Protected Areas Management and Wildlife Conservation Project

ADB Loan Number 1767-SRI (SF)

Consultancy Services Report

BIODIVERSITY BASELINE SURVEY: WASGOMUWA NATIONAL PARK

Contributors: **S.M.D. Ajantha U. De Alwis (Fish), P. Nihal Dayawansa (Herpetofauna), Ric How (Data Analysis), B.M.P. Singhakumara (Plants), Devaka Weerakoon (Birds), Mayuri R. Wijesinghe (Mammals), Wipula B. Yapa (Bats)** Editor: **Michael J.B. Green**

March 2007

Prepared for:
Department of Wildlife Conservation

Ministry of Environment and Natural Resources, Sri Lanka

Prepared by: *In association with:* *and:*

ARD Inc

Infotechs IDEAS (Pvt) Ltd

GREENTECH Consultants (Pvt) Ltd

ACKNOWLEDGEMENTS

It is a tribute to all members of the Biodiversity Baseline Survey team that this series of reports on each of the four protected areas surveyed has been produced within two months of completing the field surveys. The efforts and commitment of those who actually carried out the field work, often in demanding terrain and sometimes in very wet weather, were considerable. Members of the team are listed below and those who have contributed directly to the production of this document are named on the cover page as a contributor for the section covering their respective taxonomic group.

It has been a pleasure to work with the staff of the Department of Wildlife Conservation. The team appreciated the support of the four Park Wardens (A.H. Sumanasena, A.W. Rajapakse, Lakshman Pieris and Keerthi Chandraratne) and those of their staff who assisted with field work. Special thanks are due to the Director General (Dr Dayananda Kariyawasam) for his full engagement with the project; H.D. Ratnayake (Acting Director, Operations), S.R.B Dissanayake (Deputy Director, Research & Training) and M.S.L.R.P. Marasingha (Assistant Director) for their technical, logistic and other inputs; and to Kamani Abaysirigunawardena for applying her GIS skills to producing maps for these reports. Thanks are also due to Professor Sarath Kotagama for his guidance throughout the project and to Professor Linc Schmitt who spent a week's holiday generating statistical analyses of field data.

Michael J.B. Green
Team Leader

Biodiversity Baseline Survey Team

Management and Administration
Dr Michael J.B. Green, Uditha Lokuvithana

Database Management and Analysis Group
Dr Ric How, Sriyan De Silva, U. Rajita R. Perera

Field Survey Group
Dr Udaha Kapu Gedara Kalinga Padmalal

***Mammal Group*:** Dr Mayuri Wijesinghe, Dr Wipula Bandara Yapa, Bandara M.C. Digana, K.I. Niluka Chrishantha Kumara, Pujitha Gamage, L.M. Saman Indika

***Bird Group*:** Dr. Devaka K. Weerakoon, Mahendra Siriwardene, R.A. Rahula Perera, M. D. T. Asela, Chinthaka. Kaluthota, Karmen Ranatunga, Dammithra Samarasinghe

***Herpetology Group*:** Dr P. Nihal Dayawansa, P. Roshan Kumara Rodrigo, L.J. Mendis Wickramasinghe *Volunteers*: Deepani Jayantha, Samindra Fernando, Sanjeewa Lelwala

***Fish Group*:** Dr S.M.D. Ajantha U. De Alwis, S. Indika U.P. Kudage, A.M.S.M. Rohana Wasantha Jayasekara *Volunteer*: Chamil Perera

Vascular Plants Group: Prof. B.M.P. Singhakumara, Thilak Nalinda Peries, M. Roshan A.K. Peiris, H. Ravi Suranga, G.N. Dilruk Perera *Volunteer*: J.A. Ananda Lal Peiris

This document may be cited as follows:

DWC (2007). *Biodiversity Baseline Survey: Wasgomuwa National Park*. Consultancy Services Report prepared by Green, M.J.B. (ed.), De Alwis, S.M.D.A.U., Dayawansa, P.N., How, R., Singhakumara, B.M.P., Weerakoon, D.,Wijesinghe, M.R. and Yapa, W.B. ARD Inc in association with Infotech IDEAS and GREENTECH Consultants. Sri Lanka Protected Areas Management and Wildlife Conservation Project (PAM&WCP/CONSULT/02/BDBS), Department of Wildlife Conservation, Ministry of Environment and Natural Resources, Colombo. 49 pp.

CONTENTS

1. INTRODUCTION

1.1 Biodiversity Baseline Survey

The Biodiversity Baseline Survey is a discrete Contract within the Protected Area Management and Wildlife Conservation Project, funded by the Asian Development Bank, World Bank Global Environment Facility and the Government of the Netherlands. It has been undertaken by ARD Inc. for the Ministry of Environment in accordance with the *Contract for Consulting Services of Biodiversity Baseline Survey* (ADB Loan No. 1767 SRI (SF).

The overall aim of the Contract is to assess the current status of biodiversity within a small set of protected areas to inform their future management, using sound and practical scientific methods that can be repeated over time and applied more widely by the Department of Wildlife Conservation (DWC) to other protected areas under its remit. The Contract has been implemented during the period April 2006 – March 2007, with field work undertaken from the beginning of July 2007 until mid-January 2007.

Wasgomuwa National Park is one of **four protected areas** included in this Survey, chosen on account of its high importance for biodiversity within Sri Lanka's Intermediate and Dry zones. The following **six taxonomic groups** were selected for purposes of the Survey on the basis of being (a) well known and of general interest to scientists and managers; (b) relatively easy to survey systematically and identify; and (c) potentially of value to protected areas management:

- Mammals
- Birds
- Amphibians
- Reptiles
- Freshwater fish
- Vascular plants

1.2 Purpose of this report in relation to contract objectives

This report documents the plant and animal species recorded by this Biodiversity Baseline Survey, assesses the richness of species found within the different habitats and considers the implications of these findings for the future management of the national park. Along with reports for the other three protected areas, it addresses six of the ten objectives outlined in the Contract (Box 1).

Box 1.1 **Contract objectives addressed in this report are highlighted**

1. Establish baseline data and survey protocols for future biodiversity monitoring.
2. Establish sound, repeatable field methods appropriate for local conditions.
3. Establish rigorous methods for collection and management of data and specimens.
4. **Inform management planning by defining habitat preferences and distribution of a range of fauna/flora/assemblages and threats to them.**
5. **Identify habitats with rare, endemic and ecologically/culturally important species, guilds and assemblages.**
6. **Identify natural assemblages of plants/animals.**
7. **Provide natural history information on a range of species.**
8. **Inform management practices and identification of management zones, based on #5-7 above.**
9. **Make information, especially on the importance of each PA, available for education outreach.**
10. Improve technical skills of Departmental staff by provision of on-the-job training.

This report should be read in conjunction with the Field Manual (2007a), which documents the design of the Biodiversity Baseline Survey and methods used for sampling the different taxonomic groups in accordance with Objectives 1 and 2 of the Contract (Box 1.1). The Field Manual also describes how the field data are electronically stored and managed within a Biodiversity Information Management System and provides details about the preservation and curation of plant and animal specimens.

This report is intended for use by staff of the Department of Wildlife Conservation responsible for the management of Wasgomuwa National Park and the educational outreach of those who live around its perimeter or visit it. It should also be readily accessible to other professional individuals and organisations interested in adding to our knowledge of biodiversity within this site, be it through the collection of field data or further analyses.

Importantly, this report, together with the Field Manual and records from this baseline survey held in the Biodiversity Information Management System (DWC, 2007b, 2007c), provide the basis for monitoring future changes to the biodiversity of Wasgomuwa National Park and informing its management in so far as the constraints of the data allow.

2. WASGOMUWA NATIONAL PARK

This section provides background information about the National Park that is relevant to this Survey. Unless otherwise indicated, it has been extracted from the current management plan (DWC, 2005) and further details can be found in the resource inventory to the previous management plan (DWC, 1998). Useful background information can also be found in IUCN (1990).

2.1 Designation, area and location

Wasgomuwa was designated a national park on 7 August 1984 (Gazette Notification No. 309/4) and comprised Lot 1 (29,036 ha) and Lot 2 (4,612.7 ha), making a total area of 33,649 km^2 (IUCN, 1990). Lot 1 was originally established as a strict nature reserve on 25 February 1938 (Gazette Notification No. 8356). According to the Management Plan (DWC, 2005), the current area is 39,385 ha.

The national park lies between the Kalu Ganga to the west, Amban Ganga to the north and Mahaweli Ganga to the east in Matale and Polonnaruwa districts[1].

2.2 Physical features

The most distinctive landform is the Sudukande Range of quartzite hills running longitudinally in the west of the national park, the highest peak 535 m (Figure 2.1a). Streams drain westwards and eastwards from these hills into the Kalu Ganga and Mahaweli Ganga, respectively, dividing the area into 34 sub-basins (Figure 2.1b). The lower lying terrain is undulating, with occasional elevated outcrops of rock, and it is traversed by a series of stream gullies and small river valleys. An extensive peneplain stretches from the foothills of Sudukanda to the Mahaweli. Tanks are scattered throughout the landscape and there are also natural water holes, villus, which fill during the rainy season.

Geologically, Wasgomuwa is situated in the eastern lowlands and lies within a transitional zone between the Highland Series and the Vijayan Complex. These are the most dominant geologic formations in the country, consisting of hard crystalline metamorphic rocks of the Pre-Cambrian era. Thus, the underlying basement rocks consist of a variety of gneisses, quartzites and marble, all aligned in a north-south direction (Figure 2.1c).

Soils include a variety of Reddish Brown Earths, Loams and Clays, derived from the weathering of residual parent materials, in upper catchments areas and alluviums in the flood plains, developed from materials that have been transported by water and deposited along the banks of the major rivers (Figure 2.1d).

2.3 Climate

The climate is Tropical Dry Hot Monsoon, with a protracted dry period prior to the rains of the north-east monsoon (Maha) in October-January and uniformly high mean temperatures of 32^{o}C throughout the year. Winds are high and dry during the south-west monsoon (May-August) and low and wet during the Maha. Mean annual rainfall ranges from 1750 mm in the north to 2250 mm in the south (NPS and DCW, 1986). Relative humidity is 59-97 % at Giradurukotte and 50-95% at Aralaganwila.

[1] Wasgomuwa abuts Riverine Nature Reserve, which runs along the right bank of the Mahaweli Ganga and is generally managed as an integral part of the national park. Riverine Nature Reserve , gazetted on 23 July 1991 (Notification No: 673/4), extends over 824.2 ha.

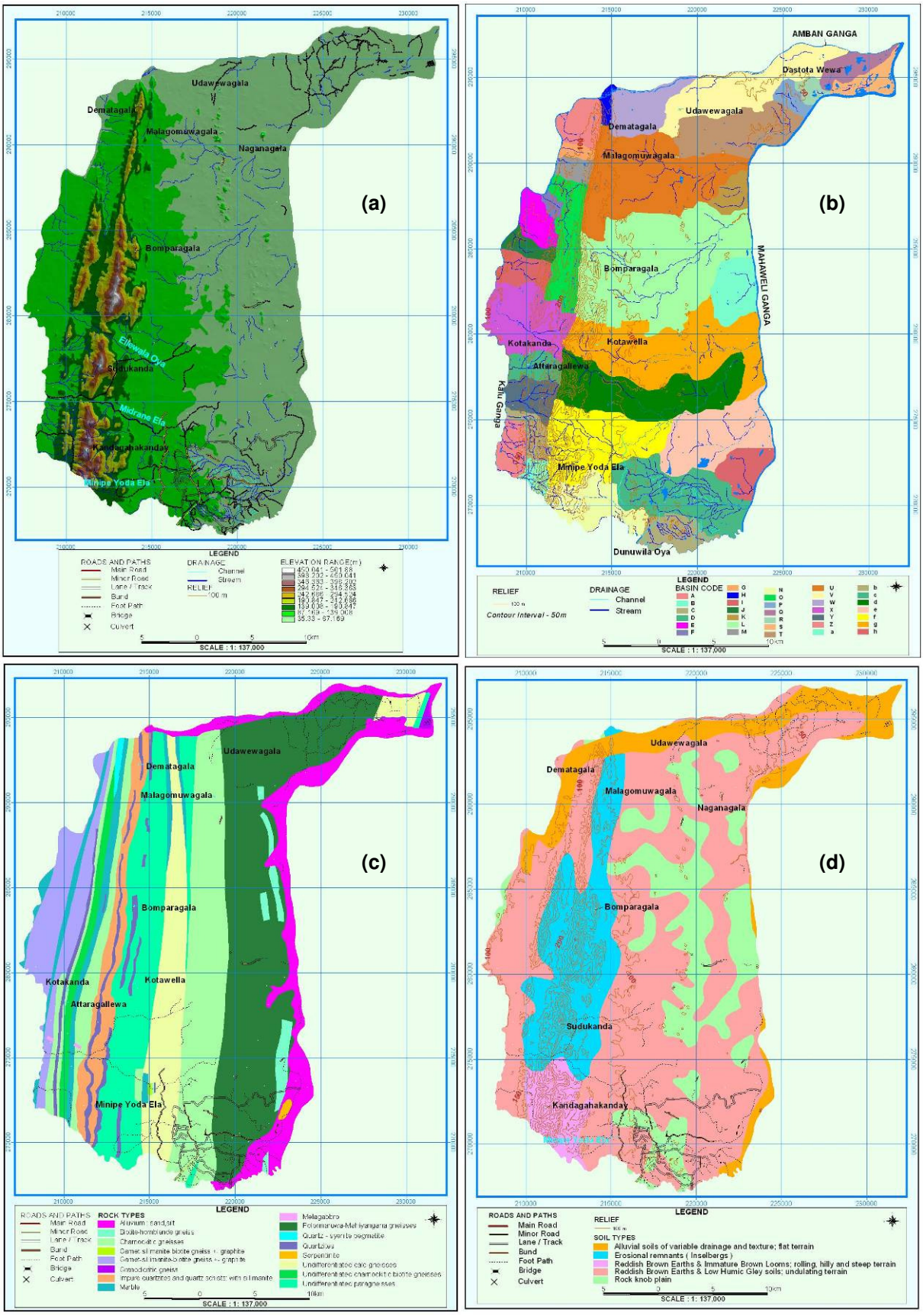


Figure 2.1 Maps of Wasgomuwa National Park showing (a) topography, (b) river sub-basins, (c) geology and (d) soils (Source: MENR, 2005)

Figure 2.2 Vegetation map of Wasgomuwa National Park (Source: MENR, 2005)

Box 2.1 **Descriptions and images of the main vegetation types in Wasgomuwa National Park[1] (Source: MENR, 2005)**

Dry-Mixed Evergreen Forest (22,662.1 ha, 57.6% total area)

This is the most extensive vegetation type in the national park. It has been subjected to varying degrees of natural and anthropological disturbances in the past, resulting in a mosaic of patches of undisturbed forest, secondary forest, grasslands and scrub often within the same area.

