalla				Not surveyed			
525	Miyandagala				*			
581	Monerakelle	*			*	*		
293	Mulatiyana	*	*		*	*		
533	Mulgama	*						
591	Murutukanda							
602	Mutugalla Tulana				Not surveyed			
294	Muwagankanda	*						
-30	Namaneliya (N=2)				Not surveyed			

Forest		Soil erosion	Flood hazard	Fog interception	Woody plant species		Animal species	
No	Name				All	Endemic	All	Endemic
306	Namunukula	*		*	*	*		
537	Narangattahinna	*			*	*	*	
318	Neugalkanda	*						
327	Ohiya	*	*	*	*	*	*	
329	Oliyagankele				*	*	*	*
333	Padawiya	Not surveyed					*	
638	Pahala Mawatawewa				Not surveyed			
650	Pallankulama	Not surveyed						
600	Palliyagodella Tulana				Not surveyed			
-34	Panilkanda (N=2)	*	*		*	*		
-36	Pedro (N=3)	*	*	*	*	*	*	
376	Potawa	Not surveyed					*	
645	Puliyamkulam							
634	Puliyankulama							
-57	Puswellagolla (N=4)		*		*		*	*
595	Radaliwinnekota				*			
383	Ragalla			*	Not surveyed			
384	Rajawaka		*		*		*	
388	Rammalakanda	*	*		*	*	*	
647	Ranawekanda							
590	Randeniya							
389	Ranwala		*		Not surveyed			
390	Ranwaragalakanda	*			*		*	*
632	Ratmale Kanda				Not surveyed			
392	Ravana Ella	*	*		*			
394	Rilagala	*	*		*	*		
395	Ritigala	*			*	*		
-39	Ruhuna/Yala (N=8)		*		*		*	*
404	Sangappale				Not surveyed			
-40	Sellandkandal (N=2)				Not surveyed			
407	Sellankandal	Not surveyed			*	*		
514	Sembawatte	*	*					
651	Semewa	Not surveyed						
-41	Sinharaja (N=14)	*	*		*	*	*	*
603	Sinnakallu				Not surveyed			
592	Sitarama				Not surveyed			
532	Talawegoda	*					*	
553	Talpattekanda				Not surveyed			
644	Tambaragalawewa				Not surveyed			

Forest		Soil erosion	Flood hazard	Fog interception	Woody plant species		Animal species	
No	Name				All	Endemic	All	Endemic
629	Tambutakanda				Not surveyed			
426	Tangamalai	*		*	*			
432	Tibbutukanda	*	*		*			
506	Tiboruwakota	*	*		*			
570	Tottawelgola	*					*	
438	Uda Walawe		*					
442	Udawattakele							
576	Ulgala				*		*	*
578	Ulgala (old)				Not surveyed			
443	Ulinduwewa	*			Not surveyed			
583	Velihela	*						
452	Victoria-Randenigala-Rantambe		*					
453	Viharekele							
604	Viyanahela							
588	Wadinahela	*			*			
-45	Walankanda (N=8)	*	*		*	*		
458	Wanniyagama		*					
659	Wathurana	Not surveyed			*	*		
463	Wedakanda		*		*	*	*	
464	Wedasitikanda						*	
465	Weerakulicholai-Elavankulam		*		Not surveyed			
471	Welihena						*	
652	Wellamudawa	Not surveyed					*	
587	Westminster Abbey				Not surveyed			
521	Wewegalatana	*			Not surveyed			
-48	Yagirala (N=3)		*		*	*	*	
510	Yakdehikanda	*			Not surveyed			
489	Yakdessakanda	*	*		*			
496	Yoda Ela				Not surveyed			