The undisturbed forest has the general appearance of a closed canopy forest, attaining a height of up to 30 m. The canopy consists of trees such as – *Manilkara* (Palu), *Drypetes* (Wira), *Chloroxylon* (Burutha), *Alseodaphne* (Wewarana), *Berrya* (Halmilla), and *Diospyros* (Kaluwara). *Drypetes* (Wira) forms the sub-canopy of these forests. The understorey vegetation includes medium sized trees, such as *Diospyros ovalifolia, D. ferrea, Feronia acidissima, Xylopia nigricans and Nothopegia beddomei,* and shrubs such as *Ochna lanceolata, Tarenna asiatica, Memecylon angustifolium, M. capitellatum, M. umbellatum, Mallotus resinosus, Croton laccifer* and *Dimorphocalyx glabellus.*

Riverine Forest (217.6 ha, 0.6% of total area)

These are narrow strips of tall forests found along the banks of Mahaweli Ganga, Amban Ganga, Kalu Ganga , Wasgamu Oya and other streams.

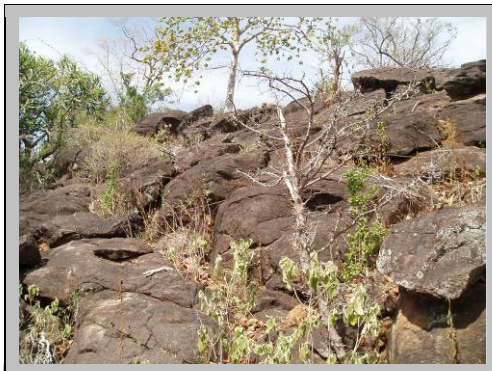
Terminalia arjuna (Kumbuk) is the most common riverine species; others are *Polyalthia longifolia*, *Madhuca longifolia*, *Diospyros malabaricum*, *D. ferrea, D. montana, D. ovalifolia, Nauclea orientalis, Mangifera zeylanica, Nothopegia beddomei, Garcinia spicata, Homonoia riparia, Cynometra zeylanica, Pongamia pinnata, Hydnocarpus venenata, Barringtonia acutangula,* and *Vitex leucoxylon*. *Dimorphocalyx glabellus* (Thenkuttiya/Weliwenna) is a common understorey species.

Vatica obscura, belonging to the Dipterocarpaceae, is an endemic and highly threatened tree species found along the Mahaweli Ganga **but** common on the small island of Kalinga Dupatha.

Scrub (10,806.2 ha, 27.5% of total area)

Scrub occurs in areas where climax forest has been degraded. It is widely interspersed with Dry-Mixed Evergreen Forest throughout the landscape. It has a different structure and physiognomy compared to undisturbed and secondary forests; its height does not exceed 10 m. It consists of many thorny species but few seedlings and saplings of forest trees are also found among shrubs.

Characteristic species, many of which are thorny, include: *Azadirachta indica, Bauhinia racemosa, Carissa spinarum, Catunaregam spinosa, Dichrostachys cinerea, Flueggea leucopyrus, Gmelina asiatica, Grewia orientalis, Hugonia mystax, Ichnocarpus frutescens, Lantana camara , Limonia acidissima, Memecylon umbellatum, Phyllanthus polyphyllus, Scutia myrtina, Syzygium cumini, Toddalia asiatica* and *Ziziphus oenoplia.*



Rock Outcrops (471.6 ha, 1.2% of total area)

A distinctive assemblage of species is associated with rock outcrops. Characteristic species include: *Euphorbia antiquorum, Cissus quadrangularis, C. vitiginea, Premna latifolia, Gmelina asiatica, Sterculia urens, Catunaregam spinosa, Ficus arnottiana, F. mollis* and *F. microcarpa.*

Forest on Quartzite (266.6 ha, 0.7% of total area)

Short stature forest is found on quartzite, which is restricted to the Sudukanda Ridge. The canopy of such forests is discontinuous and the understorey well developed.

Characteristic species include: trees such as *Drypetes sepiaria, Euphorbia antiquorum, Syzygium cumini, Pterospermum suberifolium, Waltheria indica*, and *Vitex altissima*; and shrubs such as *Carissa spinarum, Capparis zeylanica, Croton laccifer, Phyllanthus polyphyllus, Hugonia mystax, Memecylon umbellatum, Ochna lanceolata, Jasminum angustifolium, Ziziphus oenoplia, Benkara malabaica, Gardenia fosbergii, Psydrax dicoccos* and *Tarenna asiatica*.

Grasslands (1,994 ha, 5.1% of total area)

.Natural grasslands, dominated by *Imperata cylindrica* (Illuk), occur in areas surrounding water holes (eba) or villus. Other grasslands are anthropogenic, having developed on lands abandoned after being used for shifting (chena) or paddy cultivation. These are characterised by short grass species, such as *Ischemum* and *Eragrostis*, and harbour many dicotyledonous species which emerge in the rainy season. Such grassland has a turf-like appearance. *Eragrostis*-dominated grasslands, found at Yudaganawa and elsewhere, are characteristic of more rocky soils.

[1] The other habitat types, as shown in Figure 2.2, are waterbodies (1,017.4 ha, 2.6%), gardens (708.5 ha, 1.8%) and paddy (1,185.5 ha, 3.0%) out of a total area of 39,330 ha, based on GIS analysis. Note that this total area is slightly less that the official area of 39,385 ha cited in the Management Plan (DCW, 2005)

2.4 Vegetation

The vegetation can be broadly classified as Dry-Mixed Evergreen Forest (Dry Zone Monsoon Forest). Variations in geology, landform, soil and hydrological conditions give rise to several other vegetation types, such as vegetation associated with rock outcrops, and there is secondary vegetation, scrub and grasslands, which have resulted from human interventions (Figure 2.2). There is also a narrow strip of well developed Riverine Forest along the banks of the Mahaweli Ganga and, to a lesser extent, along the Kalu Ganga and Amban Ganga. Main vegetation types are described, with images, in Box 2.1.

2.5 Flora and fauna

Biodiversity surveys and related research in recent decades include the National Conservation Review (Green and Gunawardena, 1997) and a floral survey, as part of mapping the habitat of Wasgomuwa (MENR, 2005). Existing knowledge about the diversity of plant and animal species is summarised in Table 2.1.

Wasgomuwa is considered in the Management Plan to be important for sloth bear (*Melursus ursinus*), on account of being relatively easily seen, and for elephant.

Table 2.1 Diversity of plant and animal taxonomic groups recorded by previous surveys and as summarised in the current Management Plan

Survey/ Source	Taxon	Total number			
		Families	Genera	Species	Endemic species
Kotagama and Vattala (undated[a])	Butterflies	unavailable	unavailable	52	unavailable
	Amphibians	unavailable	unavailable	15	unavailable
	Reptiles	unavailable	unavailable	35	7
	Birds	unavailable	unavailable	163	5
	Mammals	unavailable	unavailable	20	unavailable
Jayasingham *et al.* (1992)	Woody plants	47	unavailable	155	unavailable
National Conservation Review (Green and Gunawardena, 1997)	Woody plants	49	120	151	22
	Butterflies	6	20	25	0
	Molluscs	4	4	4	2
	Amphibians	3	4	4	1
	Reptiles	4	7	7	6
	Birds	28	48	56	5
	Mammals	14	19	20	2
Management Plan (DWC, 2005), based on resources inventory (DWC, 1998)[b]	Flowering plants	unavailable	unavailable	150	10
	Fish	10	17	17	2
	Butterflies	7	31	50	9
	Molluscs	unavailable	5	unavailable	unavailable
	Amphibians	4	7	8	1
	Reptiles	8	13	17	5
	Birds	54	116	149	8
	Mammals	16	19	23	2
Habitat map (MENR, 2005)	Flowering plants	74	206	254	20

[a] Unpublished report produced pre-1990.
[b] Includes records for Riverine Nature Reserve.

2.6 Management

The vision for Wasgomuwa National Park outlined in the Management Plan (DWC, 2005) is to conserve the catchment area, with its rich sub-montane/intermediate climax forest that provides unique habitat for bear and other large mammals. The management goals and objectives are reproduced in Box 2.2.

Four conservation themes have been identified, namely:

- biodiversity conservation;
- management of visitor services, nature interpretation and conservation education;
- mitigation of the human-elephant conflict; and
- participation of the community in wildlife management.

Box 2.2 **Management goals and objectives for Wasgomuwa National Park (DWC, 2005)**

Management Goals

- To ensure the conservation of biodiversity, with special emphasis on the flagship species, the bear (*Melursus ursinus*), through a participatory adaptive management process.
- To conserve the population of elephants with the support of the local communities in their habitats, while mitigating the human-elephant conflict.

Management Objectives

- To manage the habitat to support a viable population of bear and other large mammals.
- To conserve and enhance the sub-montane/intermediate climate forest vegetation and its faunal diversity.
- To reduce the natural resource dependencies of the communities adjoining the national park through community outreach measures.
- To mitigate the human-elephant conflict.
- To provide opportunities for conservation-compatible visitor services, nature interpretation and conservation education
- To conserve and protect cultural artefacts and geological formations.

3. METHODS

Full details of the methodology developed for the Biodiversity Baseline Survey are provided in a separate Field Manual (DWC, 2007a). A brief overview is provided below, together with details of anything specific to the survey of Wasgomuwa.

Wasgomuwa was surveyed during the height of the dry season in the months of July and August 2006 over a period of approximately six weeks. Undoubtedly, this limited encounters with many faunal groups of species. The Bird Group returned briefly in October to survey migratory species; and the Plant Group did likewise to coincide with the flowering season for sampling Grassland habitat.

3.1 Survey design and sampling procedures

The Biodiversity Baseline Survey covered terrestrial and aquatic habitats (i.e. rivers, streams, tanks, villus). Terrestrial habitats were identified using the outputs from the Habitat Mapping Project (MENR, 2005), based principally on the vegetation types while taking into account environmental gradients, such as altitude, aspect, geology and soils, for the location and alignment of transects.

Terrestrial habitats were sampled systematically for plants, amphibians, reptiles, birds and mammals using quadrats (100 m x 5 m) aligned at 150 m intervals along transects (1 km length). Four replicate transects were located within each habitat type. Opportunistic observations were also recorded along transects, between quadrats, and elsewhere within the national park.

Freshwater habitats were treated as a single type, which was sampled systematically for fish diversity and opportunistically for other taxonomic groups. The head, mid- and lower reaches of at least four rivers or streams within each sub-basin were sampled for fish and various measures of water quality, while tanks were sampled separately.

The geographic coordinates of all sampling locations (i.e. quadrats and freshwater sites) are provided in Annex 1. Effort expended in sampling quadrats, freshwater and other sites using a variety of techniques is summarised in Annex 2.

Terrestrial habitats

A total of five vegetation types were used as a basis for sampling different terrestrial habitats for species diversity. These habitats are shown in Table 3.1, together with the number of replicate transects and quadrats located within each. Some of the 20 one-kilometre transects occupied more that a single habitat, which is why the total number of transects shown in Table 3.1 exceeds 20. This reflects the mosaic pattern of distribution of the vegetation, with Dry Mixed Evergreen Forest interspersed with Scrub and other vegetation types. The locations of the 80 quadrats are shown in Figure 3.1.

The above habitat types were subsequently reclassified from the results of Principle Coordinates Analysis (PCA) of a Bray-Curtis coefficient of similarity matrix derived from the plant quadrat data. The analysis shows a total of seven clusters of quadrats (Figure 3.2) and the first two principal coordinates account for 25% of the variation. These clusters were verified by referring back to field observations of the vegetation and they are considered to provide a more meaningful and robust basis for further analysis of survey data. Thus, Dry Mixed Evergreen Forest was differentiated into dry, medium and wet habitats; and Vegetation associated with Rock Outcrops was reclassified as Quartzite Vegetation. Quadrats were reassigned according to this revised habitat classification, as summarised in Table 3.2.

Table 3.1 Numbers of quadrats and associated transects sampled within each habitat

Habitat type	No. transects[1]	No. quadrats
Dry-Mixed Evergreen Forest	10	33
Vegetation associated with Rock Outcrops	4	8
Riverine Forest	4	16
Scrub	3	9
Grassland	4	14
Total	**20**	**80**

[1] Number of transects equates to the number of replicates in each habitat. Total number of transects is 20, which is less than the total number of replicates (25) as some replicates cover more than one habitat.

Table 3.2 Revised classification of habitats, based on PCA, with quadrats reassigned accordingly

Habitat type	No. transects[1]	No. quadrats
Dry-Mixed Evergreen Forest - dry	6	10
Dry-Mixed Evergreen Forest - medium	8	15
Dry-Mixed Evergreen Forest - wet	5	12
Quartzite Vegetation	2	5
Riverine Forest	4	14
Scrub	4	10
Grassland	5	14
Total	**20**	**80**

[1] Number of transects equates to the number of replicates in each habitat. Total number of transects is 20, which is less than the total number of replicates (34) as some replicates cover more than one habitat.

Freshwater habitat

A total of 63 sites were sampled for fish and water quality in 16 river sub-basins. Their distribution with respect to the total of 34 river sub-basins is shown in Figure 3.3. The 16 river sub-basins were amalgamated into into six units, namely the eastern and western drainages, the three rivers (i.e. Kalu, Mahaweli and Amban) and the tanks, for analysis purposes and sample sites were assigned accordingly. This amalgamation takes into account the fact that streams flowing from the Sudukanda Range drain either westwards into the Kalu Ganga or eastwards into the Mahaweli Ganga. The Amban Ganga and tanks were treated separately as both systems have some unique fish fauna.

3.2 Biodiversity Information Management System

Field data are held in the Biodiversity Information Management System, a database application designed specifically for the Biodiversity Baseline Survey. The application is described briefly in the Field Manual (DWC, 2007a) and full details about its design and use are documented elsewhere. (DWC, 2007b, 2007c).

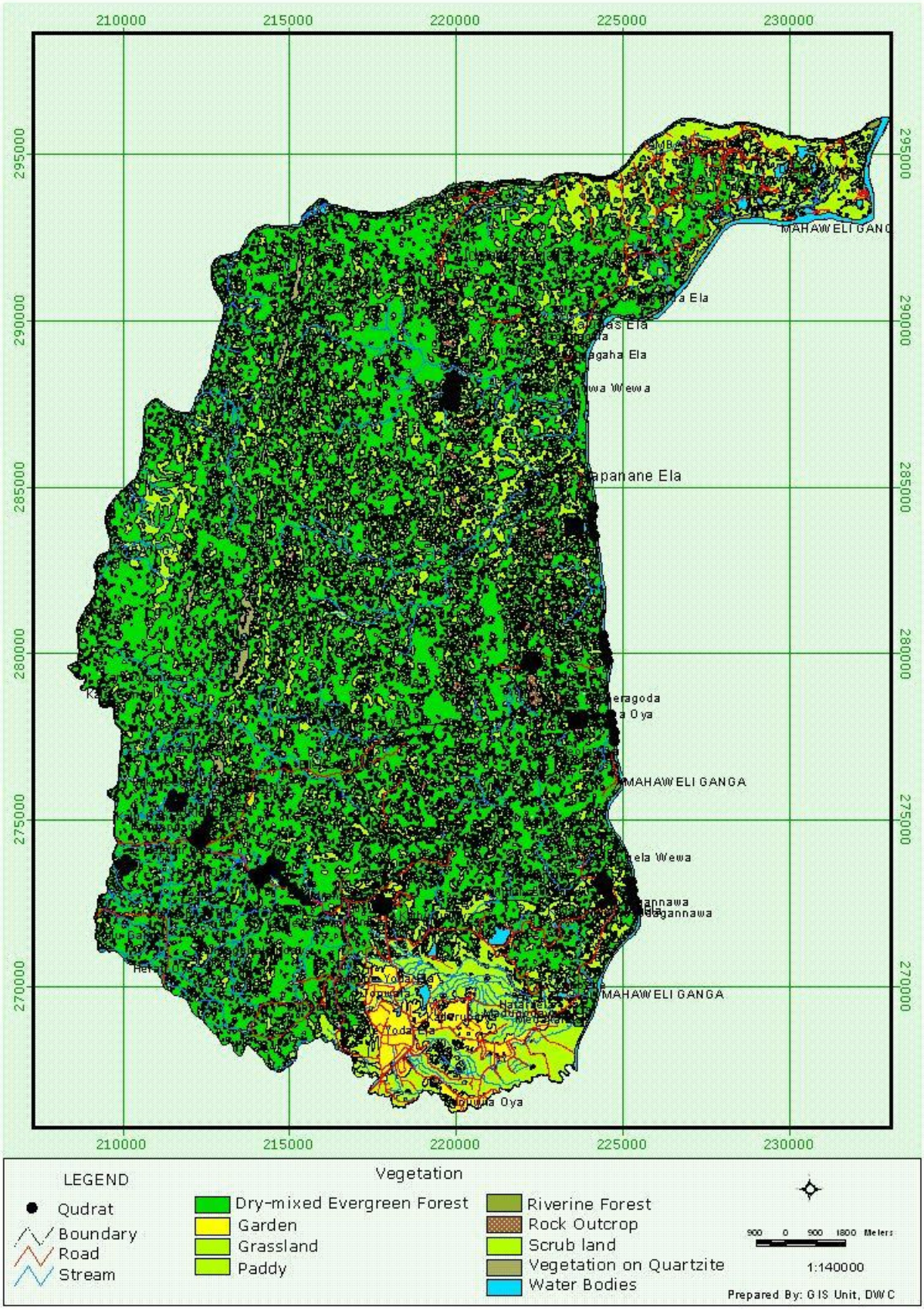


Figure 3.1 Locations of 80 quadrats sampled by Biodiversity Baseline Survey

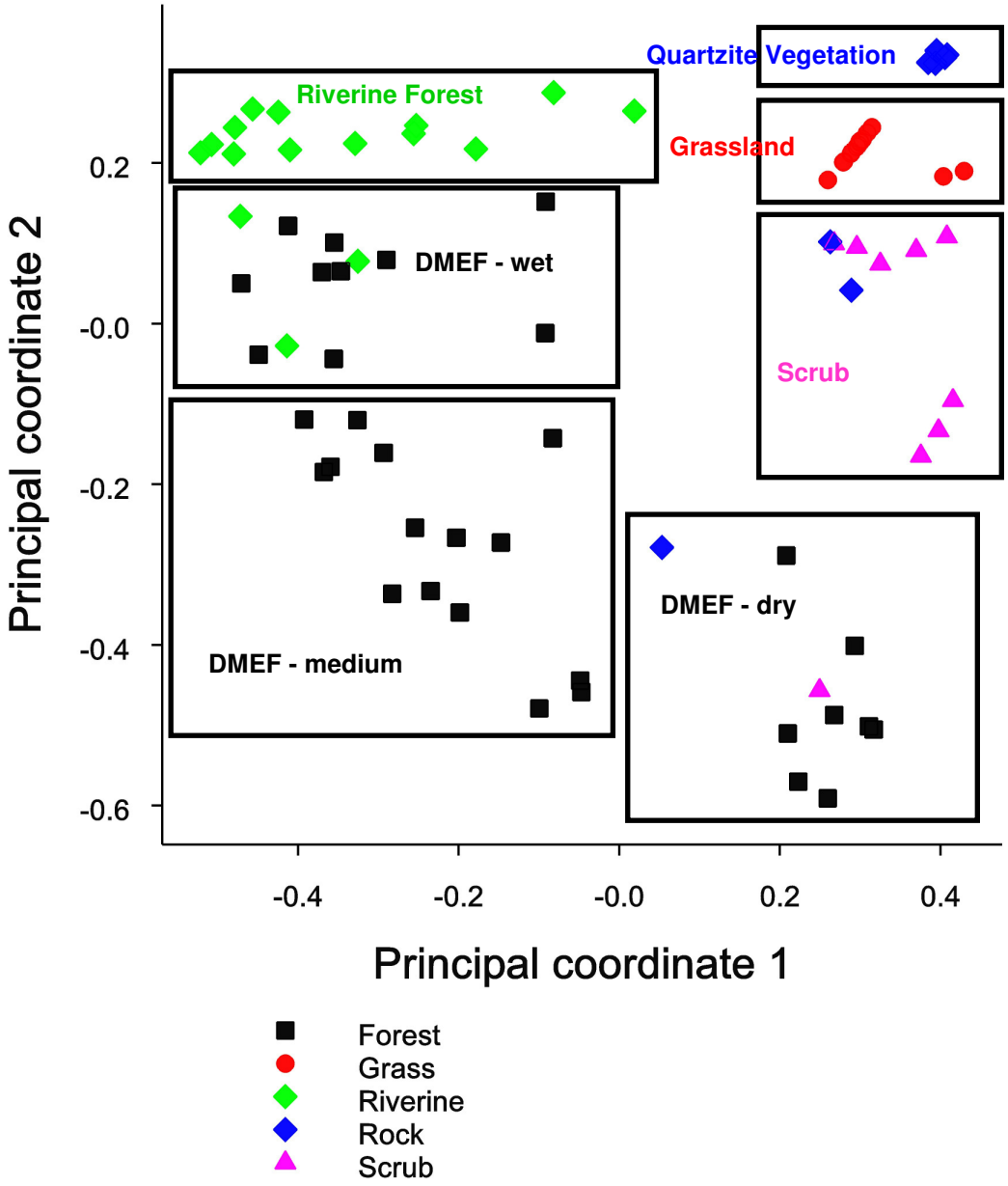


Figure 3.2 Seven clusters of quadrats, similar with respect to their floristics, can be identified from a Principle Coordinates Analysis of plant quadrat data.

3.3 Herbarium and specimen collections

Provisional numbers of herbarium and animal specimens collected during the Biodiversity Baseline Survey are summarised in Table 3.3 for each taxon. Details of voucher specimens are provided in Annex 3. Plant and animals specimens are being lodged with the National Wildlife Training, Giritale and, in the case of plants, a duplicate set will be deposited with the National Botanic Gardens, Peradeniya.

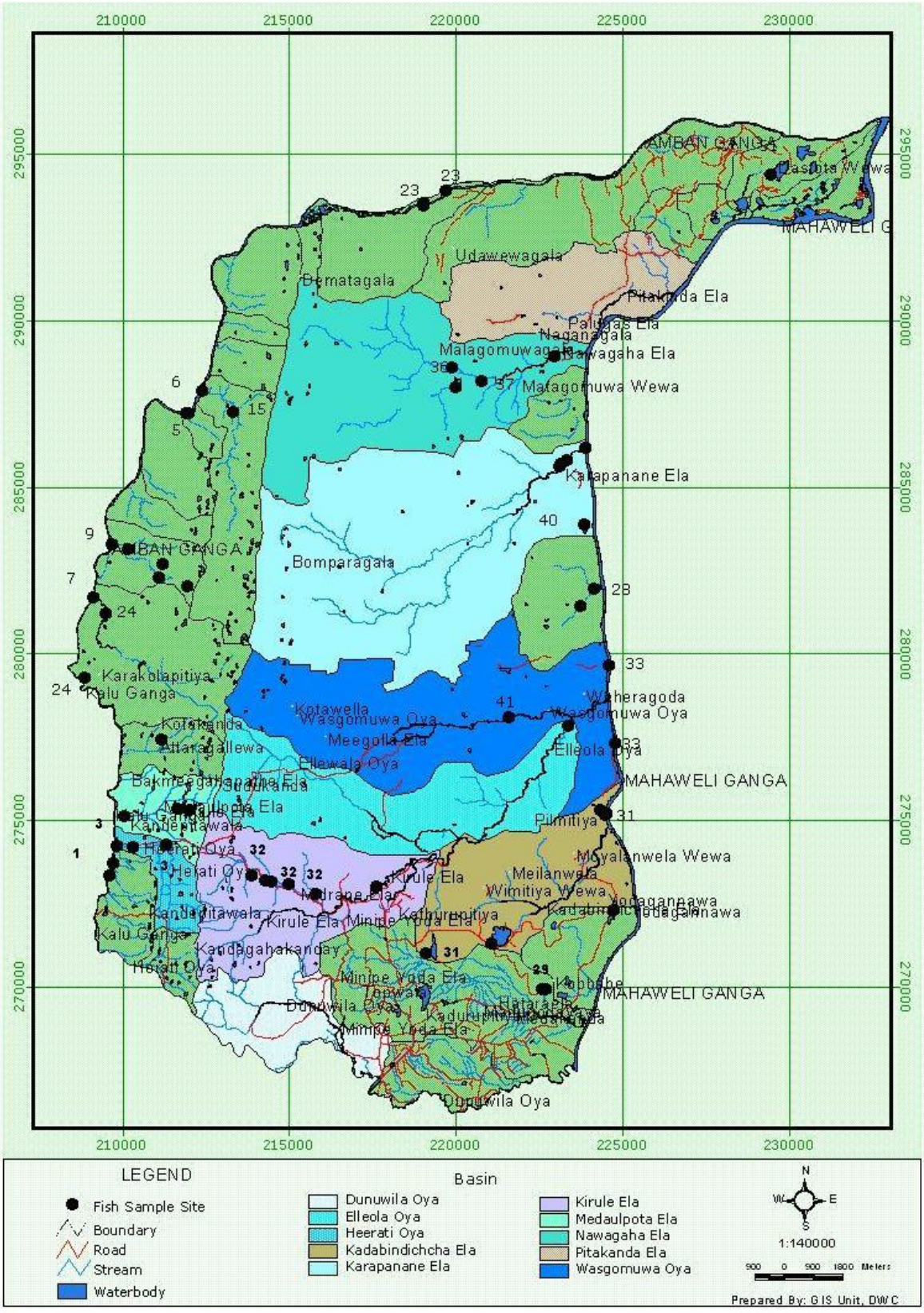


Figure 3.3 Location of 63 freshwater sites sampled by Biodiversity Baseline Survey

Table 3.3 Provisional numbers of voucher specimens collected and identified for each taxon

Taxon	Voucher specimens		
	Total collected	No. identified	No. unidentified
Plants	22	15	7
Fish	40	40	0
Herpetofauna	0	0	0
Birds[1]	37	37	37
Mammals	10	8	2

[1]Feather samples only, for potential future DNA analysis.

3.4 Data and analyses

Sample sizes and records

Field data comprise quantitative and opportunistic records. The sizes of datasets are summarised in Tables 3.4 and 3.5 for each taxonomic group. In Table 3.4 the number of records refers to records of species within quadrats; the number of individuals is the total number of individuals recorded for each species. In the case of birds, only those recorded within Bands 1 or 2 of Variable Circular Plots are treated quantitatively; those recorded in Band 3 (i.e. >20 m from the observer) are treated as opportunistic.

Opportunistic records contribute considerably to species inventories in the case of plants, birds and mammals. In the case of mammals, such records are based largely on indirect observations of tracks and scats or pellets.

Table 3.4 Breakdown of quantitative and opportunistic records of plants and animals

Taxon	Total no. records	Total no. individuals	No. species identified	No. species unidentified
Quantitative records from within quadrats/sampling points				
Plants	1478	3428	134	17
Fish	327	5830	40	0
Amphibians	15	15	5	1
Reptiles	83	83	17	3
Birds	1231	1231	78	0
Mammals	153	179	26	0
Additional opportunistic records from outside quadrats/sampling points				
Plants	unavailable	unavailable	154	unavailable
Fish	0	0	0	0
Amphibians	2	2	2	0
Reptiles	43	43	11	3
Birds	3364	3364	148	0
Mammals	167	582	26	3

Table 3.5 Breakdown of quantitative and all records of species of plants and animals

Taxon	No. families	No. genera	No. species			
			Total	Endemic	Indigenous	Exotic
Quantitative records from within quadrats/sampling points						
Plants	43	106	138	unavailable		
Fish	15	27	40	8	26	6
Amphibians	1	5	5	3	3	0
Reptiles	8	14	20	unavailable	?	0
Birds	27	57	78	8		
Mammals	16	23	26	3	21	2
All records (including opportunistic)						
Plants			278	20	241	17
Fish	15	27	40	8	26	6
Amphibians	1	4	6	3	3	0
Reptiles	9	16	25	7	18	0
Birds	47	111	148	8	unavailable	unavailable
Mammals	21	31	40	4	36	2

Adequacy of sample sizes

Species discovery curves are shown in Figure 3.4 for each taxon, based on the cumulative number of species recorded over the survey period in the entire National Park. In the case of plants and fish, curves have been generated only for quadrat and sample record data, respectively[2]. In the case of vertebrate taxa, curves are shown for quadrat data and for combined quadrat and opportunistic data. These curves shown signs of reaching a plateau in the case of plants, fish and birds but are in the ascent for herpetofauna and mammals. More field work is required for all taxa in order to gain a more complete picture of species diversity.

Analyses

Analyses were undertaken principally at the protected area and habitat or sub-basin levels. While the former provides an overview of the biodiversity values of the protected area, the latter is likely to be more useful for informing management about diversity within different habitats and sub-basins. A summary matrix of species diversity within each habitat or sub-basin is provided in Annex 4.

[2] There are no opportunistic records for fish and recording dates are not readily available for plant opportunistic data.

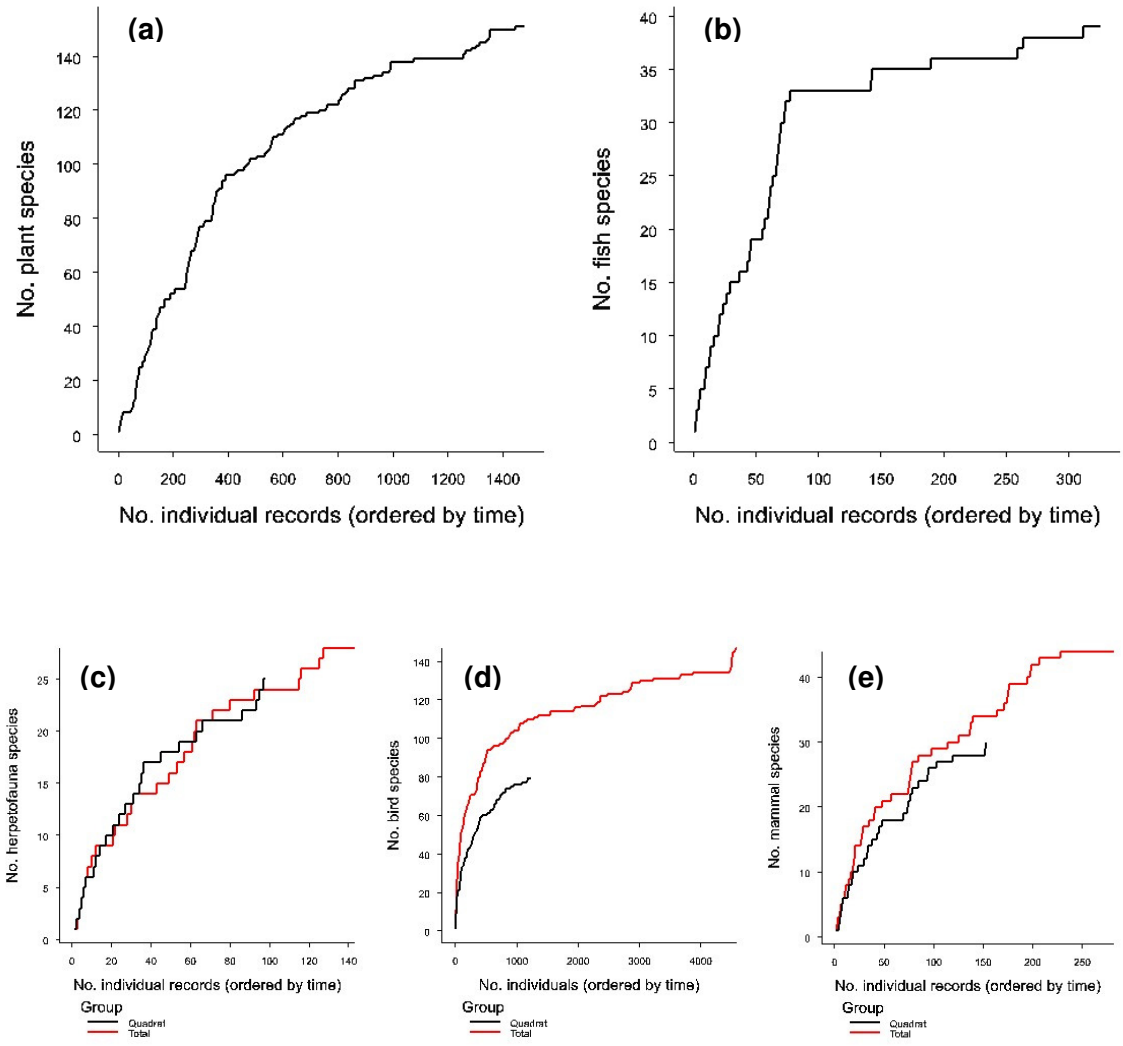


Figure 3.4 Species discovery curves for **(a)** plants and **(b)** fish based on quadrats and sample records, respectively; and for **(c)** herpetofauna, **(d)** birds and **(e)** mammals based on quadrats and combined quadrat and opportunistic records

4. PLANT DIVERSITY ANALYSIS

4.1 Introduction

The vegetation of Wasgomuwa, broadly classified as Dry-Mixed Evergreen Forest or Monsoon Forest, is described in Section 2.4. The national park straddles the Intermediate Zone to the south and Dry Zone to the north. Few endemic species have been recorded from the national park and only one species, *Vatica obscura* (Dipterocarpaceae), confined to the Riverine Forest along Mahaweli Ganga, is globally threatened.

A total area of 4 ha was sampled within the different habitats, details of which are summarised in Annex 2. A list of voucher specimens is provided in Annex 3.

4.2 Diversity within habitats

A total of 151 species of vascular plants were recorded from Wasgomuwa National Park during this Survey, details of which are provided in Annex 4 for each habitat.

Species richness and other measures of species diversity are highest for the wet facies of Dry-Mixed Evergreen Forest. To a lesser extent, Riverine Forest along the Mahaweli Ganga is also rich in species. Such forest habitats, close to perennial water sources, form tall Dry-Mixed Evergreen Forest with a species composition and physiognomy that differs from that of dry sites close to rock outcrops or ridge tops. Species richness and most other measures of the diversity are lowest for Quartzite Vegetation along the Sudukanda Range and Grasslands (Table 4.1).

Table 4.1 Plant diversity indices for habitats, based on quadrat sampling

Habitat type (revised after PCA)	DMEF			QV	RF	Scrub	Grass-land
	Dry	Medium	Wet				
Total number of species	49	60	63	12	49	40	30
Number of endemic species							
Diversity indices							
Species richness	49	60	63	12	49	40	30
Shannon-Weinner diversity H	2.73	2.78	2.94	0.823	2.65	2.85	2.82
Shannon-Weinner evenness J	0.70	0.68	0.71	0.331	0.68	0.77	0.83
Simpson diversity 1/D	6.83	7.30	7.86	1.461	7.36	10.96	10.86
Alpha of log series	10.68	11.92	14.79	2.749	10.06	10.30	8.53

KEY: DMEF = Dry-Mixed Evergreen Forest, QV Quartzite Vegetation, RF = Riverine Forest

4.3 Discussion

Significant findings

Most of the national park lies in the Dry Zone and the typical vegetation formation is the Dry-Mixed Evergreen Forest. However, a mosaic of habitat types has developed as a result of natural disturbances or anthropogenic activities. Undisturbed and partly degraded Dry-Mixed Evergreen Forest in different stages of succession occurs in the same area, indicative of small- scale disturbances to these habitats such as chena cultivation and fires. Importantly, species richness and other measures of diversity are highest for the climax vegetation, Dry-Mixed Evergreen Forest.

Grasslands are subjected to periodic fires in the dry months, following the October-January rains. Such fires may be initiated by villagers along the park boundary and also by poachers. Fires prevent the establishment of many tree seedlings, while encouraging the growth of some fire resistant woody species, such as *Bauhinia racemosa, Cassia fistula, Gmelina asiatica, Carissa spinarum* and *Randia dumetorum*,. and many grasses and herbs.

Adequacy and shortcomings of survey data

Information from other surveys indicates that the Biodiversity Baseline Survey is not comprehensive for plants. For example, a similar number (151) species of plants was recorded by the National Conservation Review (Green and Gunawardena, 1997), based on 49 quadrats as compared with 80 quadrats sampled for this Survey. It is known from the Habitat Map Project (MENR, 2005), which recorded 254 species, that species richness is much higher. The difference between the National Conservation Review and this Survey can be attributed to sampling design objectives: whereas the former used line transects, several kilometres in length, that were orientated along environmental gradients (e.g. altitude) to maximise the accumulation of species records at the park level, this Survey used four 1-km length replicates to maximise adequacy of sampling at the habitat level.

5. HERPETOFAUNA DIVERSITY ANALYSIS

5.1 Introduction

A total of 210 plots (5 x 5 m^2) were sampled daytime, using the Quadrat Cleaning Technique, and additional plots (2.5 x 10 m^2) were surveyed at night, using the Visual Encounter Technique, providing 143 records of amphibians and reptiles. Of the 210 plots searched, no herpetofauna were found in 137 (65%) of them. The distribution of sampling effort in each habitat is shown in Annex 2.

No voucher specimens were collected.

5.2 Diversity within habitats

A total of six species of amphibians and 25 species of reptiles were recorded during the Survey, details of which are provided in Annex 4. Only species that were positively identified without doubt are included in this list. Some of the rare species recorded are based on opportunistic encounters. The following points are noteworthy:

- Of the six species of amphibians, three are endemic and threatened. Of the 25 species of reptiles, eight are endemic and five of them are threatened (Annex 4).
- The dwarf day gecko (*Cnemaspis podihuna*), which is highly threatened and confined to the Dry Zone, was frequently encountered, especially on tree trunks with peeling bark. In addition to this day gecko, three species of nocturnal geckos were recorded, including *Hemidactylus. frenatus*.
- Haly's tree skink (*Dasia halianus*), which is threatened and the only species of tree skink found in Sri Lanka, was recorded.
- The relict genus *Nessia*, represented by *N. sarasinorum* (Sarasin's snake skink), is a rare, endemic species that inhabits soft substrate under rotting logs. *Lankaskincus fallax*, an endemic genus and threatened species, is common in Wasgamuwa.
- Agamid lizards are common in the forests of Wasgamuwa. For instance, *Otocryptis nigristigma* (black patched kangaroo lizard) and *Calotes ceylonensis* (painted lip lizard) were found sympatric in Riverine Forest, Dry-Mixed Evergreen Forest and even in mature Scrub.
- Only seven species of snakes were recorded. Surprisingly, common species previously recorded in the national park, such as rat snake, cobra, Russel's pit viper and python, were not recorded during the Survey. *Trimeresurus trigonocephalus* (green pit viper), an endemic and threatened species, was recorded in Riverine Forest.

Table 5.1 Herpetofauna diversity indices for habitats, based on plot sampling

Habitat type (revised after PCA)	DMEF			QV	RF	Scrub	Grass-land
	Dry	Medium	Wet				
AMPHIBIANS							
Total number of species	0	3	4	0	2	0	0
Number of endemic species							
REPTILES							
Total number of species	3	7	9	2	10	6	1
Number of endemic species							
Diversity indices							
Species richness	3	7	9	2	10	6	1
Shannon-Weinner diversity H	0.87	1.67	1.86		2.09	1.68	-
Shannon-Weinner evenness J	0.79	0.86	0.85		0.91	0.94	-
Simpson diversity 1/D	2.50	5.28	6.36		9.13	9.00	-
Alpha of log series	2.00	3.13	3.57		5.00	4.81	-

5.3 Discussion

Significant findings

- Although the Dry Zone, within which Wasgomuwa partly lies, is not particularly rich in endemic species, this Survey indicates higher levels of endemism among herpetofauna that previously recorded (see Table 2.1).
- As shown in Table 5.1, highest numbers of species and abundance of individuals was recorded in Riverine Forest and Dry-Mixed Evergreen Forest during the dry season of the Survey, with most records reflecting damper microhabitats. Very few individuals were recorded in Grasslands and other dry habitats, a scenario which could change markedly during the rainy season. Typically, herpetofauna are known to be less abundant while dry conditions prevail as they become more cryptic and their population sizes drop.

Adequacy and shortcomings of survey data

- Sampling was limited to the dry season and, as evident from Figure 3.4c, it was inadequate. This means that comparisons of species diversity between habitats need to be treated cautiously in view of the small sample sizes, particularly in the case of amphibians with only 15 records (Table 3.4).
- The limitations of the Survey are further evident by comparison with the results of the GEF Project which recorded a total of eight amphibian and 17 reptile species (Table 2.1). Examination of the inventory (DWC, 1998) shows that only a handful of recorded species are common to both surveys.

6. BIRD DIVERSITY ANALYSIS

6.1 Introduction

Four main sampling methods were used to record bird diversity in Wasgomuwa National Park: variable circular plots (VCPs), mist netting, water hole counts and opportunistic encounters. A total of 320 VCPs were sampled, providing 4,278 records. A total of 214 hours of mist netting (1,400 net metre hours) was carried out during the wet season resulting in 39 captures. Six water bodies were sampled yielding 192 observations. In addition 125 observations were made opportunistically. The distribution of sampling effort across habitats is summarised in Annex 2.

It was not necessary to collect any voucher specimens as all birds observed were identified with certainty. However, feather samples were collected from birds captured in mist nets in order to carry out DNA analysis at a future date. Details of the DNA samples collected are provided in Annex 3.

6.2 Diversity within habitats

A total of 148 bird species were recorded during the Survey, including seven endemic and three globally threatened species. Of this total, only 78 species were recorded in the first two bands of VCPs and, therefore, subjected to further analysis. The balance of 70 bird species was treated as opportunistic observations. A list of species recorded within each habitat is provided in Annex 4.

Table 6.1 Bird diversity indices for habitats, based on species recorded within 1st and 2nd bands of VCPs quadrat sampling

Habitat type (revised after PCA)	**Total**	DMEF			QV	RF	Scrub	Grass-land
		Dry	Medium	Moist				
Total number of species	**78**	31	36	46	15	41	38	48
Number of endemic species	**8**	1	2	4	1	3	2	-
Diversity indices								
Species richness	**78**	31	36	46	15	41	38	48
Shannon-Weinner diversity H	**3.53**	2.78	3.03	3.37	2.62	3.4	3.19	3.19
Shannon-Weinner evenness J	**0.81**	0.81	0.84	0.88	0.97	0.91	0.88	0.82
Simpson diversity 1/D	**22.86**	11.53	14.87	23.91	30	27.62	19.66	16.59
Alpha of log series	**15.13**	7.74	9.85	12.37	16.95	13.23	14.2	13.04

KEY: DMEF = Dry Mixed Evergreen Forest, QV Quartzite Vegetation, RF = Riverine Forest

Wasgomowa supports a species-rich avifauna. Of Sri Lanka's 220 breeding resident species, 63% were recorded in the national park by this Survey. Similarly, 31% of the country's endemic avifauna (26 species[3]) was recorded in the national park. Compared to protected areas in the Wet Zone, however, the level of endemism (5% of 148 species) is relatively low. Only about 8% of Sri Lanka's 112 migrant species were recorded during this Survey but this number would be much higher if sampling was fully extended to the migratory season.

Levels of diversity and endemism within the different habitats are summarised in Table 6.1, accompanied by various measures of diversity. Highest species richness was recorded in Grassland, followed by moist Dry-Mixed Evergreen Forest and Riverine Forest. Lowest species richness was recorded in Quartzite Vegetation but the assemblage of species in this habitat was uniquely different from the other habitats. However, this result needs to be treated with caution as only five quadrats were sampled in this habitat type.

[3] Whereas the total number of endemic bird species was considered to be 25, a recent revision of Asian babblers indicates that the Scimitar Babbler (Pomatorhinus horsfieldii) is an endemic species (Coller, 2006).

6.3 Discussion

Significant findings

Some key points arising from this survey include:

- The endemic bird species *Phaenicophaeus pyrrhocephalus* (Red faced malkoha) was recorded in abundance in the Riverine Forest, indicating a substantial population resides in the national park. The species is restricted to riverine habitat and, since this is likely to be an isolated sub-population from the main population in the Wet Zone, it would be instructive to evaluate any genetic differences that may be present in this sub-population.
- The avifaunal assemblage present in Quartzite Vegetation appears to be unique but further sampling is required to substantiate this preliminary finding.
- The Grassland species assemblage is also unique, with a few species restricted to this habitat. Grassland is an important habitat, covering 5% of the national park (Box 2.1),and further study of its associated species is warranted.
- Water bodies are home to a number of threatened and near threatened avifaunal species.

Other relevant information

Comparison of species recorded by this Survey with records from the 1998 Management Plan for Wasgomuwa National Park (DWC, 1998) indicates that during this survey 30 new species were recorded including 2 endemic species while 21 species listed in the 1998 list were not recorded during this survey. Most of these birds that were not recorded during this survey are either aquatic or migrant species. Since the survey period was mostly confined to the dry season where migrant bird species were not present and the most of the small water bodies have completely dried up this result is an inevitable one.

Adequacy and shortcomings of survey data

This dataset provides a reliable, georeferenced baseline for Wasgomuwa National Park which can be used to inform park management. However, the data should be used judiciously, taking full account of the following limitations:

- A major shortcoming of this Survey is the sampling inadequacy in spatial and temporal dimensions. Most sampling was restricted to the dry season when seasonal water bodies have completely dried up.
- Sampling coincided with part of the non-migrant season for birds. Few migrant species were recorded and all records were treated as opportunistic observations. Thus, habitat distribution patterns could not be elucidated.
- There are some significant gaps in areas sampled, such as the Sudukanda Range which may hold a unique assemblage of bird species.

7. MAMMAL DIVERSITY ANALYSIS

7.1 Introduction

This Biodiversity Baseline Survey is the first extensive survey undertaken in Wasgomuwa National Park that has used live trapping and mist-netting techniques to record the diversity of the nocturnal rodents, shrews and bats.

Additionally the presence of the animals in a particular area was inferred from fresh droppings, foot prints and other signs. A total of 40 quadrats were sampled quantatively for small mammals, using traps, and the length of each transect (20 km in total) was surveyed for signs of all mammals, based on direct and indirect observations (e.g. tracks and fresh droppings). Opportunistic encounters with mammals elsewhere in the national park were recorded. Vehicle-based night rides proved particularly useful for encountering carnivores. Mist nets to capture bats were laid at appropriate locations within quadrats and at other locations, such as dry stream beds, along roads and other potential fly routes

The distribution of sampling effort across the different habitats is shown for non-volant mammals and bats in Annex 2. Ten voucher specimens were collected from Wasgomuwa, of which one is still to be identified. Provisional details of these specimens are provided in Annex 3.

7.2 Diversity within habitats

Twenty six species of mammals were recorded within quadrats and an additional 14 species were recorded opportunistically during the survey period (see Table 3.5). A list of species recorded within each habitat is provided in Annex 4. Key points are as follows:

- Wasgomuwa supports a rich indigenous mammalian fauna. This is reflected in the presence of seven species of bats, seven rodents (three species of squirrels, one porcupine and three rats), three wild cats including leopard, sloth bear, three civets, three mongoose species, otter, jackal, eight ungulate species, one shrew, three monkeys, elephant and hare. Also presesent are two introduced species (*Bubalus bubalis* and *Bos indicus*).
- Four endemic species were recorded: *Macaca sinica*, *Trachypithecus vetulus*, *Paradoxurus zeylonensis* and *Moschiola meminna.*
- Ten species are nationally threatened and nine are threatened at the global level
- The most commonly recorded species were *Axis axis, Bubalus arnee* and *B. bubalis*, *Lepus nigricollis* and *Rattus rattus.* Although sightings of sloth bear were rare, the species appears to be relatively abundant as indicated by frequent encounters with fresh droppings along roads and dry stream beds in forested and rocky habitats.
- The large number of young observed in most elephant herds is indicative of a healthy population.
- Small carnivores were less commonly recorded species, namely *Paradoxurus zeylonensis*, *Prionailurus rubiginosus* and *P. viverrinus.* However, fresh leopard scat was frequently encountered in forest, rocky areas and along roads.
- Of the seven species of bats recorded, the fruit bat *Cynopterus sphinx* was most common and frequently captured in mist nets.

Levels of diversity and endemism, together with measures of diversity, within the different habitats are summarised in Table 7.1 for all species of mammals and in Table 7.2 for mammal species other than bats, for which data were to few to analyse separately. The results, which are based on relatively small samples, indicate the following:

- The various habitat types support different assemblages of species.

- Scrub is the least rich habitat for species diversity.
- With the exception of the scrubland, the other five habitat types supported relatively rich mammal communities of between eight to eleven species.
- The disparity between the habitats lessens, however, when the bat species are excluded with all habitats seeming to be favourable for selected species of non-volant mammals.
- The forests appeared to be more conducive for the squirrels and monkeys but was also frequently inhabited by the sloth bear, while grassland often comprised elephants and ungulates such as the spotted deer, buffaloes and the blacked napped hare.
- Most species utilized a combination of habitat types. Among the bats, *Cynopterus sphinx*, the most abundant species, was equally distributed in all habitats except in moist forests.

Table 7.1 Mammal diversity indices (all species) for habitats, based on quadrat sampling

Habitat type (revised after PCA)	DMEF			QV	RF	Scrub	Grass-land
	Dry	Medium	Wet				
Total number of species	8	11	8	9	10	6	10
Number of endemic species	1	2	2	0	0	0	0
Diversity indices							
Species richness	8	11	8	9	10	6	10
Shannon-Weinner diversity H	1.95	1.87	1.90	2.15	2.00	1.85	1.88
Shannon-Weinner evenness J	0.94	0.78	0.91	0.98	0.83	0.95	0.85
Simpson diversity 1/D	9.00	4.68	7.70	27.50	6.77	11.00	6.53
Alpha of log series	3.57	4.32	2.61	19.82	4.95	5.38	3.28

KEY: DMEF = Dry Mixed Evergreen Forest, QV Quartzite Vegetation, RF = Riverine Forest

Table 7.2 Mammal diversity indices (except bats) for habitats, based on quadrat sampling

Habitat type (revised after PCA)	DMEF			QV	RF	Scrub	Grass-land
	Dry	Medium	Wet				
Total number of species	8	9	8	8	9	6	7
Number of endemic species	1	2	2	0	0	0	0
Diversity indices							
Species richness	8	9	8	8	9	6	7
Shannon-Weinner diversity H	1.95	1.98	1.90	2.04	1.80	1.85	1.60
Shannon-Weinner evenness J	0.94	0.90	0.91	0.98	0.82	0.95	0.82
Simpson diversity 1/D	9.00	8.57	7.70	36.00	5.39	11.00	4.81
Alpha of log series	3.57	5.08	2.61	30.87	4.47	5.38	2.59

KEY: DMEF = Dry Mixed Evergreen Forest, QV Quartzite Vegetation, RF = Riverine Forest

7.3 Discussion

Significant findings

- Wasgomuwa is an important national park for the conservation of the country's mammalian fauna, with its rich diversity of species and, based on frequent encounters with animals or their spoor, relatively large populations of its two flagship species, the elephant and sloth bear.
- Three rats were recorded in Wasgomuwa for the first time. Of the small mammals, the common house rat (*Rattus rattus kandianus*) was most frequently recorded.. Although an indigenous species, this particular subspecies is known to be increasing in number at least in Wet Zone forests. Hence, its population dynamics merits investigation to assess potential impacts on other rodent species. Some *R. rattus* individuals exhibited variations in colour.

- The national park is also rich in species of bats. All such species were recorded for the first time, as Wasgomuwa has not been previously surveyed. Two recorded species (*Murinna* sp. and *Pipistrellus affinis*) are nationally threatened.
- Several species previously recorded in the national park were not encountered during this Survey. Such species include the pangolin and flame-backed squirrel (*Funambulus layardi*). The absence of records of the former is particularly surprising because 43 individuals were recorded during the NCR (Green and Gunawardena, 1997) and it is rated as common by DWC (1998).

Adequacy and shortcomings of survey data

- Small mammals undergo characteristic population fluctuations, with population densities lowest during the driest time of year. Many larger mammals, during the dry season, tend to aggregate in areas where water is available. Further survey during the wet season is required to capture seasonal variations in diversity and abundance of mamma species.
- Mist netting could not be carried out at certain locations (e.g. Mukkarukanda) that were not approachable after dark due to potential encounters with elephants.
- Certain equipment, such as tomahawk traps and camera traps, were not available at the onset of the Survey because it had to be obtained from overseas.

8. FRESHWATER FISH DIVERSITY ANALYSIS

8.1 Introduction

Wasgomuwa National Park has a rich variety of aquatic habitats, comprising three main peripheral rivers (Mahaweli, Kalu and Amban), streams and tanks (wewas). The Mahaweli is fed by seven main streams and numerous other smaller small streams that drain eastwards from the Sudukanda Range while the Kalu Ganga is fed by about 20 small streams that drain westwards from this Range. Three streams drain northwards into the Amban Ganga, which is also part of the catchment area of the greater Mahaweli. There are 10 tanks within the park, some predating the park's establishment and others built subsequently. During dry seasons the majority of streams and tanks dry up completely.

Of the 63 sites sampled, 19 did not have fish present. Of those with fish, four were in the Amban Ganga, three in the Kalu Ganga, five in the Mahaweli Ganga, six in tanks, 19 in streams draining into the Mahaweli and seven in streams draining into the Kalu Ganga. Eight streams draining into the each of the Mahaweli and Kalu rivers were sampled.

Sampling effort in relation to drainage units is summarised in Annex 2. Details of voucher specimens are provided in Annex 3.

8.2 Diversity within sub-basins

A total of 40 species of fish, belonging to 15 families and 26 genera, were recorded from Wasgomuwa National Park during this Survey, details of which are provided in Annex 4 for each amalgamation of sub-basins (i.e. drainage units). The following points are noteworthy:

- The most abundant family is Cyprinidae and the most common genus is *Puntius*, within the same family Cyprinidae.
- Of the 8 endemic species found in the park, *Puntius martenstyni* is of particular conservation interest because it has been recorded only from the Kalu and Amban river systems and is nationally highly threatened and globally endangered. Of the other seven endemic fish species, namely, *Belontia signata, Clarias brachysoma, Esomus thermoicos, Garra ceylonensis, Puntius sarana, Puntius singhala* and *Puntius srilankensis,* all except *Puntius sarana* and *Puntius singhala* are nationally threatened.
- Exotic species have been recorded only in tanks and the Mahaweli Ganga, whereas indigenous species are distributed throughout the rivers, streams and other water bodies in the national park (Annex 4). It is also of ecological interest that *Rasbora caverii, R. daniconius* and *Devario malabaricus*, all exotic species, occurred together in most sites surveyed.

Drainage units

Levels of diversity and endemism of fish within the different drainage units are summarised in Table 8.1 and various measures of diversity are provided. Species richness is highest in the Amban Ganga (20 species) and lowest in the Mahaweli Ganga (17). Levels of endemism are moderate, compared to the national average of 54% (Bambaradeniya, 2006). Endemism is higher in the western and northern drainages (6 endemics) than in the eastern drainages, including the Mahaweli (3 endemics) and tanks (1 endemic). The low incidence of endemics in tanks is likely to be attributed to the presence of exotic species, which were not recorded in rivers or streams.

Species richness does not vary markedly (17-20) across the major drainages sampled and, similarly, variation in the diversity values, both H and Alpha, are relatively slight. Tanks, although not having either high richness or diversity of fish, are important for waterbirds as many species depend on the fish inhabiting the tanks as one of their main food items.

Table 8.1 Freshwater fish diversity indices for sub-basins, based on sampling protocol

Drainage unit	Mahaweli Ganga	Kalu Ganga	Amban Ganga	Western drainage	Eastern drainage	Tanks (Wewa)
Number of sampling locations	5	3	5	17	23	10
Total number of species	17	19	20	18	19	19
Number of endemic species	3	6	6	6	4	1
Diversity indices						
Species richness	17	19	20	18	19	19
Shannon-Weinner diversity H	2.44	1.91	2.38	2.13	2.09	2.21
Shannon-Weinner evenness J	0.88	0.65	0.79	0.74	0.71	0.75
Simpson diversity 1/D	10.17	4.36	8.71	6.27	5.96	6.47
Alpha of log series	3.77	3.97	3.94	2.74	2.66	3.47

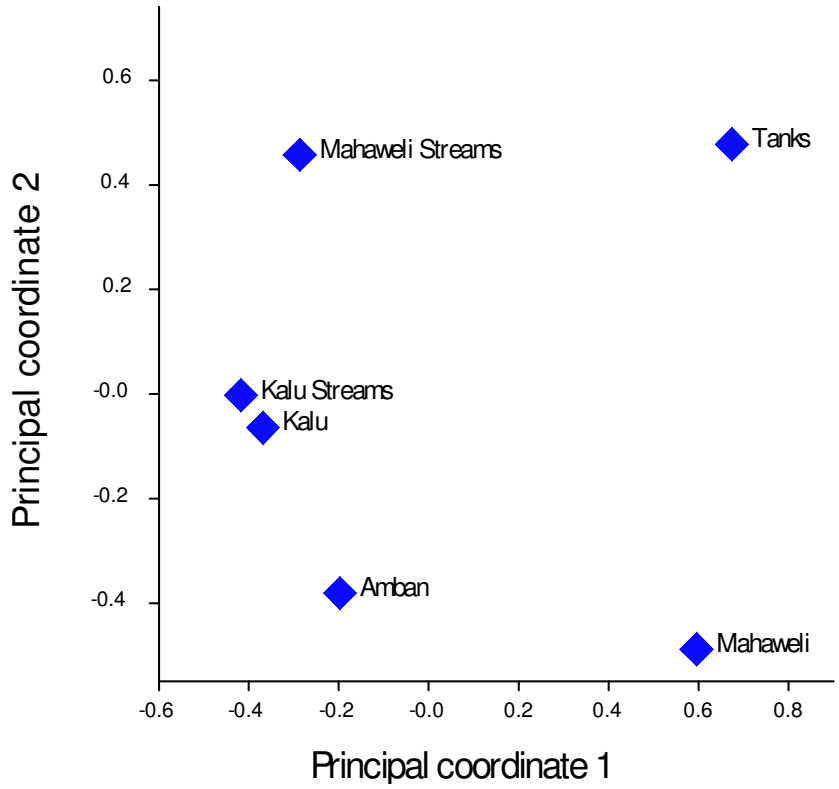


Figure 8.1 Plot of the first two principal coordinates that explain 59% of the variation for fish assemblages sampled in the Kalu Ganga, Amban Ganga and Mahaweli Ganga drainage basins

An evaluation of fish faunal assemblages shows major variations between most of the principal drainages (Figure 8.1). The fish assemblages in the Mahaweli Ganga and tanks (wewas) differ from those in the other drainages on principal coordinate 1. On principal coordinate 2 there are differences between the assemblages in the tanks and Mahaweli Ganga and also between the eastern (Mahaweli streams) and western (Kalu streams) sub-drainages. Figure 8.1 indicates that fish assemblages in streams draining to the west (Kalu streams) are similar to those in the Kalu Ganga, while those draining to the east (Mahaweli streams) are very different to assemblages in the Mahaweli Ganga and also differ from the assemblages in westward draining streams.

Water quality

Mean values of various measures of water quality are provided in Table 8.2. In general, water quality in those drainage units covered by this Survey falls within accepted levels for aquatic life (CEA, 2003). Further sampling of the Mahaweli Ganga (for which equipment was not available at the onset of the Survey) and analysis is required to examine potential relationships between these measures and fish diversity.

Table 8.2 Physical and chemical measures of water quality within drainage units (Values are means ±1SD.)

Water quality measure	**pH**	**Conductivity**	**Turbidity**	**Total Dissolved Solids**	**Dissolved Oxygen**	**Temperature**	**Depth**	**Fish species**
Drainage unit		**mhos /cm**	**NTU**	**ppt**	**ppm**	**^{o}C**	**cm**	**No.**
Mahaweli Ganga	*	*	*	*	*	*	92.5 ±33.12	17
Kalu Ganga	8.03 ±0.01	0.15 ±0.04	23.50 ±12.02					19
Amban Ganga	7.63 ±1.23	0.25 ±0.01	16.50 ±12.23	0.16 ±0.01	5.96 ±0.84	27.20 ±1.00	43.66 ±27.59	20
Western drainage	6.49 ±0.1	0.54 ±0.05	11.44 ±21.04	0.56 ±0.1	4.28 -	24.60 ± 0.63	90.60 ±117.51	19
Eastern drainage	8.01 ±0.27	0.27 ±0.36	8.67 ±8.62	0.49 ±0.48	5.43 ±0.88	24.80 ±0.15	52.29 ±17.64	19
Tanks (Wewa)	7.88 -	0.25 -	54 -	0.16 -	4.45 -	27.30 -	89.62 ±25.48	18

*Equipment unavailable for sampling

8.3 Discussion

Significant findings

These can been summarised as follows:

- Wasgomuwa National Park contains a very important assemblage of freshwater fish that amounts to 34 of Sri Lanka's 82 indigenous species. (The total number of species recorded in this Survey is 40, of which six are exotic species.)
- A total of eight species recorded in this Survey are endemic, which is 18% of the total (44) number of endemic freshwater fish species in the country. The level of endemism recorded in the park (24% of 34 indigenous species) is lower that the national level of 54%.
- A total of five species (*Belontia signata, Clarias brachysoma, Esomus thermoicos, Garra ceylonensis, Puntius srilankensis).*are nationally threatened and a sixth (*Puntius martenstyni*) is highly nationally threatened and globally endangered.
- *Puntius martenstyni*, recorded in the Kalu Ganga and Amban Ganga by this Survey, has previously been recorded only in their tributaries at elevations of 150-500 m (Pethiyagoda, 1991). The presence of this globally endangered species in these two main rivers that border the national park has important conservation implications.
- The fish assemblages show marked differences between the Kalu and Amban Gangas on the one hand and the Mahaweli Ganga and tanks on the other. The fish faunas in the streams of the eastern (Mahaweli) and western (Kalu) drainages also are noticeably different on the current survey results.

- Anthropogenic activities such as gem and sand mining, blast fishing, fish poisoning in the main rivers and felling of trees along their banks, along with solid waste pollution at camping sites within the national park were documented. These activities pose threats to freshwater fish.

Other relevant information

Very little attention has been given previously to the fish fauna, other than a survey by the Department of Wildlife Conservation in the late 1990s when 17 species were inventoried (see Table 1). Three species, namely *Wallago attu, Aplocheilus parvus* and *Pseudosphromenus cupanus,* recorded by DWC (1998) were not found in the present Survey.

Adequacy and shortcomings of survey data

Only 16 of 34 sub-basins were surveyed. With respect to those sub-basins surveyed:

- The eastern sub-basins and tanks are considered to have been adequately surveyed.
- The western sub-basins and Kalu Ganga require more sampling.
- Water quality sampling needs to be repeated for all sites in order to fill in the gaps for the Mahaweli Ganga and Kalu Ganga, while providing for comparative analyses between drainage units.

9. OVERVIEW

9.1 Data limitations

Examination of sampling effectiveness (Figure 3.4) for plants and vertebrate groups indicates that further sampling of all groups would be appropriate to better document the biodiversity of Wasgomuwa National Park. Only in the case of plants, birds and fish has the sampling effort generated reasonably comprehensive sets of data that justify further analysis. All three taxonomic groups show a discernable plateau of species accumulated over the entire national park during the Survey period and, when examined at the habitat level, they also indicate that further preliminary analysis is warranted. Fish were examined at the river, stream and tank levels and some preliminary analysis was undertaken to determine the extent to which the upper, middle and lower drainages can be differentiated within their respective catchments.

9.2 Comparative analyses

Flora and fauna diversity within habitats

Table 9.1 Diversity values for terrestrial groups in the seven habitats sampled in Wasgomuwa National Park. Alpha diversity values (α of log series) are presented in italics.

Habitat type (revised after PCA)	DMEF			QV	RF	Scrub	Grass-land	TOTAL
	Dry	Medium	Wet					
SPECIES RICHNESS								
Plants	49	60	63	12	49	40	30	151
Amphibians	0	3	4	0	2	0	0	6
Reptiles	3	7	9	2	10	6	1	19
Birds	31	36	46	15	41	38	48	78
Mammals	8	11	8	9	11	7	9	26
ALPHA DIVERSITY								
Plants	*10.68*	*11.2*	*14.79*	*2.75*	*10.06*	*10.3*	*8.53*	*27.65*
Birds	*7.74*	*9.85*	*12.37*	*16.95*	*13.23*	*14.2*	*13.04*	*15.13*

Highest species richness for amphibians, birds and plants occurs in Dry-Mixed Evergreen Forest-wet , while the richest habitat for mammals and reptiles is Riverine Forest. Species diversity, as indicated by α, is highest in Quartzite Vegetation for birds and mammals; and in Dry-Mixed Evergreen Forest-wet for plants. A combination of low species richness and even distributions may account for the high diversity value of Quartzite Vegetation for birds (Table 9.1).

The bird assemblage in Quartzite Vegetation is the most divergent of those recorded, probably reflecting low species richness but high evenness. There is a gradational change in the Dry-Mixed Evergreen Forest assemblages, with wet forest closer in composition to Riverine Forest and dry forest closer to Scrub.

Likewise for plants, the wet assemblage within Dry-Mixed Evergreen Forest is more similar to Riverine Forest than to the dry or medium two categories of Dry-Mixed Evergreen Forest. Grassland and Quartzite Vegetation are markedly lower in species number and diversity (Table 9.1).

Freshwater fish diversity within sub-basins

Extensive evaluation of the fish fauna in streams of the Mahaweli Ganga and Kalu Ganga did not indicate any clear pattern of association within the sub-basins of the major drainages; assemblages in the upper, middle and lower reaches of streams seem to have similar species and abundances.

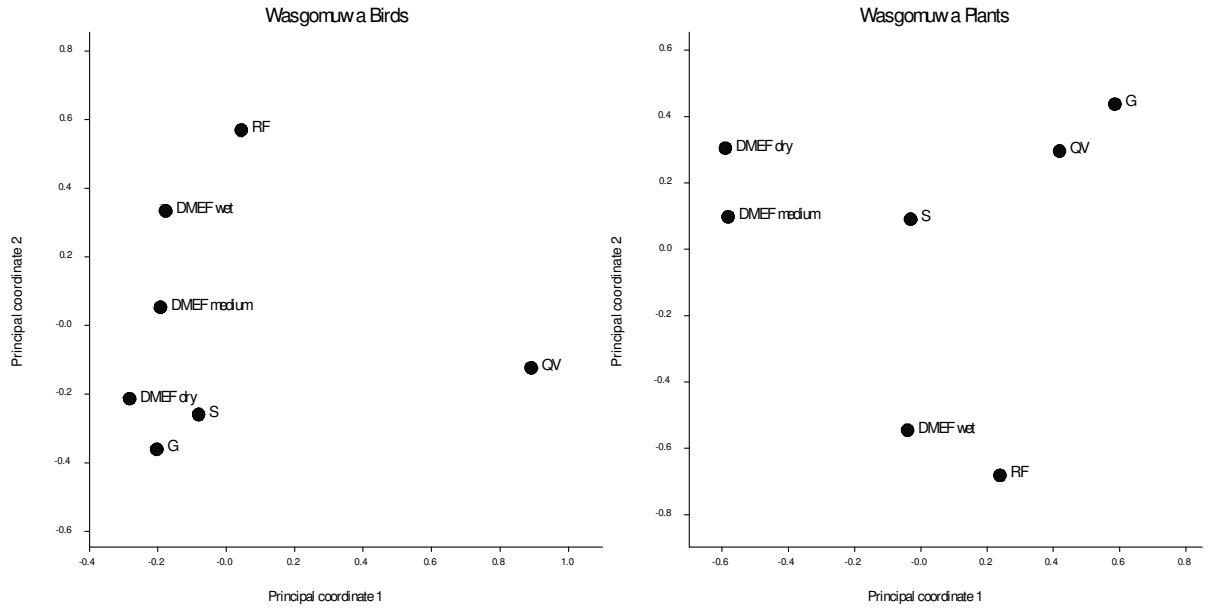


Figure 9.1 Plot of first two principal coordinates for bird assemblages [left] and plant assemblages [right] in the seven habitat types at Wasgomuwa, using the Bray Curtis coefficient of similarity. These two axes account for 30% of the variation in the distance matrix for birds and 22% for plants.

However, there is a marked separation of the fish faunas of the river systems, tanks and the sub-catchments of the major drainages (Figure 8.1). Further sampling should confirm that the fish assemblages occupying the eastern (Mahaweli) drainage are significantly different to those of the western (Kalu) drainage. This finding has major implications for the management and conservation of aquatic resources of Wasgomuwa National Park

9.3 Conclusions

Key findings arising from this Survey and their implications for conservation and management are summarised below. Future priorities for biodiversity monitoring and related research are identified.

Key biodiversity values

- A principal result from the biodiversity survey of Wasgomuwa National Park is the classification of Dry-Mixed Evergreen Forest into three principal vegetation associations. These findings are not unique, as the earlier habitat mapping project indicated heterogeneity in this vegetation category, but it clearly illustrates that there are floristic differences within Dry-Mixed Evergreen Forest that represent a gradient between dry Scrub and moist Riverine Forest.
- The diverse mosaic of habitats makes Wasgomuwa an important national park for conserving the country's vertebrate diversity. It has been shown by this Survey, despite the relatively restricted sampling period, to be species rich in most groups and it provides for numerous endemic and globally threatened species. This includes an important assemblage of freshwater fish, with 34 of Sri Lanka's 82 indigenous species recorded. The Survey also shows that fish assemblages in streams draining into the Kalu Ganga differ from those of the Mahaweli Ganga.
- The plant and avifaunal assemblages present in Quartzite Vegetation appear to be unique but further sampling is required to substantiate this preliminary finding.
- Water bodies are home to a number of threatened and near threatened avifaunal species and contain fish populations that are essential to their maintenance.

Conservation and management implications

- Conservation of Riverine Forests along the Mahaweli Ganga and Amban Ganga is particularly important for the safeguarding of several populations of *Vatica obscura* (Dipterocarpaceae), a nationally threatened and globally endangered tree species that is confined to the riparian forests in Polonnaruwa and Moneragala districts. Riverine Forests also contain abundant populations of the endemic bird species, *Phaenicophaeus pyrrhocephalus* (Red-faced malkoha).
- The presence of the globally endangered fish species, *Puntius martenstyni*, in the Kalu Ganga and Amban Ganga, two main rivers that border the national park, has important conservation implications, particularly since these rivers are fished and subject to a wide range of other activities.
- Anthropogenic impacts such as illicit felling of timber, gem mining along the Amban Ganga, poaching, and deliberate burning of grasslands, have a detrimental impact on the vegetation, and all vertebrate groups. Grassland burning warrants more specialist research to assess its beneficial and detrimental impacts on biodiversity.
- Data gathered from this Survey can be used to inform management activities, notably through the management planning and implementation process, and to provide new information on biodiversity for community outreach work and for the benefit of visitors.

Future directions and priorities

Baseline data and survey protocols have been established for future biodiversity monitoring. Future priorites are considered to be as follows:

- In the short-term, over the next five years, surveys should expanded temporally (covering wet and dry seasons) and spacially (covering more remote, less accessible parts of the national park) to fill major gaps not covered by this Survey.
- In the longer term (7-10 years hence), monitoring should commence with repeat surveys undertaken in the same locations covered by this Survey and subsequent surveys completed.
- Community and species specific research includes more extensive sampling of plants and birds in the Quartzite Vegetation, which may prove to have certain affinities with some the unique biodiversity found on the summits of Ritigala Strict Natural Reserve.

References

Bambaradeniya, C.N.B. (ed.) (2006). *The fauna of Sri Lanka: Status of taxonomy, research and conservation.* The World Conservation Union, Colombo, Sri Lanka & Government of Sri Lanka. 308 pp.

CEA (2003). Proposed inland water quality standards for different uses. Central Environment Authority, Battaramulla.

Coller, N.J. (2006). A partial revision of the Asian babblers (Timulidae). *Forktail* 22: 85-112.

DWC (1998). *Wasgomuwa National Park and Riverine Nature Reserve Management Plan*. Volume I. *Existing Situation*. Global Environment Facility Project, UNDP and Department of Wildlife Conservation, Colombo.

DWC (2005). *Wasgomuwa National Park Management Plan*. Final Draft. Protected Areas Management and Wildlife Conservation Project, Department of Wildlife Conservation, Colombo. 123 pp.

DWC (2007a). *Biodiversity Baseline Survey: Field Manual*. Consultancy Services Report prepared by Green, M.J.B. (ed.), De Alwis, S.M.D.A.U., Dayawansa, P.N., How, R., Padmalal, U.K.G.K., De Silva, S., Singhakumara, B.M.P., Weerakoon, D.,Wijesinghe, M.R. and Yapa, W.B. ARD Inc in association with Infotech IDEAS and GREENTECH Consultants. Sri Lanka Protected Areas Management and Wildlife Conservation Project (PAM&WCP/CONSULT/02/BDBS), Department of Wildlife Conservation, Ministry of Environment and Natural Resources, Colombo. 43 pp.

DWC (2007b). *Biodiversity Information Management System: Users guide.* Consultancy Services Report prepared by De Silva, S. ARD Inc in association with Infotech IDEAS and GREENTECH Consultants. Sri Lanka Protected Areas Management and Wildlife Conservation Project (PAM&WCP/CONSULT/02/BDBS), Department of Wildlife Conservation, Ministry of Environment and Natural Resources, Colombo.

DWC (2007c). *Biodiversity Information Management System: Technical design guide.* Consultancy Services Report prepared by De Silva, S. ARD Inc in association with Infotech IDEAS and GREENTECH Consultants. Sri Lanka Protected Areas Management and Wildlife Conservation Project (PAM&WCP/CONSULT/02/BDBS), Department of Wildlife Conservation, Ministry of Environment and Natural Resources, Colombo.

Green, M.J.B. and Gunawardena, E.R.N. (1997). *Designing an optimum protected areas system for Sri Lanka's natural forests.* 2 volumes. Environmental Management in Forestry Developments Project, Forest Department, Government of Sri Lanka, Colombo. 399 pp.

IUCN (1990). *IUCN Directory of South Asian protected areas*. Compiled by Green, M.J.B., World Conservation Monitoring Centre. IUCN, Gland, Switzerland and Cambridge, UK. 280 pp.

Jayasingam, J, Balasubramaniam, S. and Vivekanantharaja, S. (1992). Vegetation survey of the Wasgomuwa National Park: reconnaissance. *Vegetatio* 101: 171-181.

MENR (2005). Habitat maps for selected areas in Sri Lanka: Wasgomuwa National Park. Final Report. Prepared by EML Consultants. Ministry of Environment & Natural Resources. Colombo. 55 pp.

NPS and DCW (1986). *Master plan: Wasgomuwa National Park.* US National Park Service and Department of Wildlife Conservation, Colombo. 43 pp.

Pethiyagoda, R. (1991). *Freshwater fishes of Sri Lanka*. Wildlife Heritage Trust of Sri Lanka. Sarvodaya Vishva Lekha Printers, Sri Lanka. 362 pp.

Annex 1 Geographic coordinates of sampling locations

AQUATIC LOCATIONS

***Abbreviations: S**tream, **T**ank, **R**iver

NAME OF SITE AND HABITAT TYPE*	SITE NO.	NORTHING	EASTING
Allewela Oya (S)	1	216693	273957
Medapitiya camp site 2(S)	2	213555	274084
Kalu Ganga (river)near Kiri Oya Beat Office(R)	3	208683	274297
Kiri Oya Wewa (T)	4	7° 40. 407'N	80° 51. 154'E
Ulpath Hatha (S)	5	210383	275220
Meda Ulpotha (S)	6	210706	276285
Sansthapitiya Wewa (T)	7	221682	270859
Sansthapitiya Wewa (T)	8	221773	270887
Udaganawa Ebbay (T)	9	223836	273241
Wilmitiya Wewa (T)	10	220145	272235
Mahaweli river near Beat office(camp site) (R)	11	223578	276138
Wavul Ebbey (T)	12	223393	276263
Dambarawa Wewa (T)	13	218191	271940
Mahaweli river near Beat office(camp site) (R)	14	223551	276115
Gaslabu ara (S)	15	209124	276047
Medaulpotha (close to Gaslabuara) (S)	16	210246	278365
Medaulpotha (upstream) (S)	17	211081	276234
Allawalwe Oya (S)	18	212952	274277
Allawalwe Oya(S)	19	222460	278758
Allawalwe Oya(S)	20	214864	273730
Allawalwe Oya(S)	21	214046	274011
Medapitiya camp site 2(S)	22	213355	274143
Ulpathhatha(S)	23	209372	275129
Ulpathhatha (site where Ulpathhatha joins Kalu Ganga)(S)	24	208902	275179
Wasgamu Oya(S)	25	7° 42. 540N	80° 55.969' E
Wasgamu Oya(S)	26	No reception	
Was gomu Oya(S)	27	7 º 42.689' N	80 º 55.030E
Raja ela(S)	28	223223	282880
Raja ela(S)	29	222811	282352
Hatharamanhandiya (Mahaweli river) (R)	30	223668	280590
Wavul Ebbay camping site (Mahaweli river)(R)	31	223840	278255
Near Wavul Ebbay bungalow (Mahaweli river)(R)	32	223551	276115
Malagamuwa Wewa (T)	33	219065	288950
Karapanam ella(S)	34	222422	286743
Karapanam ella (close to where the stream meets Mahaweli river)(S)	35	222982	287113
Nawagaha ela(S)	36	218942	289514
Nawagaha ela(S)	37	219863	289120
Nawagaha ela(S)	38	219862	289118
Kiri Ebbey(T)	39	222040	289868
Wasgomu oya(S)	40	222945	284827
Wasgomu oya(S)	41	220669	279048
Wasgomu oya(S)	42	220870	279048
Karapanam ella(S)	43	222208	286626
Karapanam ella(S)	44	222193	286555
Karapanam ella(S)	45	222193	286555
Muthuwanganawa oya (Kumara ella)(S)	46	208194	282631
Muthuwanganawa oya (Kumara ella)(S)	47	208568	282158
Amban ganga(R)	48	218785	294829
Amban ganga(R)	49	218101	294452
Kohilawala ela(Ehagange ela)(S)	50	218111	294396
Dasthota wewa(T)	51	228544	295323
Amban ganga(R)	52	210987	288167
Walas ela(S)	53	211054	288161
Amban ganga(R)	54	211457	288806
Diyasevel ela(S)	55	212394	288197
Galgedi ela(S)	56	No reception	
Galgedi ela(S)	57	209222	284089
Galgedi ela(S)	58	210278	283633
Na ela (Nagas ela)(S)	59	208755	284237
Na ela (Nagas ela)(S)	60	211026	282957
Na ela (Nagas ela)(S)	61	210183	283216
Kalu ganga(R)	62	208790	274648
Kalu ganga(R)	63	207939	280220

TERRESTRIAL QUADRAT LOCATIONS

Transect	Quadrat	Habitat	Habitat code	GPS start Easting	GPS start Northing	Locality
1	A	Scrub	S	213668	274342	Medapitiya
1	B	Scrub	S	213782	274554	Medapitiya
1	C	Scrub	S	213561	274676	Medapitiya
1	D	Scrub	S	213448	274455	Medapitiya
2	A	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	213339	274182	Medapitiya
2	B	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	213134	274063	Medapitiya
2	C	Dry-Mixed Evergreen Forest - moist	DMEF wet	212997	274265	Medapitiya
2	D	Dry-Mixed Evergreen Forest - dry	DMEF dry	213208	274401	Medapitiya
3	A	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	213897	274077	Kadu/Medapitiya
3	B	Dry-Mixed Evergreen Forest - dry	DMEF dry	214170	273879	Kadu/Medapitiya
3	C	Dry-Mixed Evergreen Forest - dry	DMEF dry	214345	273691	Kadu/Medapitiya
3	D	Dry-Mixed Evergreen Forest - dry	DMEF dry	214532	273497	Kadu/Medapitiya
4	A	Grassland	G	216907	273207	Kadurupitiya
4	B	Grassland	G	217025	273429	Kadurupitiya
4	C	Grassland	G	216817	273552	Kadurupitiya
4	D	Grassland	G	216711	273338	Kadurupitiya
5	A	Riverine Forest	RF	224521	273200	Yudaganawa
5	B	Riverine Forest	RF	224455	273478	Yudaganawa
5	C	Dry-Mixed Evergreen Forest - moist	DMEF wet	224383	273785	Yudaganawa
5	D	Dry-Mixed Evergreen Forest - moist	DMEF wet	224355	274041	Yudaganawa
6	A	Grassland	G	223492	273404	Yudaganawa
6	B	Grassland	G	223732	273490	Yudaganawa
6	C	Grassland	G	223648	273688	Yudaganawa
6	D	Grassland	G	223646	273692	Yudaganawa
7	A	Dry-Mixed Evergreen Forest - moist	DMEF wet	223442	273838	Yudaganawa
7	B	Grassland	G	223645	274000	Yudaganawa
7	C	Grassland	G	223497	274199	Yudaganawa
7	D	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	223328	274022	Yudaganawa
8	A	Dry-Mixed Evergreen Forest - moist	DMEF wet	224459	273300	Yudaganawa
8	B	Dry-Mixed Evergreen Forest - moist	DMEF wet	224370	273550	Yudaganawa
8	C	Dry-Mixed Evergreen Forest - moist	DMEF wet	224298	273813	Yudaganawa
8	D	Dry-Mixed Evergreen Forest - moist	DMEF wet	224285	274054	Yudaganawa
9	A	Dry-Mixed Evergreen Forest - moist	DMEF wet	210755	276355	Sudukanda road
9	B	Dry-Mixed Evergreen Forest - moist	DMEF wet	210501	276393	Sudukanda road
9	C	Dry-Mixed Evergreen Forest - moist	DMEF wet	210585	276651	Sudukanda road
9	D	Dry-Mixed Evergreen Forest - moist	DMEF wet	210846	276578	Sudukanda road
10	A	Quartzite Vegetation	QV	211421	275222	Sudukanda
10	B	Scrub	S	211546	275428	Sudukanda
10	C	Dry-Mixed Evergreen Forest - dry	DMEF dry	211353	275529	Sudukanda
10	D	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	211223	275310	Sudukanda
11	A	Scrub	S	209343	274527	Kirioya road
11	B	Scrub	S	209125	274380	Kirioya road

Transect	Quadrat	Habitat	Habitat code	GPS start Easting	GPS start Northing	Locality
11	C	Scrub	S	208971	274593	Kirioya road
11	D	Scrub	S	209183	274710	Kirioya road
12	A	Quartzite Vegetation	QV	211633	275898	Sudukanda
12	B	Quartzite Vegetation	QV	211590	275736	Sudukanda
12	C	Quartzite Vegetation	QV	211557	275564	Sudukanda
12	D	Quartzite Vegetation	QV	211508	275399	Sudukanda
13	A	Riverine Forest	RF	223643	280689	Wauleba
13	B	Riverine Forest	RF	223609	280926	Wauleba
13	C	Riverine Forest	RF	223535	281191	Wauleba
13	D	Riverine Forest	RF	223474	281458	Wauleba
14	A	Riverine Forest	RF	223828	278272	Hatarman junction
14	B	Riverine Forest	RF	223806	278543	Hatarman junction
14	C	Riverine Forest	RF	223741	278827	Hatarman junction
14	D	Riverine Forest	RF	223689	279065	Hatarman junction
15	A	Scrub	S	221162	280614	Round road
15	B	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	221372	280479	Round road
15	C	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	221512	280680	Round road
15	D	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	221305	280819	Round road
16	A	Dry-Mixed Evergreen Forest - dry	DMEF dry	222849	279062	Wasgamu oya
16	B	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	222863	278807	Wasgamu oya
16	C	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	222603	278783	Wasgamu oya
16	D	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	222584	279005	Wasgamu oya
17	A	Dry-Mixed Evergreen Forest - dry	DMEF medium	218862	288672	Malagamuwa
17	B	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	219068	288567	Malagamuwa
17	C	Dry-Mixed Evergreen Forest - dry	DMEF dry	218942	288356	Malagamuwa
17	D	Dry-Mixed Evergreen Forest - dry	DMEF dry	218710	288465	Malagamuwa
18	A	Riverine Forest	RF	223211	284445	Kirieba road
18	B	Riverine Forest	RF	223169	284708	Kirieba road
18	C	Riverine Forest	RF	223167	285032	Kirieba road
18	D	Riverine Forest	RF	223186	285283	Kirieba road
19	A	Grassland	G	219085	288868	Malagamuwa
19	B	Grassland	G	219146	289104	Malagamuwa
19	C	Grassland	G	218908	289176	Malagamuwa
19	D	Grassland	G	218804	288946	Malagamuwa
20	A	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	222736	284589	Kirieba
20	B	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	222490	284577	Kirieba
20	C	Dry-Mixed Evergreen Forest - dry	DMEF dry	222466	284838	Kirieba
20	D	Dry-Mixed Evergreen Forest - intermediate	DMEF medium	222707	284870	Kirieba

ANNEX 2 SUMMARY OF SAMPLING EFFORT: WASGOMUWA NATIONAL PARK (Survey period: July - August 2006)

Key to habitats: **Dr** DMEF-dry; **Me** DMEF-intermediate; **We** DMEF-wet; **QV** Quartzite Vegetation; **RF** Riverine Forest; **Sc** Scrub; **Gr** Grassland; **Op** Opportunistic (all habitats)

Taxonomic group	Sampling effort achieved in the field									Method: description	No./km transect	Sampling intensity per habitat type (based on 4 replicates/habitat)
	Method	Sampling effort per habitat type (N = no. quadrats)										
		Dr 10	Me 15	We 12	QV 5	RF 14	Sc 10	Gr 14	Op			
Small mammals	**No. traps set**	66	55	77	33	77	55	77		**Sherman traps:** located at 10 m intervals within 2 vegetation quadrats (100m x 5m), for 4 nights	22 traps	22 x 4 x 4 = 352 trap nights/ habitat
	Total no. trap nights	264	220	308	132	308	220	308				
	No. quadrats sampled	6	5	7	3	7	5	7				
Larger mammals	**No. traps set**	Tomahawk traps not available								**Tomahawk traps:** located at each end of 2 vegetation quadrats (100m x 5m), for 4 nights	4 traps	4 x 4 x 4= 64 trap nights/ habitat
	Total no. trap nights											
	No. quadrats sampled											
Bats	**No. mist nets set**	4	12	0	4	16	4	8		**Mist nets:** 2 nets (at canopy and ground levels) manned by 2 persons at 6-9am and at 4.30-6.30pm at appropriate location along transect	2 mist nets	2 x 2 x 4 = 16 mist net sessions (totalling 40 mist net hours)/ habitat
	Total hours of mist netting											
	No. quadrats	1	3	0	1	4	1	2				
	No. mist nets set									**Mist nets:** 2 nets (at canopy and ground levels) manned by 2 persons at 6-9am and at 4.30-6.30pm along selected waterholes, trails and near roosts	2 mist nets	2 x 2 x 4 = 16 mist net sessions (totalling 40 mist net hours)/ habitat
	Total hours of mist netting											
	No. locations											
All mammals										**Direct observations:** along 1 km transects, recording perpendicular distance from transect to mammal sighted/ spoor	1 km	4 km, variable width/ habitat
Birds on land	**No. VCPs completed**	**40**	**60**	**48**	**20**	**56**	**40**	**56**		**Variable Circular Plots:** 8 VCPs (radius = 0-10m, 11-20m and >20m) aligned at each end of 4 vegetation quadrats (100m x 5m): birds recorded for 10 mins within each VCP, once at dawn and once at dusk	8 VCPs	8 x 2 x 4 = 64 VCP visits/ habitat
	No. quadrats sampled	**20**	**30**	**24**	**10**	**28**	**20**	**28**				
	No. transects surveyed									**Direct observations:** record birds along 1 km transects between vegetation quadrats	600m	2.4 km/habitat
Birds on water	**No. locations on waterbodies counted**	**8**								**Total counts**: for discrete water bodies, using one or more stations from which to record birds, as appropriate.	n/a	n/a
	Total no. waterbodies surveyed	**6**										
Birds	**No. mist nets set**		**3**	**2**		**5**	**4**	**6**		**Mist nets:** 2 nets (at canopy and ground levels) manned by 2 persons during daytime (total of hours)at appropriate location adjacent to transect	2 mist nets	2 x 4 x 6 = 48 mist net hours/ habitat
	Total hours of mist netting		**46**	**31**		**55**	**40**	**42**				
	No. locations		**1**	**1**		**3**	**2**	**2**				
Reptiles and amphibians	**No. QCTs completed**	**15**	**50**	**30**	**10**	**40**	**25**	**35**		**Quadrat cleaning (daytime):** 5 quadrats (5m x 5m) in open habitat, 10m x 2.5m in closed habitat) cleared in each of 2 vegetation quadrats (100m x 5m)	10 quadrats	10 x 4 = 40 quadrats (0.1 ha)/ habitat
	No. quadrats examined	**3**	**10**	**6**	**2**	**8**	**5**	**7**				
	No. nocturnal quadrats examined	unavailable								**100m x 5mm quadrats:** visual encounters at night time	1 quadrat	1 x 4 = 4 quadrats (0.04 ha/habitat)
Vascular plants	**No. transects established**	20 transects (1 km length) in total								**100m x 5m quadrats:** located at 150m intervals along 1km transect	4	4 x 4 = 16 quadrats (0.8 ha)/ habitat
	No. quadrats sampled	10	15	12	5	14	10	14				

Key to drainage units: 1 = Mahaweli Ganga; 2 = Kalu Ganga; 3 = Amban Ganga; 4 = Western drainage; 5 = Eastern drainage; 6 = Tanks (Wewa)												
Freshwater fish	**Sub-basin ref. no.**	1	2	3	4	5	6			**Water quality:** pH, conductivity, phosphate, nitrate, dissolved oxygen, turbidity, temperature recorded at head, mid- and lower reaches of river	n/a	3 x 4 = 12 samples/ subcatchment
	No. fish/water quality locations	5	3	5	17	23	10					

Annex 3 List and reference numbers of voucher specimens

PLANTS

Family	Genus	Specimen numbers
Annonaceae	*Uvaria macropoda*	WG49
Connaraceae	*Connarus monocarpus*	WG76
Convolvulaceae	*Evolvulus alsinoides*	WG53
Cyperaceae	*Cyperus iria*	WG 10
Cyperaceae	*Fimbristylis ovata*	WG 23
Cyperaceae	*Fimbristylis pubisquama*	WG 03
Cyperaceae	*Kyllinga bulbosa*	WG 04
Ebenaceae	*Diospyros malabarica*	WG48
Euphorbiaceae	*Drypetes sepiaria*	WG80
Euphorbiaceae	*Suregada lanceolata*	WG67
Euphorbiaceae	*Trewia nudiflora*	WG92
Fabaceae	*Crotalaria verrucosa*	WG99
Fabaceae	*Cynometra zeylanica*	WG63
Fabaceae	*Painteria nitida*	WG47
Flacourtiaceae	*Hydnocarpus venenata*	WG69
Melastomataceae	*Memecylon capitellatum*	WG123
Moraceae	*Streblus taxoides*	WG73
Myrtaceae	*Syzygium zeylanicum*	WG50
Poaceae	*Alloteropsis cimicina*	WG 07
Poaceae	*Chrysopogon fulvus*	WG 09
Poaceae	*Cyrtococcum trigonum*	WG 26
Poaceae	*Echinochloa colona*	WG 21
Poaceae	*Sporobolus diander*	WG 02
Rubiaceae	*Ixora coccinea*	WG68
Rubiaceae	*Nauclea orientalis*	WG52
Rutaceae	*Pleiospermium alatum*	WG78
Sapindaceae	*Sapindus emarginata*	WG90
Sapotaceae	*Manilkara hexandra*	WG81
Sterculiaceae	*Pterospermum suberifolium*	WG82
Verbenaceae	*Vitex altissima*	WG72
Annonaceae	*Uvaria macropoda*	WG49
Connaraceae	*Connarus monocarpus*	WG76
Convolvulaceae	*Evolvulus alsinoides*	WG53
Cyperaceae	*Cyperus iria*	WG 10
Cyperaceae	*Fimbristylis ovata*	WG 23
Cyperaceae	*Fimbristylis pubisquama*	WG 03
Cyperaceae	*Kyllinga bulbosa*	WG 04
Ebenaceae	*Diospyros malabarica*	WG48
Euphorbiaceae	*Drypetes sepiaria*	WG80
Euphorbiaceae	*Suregada lanceolata*	WG67
Euphorbiaceae	*Trewia nudiflora*	WG92
Fabaceae	*Crotalaria verrucosa*	WG99
Fabaceae	*Cynometra zeylanica*	WG63
Fabaceae	*Painteria nitida*	WG47
Flacourtiaceae	*Hydnocarpus venenata*	WG69
Melastomataceae	*Memecylon capitellatum*	WG123
Moraceae	*Streblus taxoides*	WG73
Myrtaceae	*Syzygium zeylanicum*	WG50
Poaceae	*Alloteropsis cimicina*	WG 07
Poaceae	*Chrysopogon fulvus*	WG 09
Poaceae	*Cyrtococcum trigonum*	WG 26
Poaceae	*Echinochloa colona*	WG 21

ANIMALS

Family	Genus	Species	Specimen numbers				
FISH							
Under preparation							
HERPETOFAUNA							
None collected							
BIRDS [feather samples for potential DNA analysis]							
Alcedinidae	*Ceyx*	*erithacus*	WG14				
Bucerotidae	*Ocyceros*	*gingalensis*	WG17				
Cisticolidae	*Prinia*	*hodgsonii*	WG29				
Corvidae	*Dicrurus*	*paradiseus*	WG13				
Corvidae	*Hypothymis*	*azurea*	WG2	WG16			
Corvidae	*Terpsiphone*	*paradisi*	WG6	WG26			
Columbidae	*Chalcophaps*	*indica*	WG10	WG11	WGU	WG32	
Columbidae	*Streptopelia*	*chinensis*	WG28				
Cuculidae	*Cacomantis*	*passerinus*	WG31				
Cuculidae	*Eudynamys*	*scolopacea*	WG39				
Halcyonidae	*Halcyon*	*smyrnensis*	WG38				
Laniidae	*Lanius*	*cristatus*	WG33				
Meropidae	*Merops*	*orientalis*	WG34				
Muscicapidae	*Copsychus*	*malabaricus*	WG4	WG5	WG9	WG19	
			WG21	WG20	WG24	WG27	
Muscicapidae	*Cyornis*	*tickelliae*	WG12	WG18	WG36		
Nectariniidae	*Nectarina*	*zeylonica*	WG37				
Passeridae	*Dendronanthus*	*indicus*	WG8				
Pycnonotidae	*Pycnonotus*	*melanicterus*	WG25				
Sylviidae	*Pellorneum*	*fuscocapillum*	WG15				
Sylviidae	*Rhopocichla*	*atriceps*	WG3	WG22	WG23		
Sylviidae	*Turdoides*	*affinis*	WG35				
MAMMALS [provisional list]							
Muridae	*Rattus*	*Rattus*	WGM27	WGM30	WGM33		
Vespetilionidae	*Pipistrellus*	*affinis*	WGM32				
Vespetilionidae			WGM35	WGM29			
Rhinolophidae	*Rhinolophus*	*Beddomei*	WGM34				
Rhinolophidae	*Rhinolophus*	*rouxii*	WGM31	WGM26	WGM28		

Annex 4 List of species recorded from Wasgomuwa National Park

Key to species geographic status:
E endemic; **I** indigenous; **X** exotic

Key to species conservation status:
Ex extinct; **C** critically endangered, **NT** nationally threatened, **NHT** nationally highly threatened, **GLR** globally at lower risk, **GE** globally endangered.

PLANTS

Taxon	Total	DMEF dry	DMEF medium	DMEF wet	RF	G	QV	S
1003	26		1	7	4			
1008	6	1					1	
1010	2							1
Acanthaceae Hygrophila schulli	7					3		
Anacardiaceae Mangifera zeylanica	7			2	1			
Anacardiaceae Nothopegia beddomei	3				3			
Annonaceae Miliusa indica	2				2			
Annonaceae Polyalthia coffeoides	5		1	3				
Annonaceae Polyalthia korinti	59	1	4	6	3			4
Annonaceae Polyalthia longifolia	21			2	7			
Annonaceae Uvaria macropoda	10		1	3	2			1
Annonaceae Xylopia nigricans	3		1	1				1
Apocynaceae Alstonia scholaris	1			1				
Arecaceae Phoenix pusilla	3	3						
Asteraceae Eupatorium odoratum	1					1		
Bigoniaceae Stereospermum colais	2			1				
Boraginaceae Cordia dichotoma	4			2				1
Catunaregam Catunaregam spinosa	1							1
Celastraceae Cassine glauca	2		1	1				
Celastraceae Pleurostylia opposita	6	3	2					
Chloroxylon Chloroxylon swietenia	1							1
Clusiaceae Garcinia spicata	8		2	2	3			
Clusiaceae Mesua ferrea	6				3			
Combretaceae Terminalia arjuna	31			2	5			
Connaraceae Connarus monocarpus	9		1	3	1			
Cyperaceae Cyperus iria	1					1		
Cyperaceae Eleocharis caribaea	6					2		
Cyperaceae Fimbristylis falcata	1					1		
Cyperaceae Fimbristylis ovata	2					2		
Cyperaceae Fimbristylis pubisquama	10					4		
Cyperaceae Kyllinga bulbosa	3					3		
Cyperaceae Unidentified Unidentified	1					1		
Dilleniaceae Dillenia indica	1				1			
Dipterocarpaceae Vatica obscura	111				12			
Ebenaceae Dimorphocalyx glabellus	10				1			
Ebenaceae Diospyros affinis	1			1				
Ebenaceae Diospyros ebenum	23	4	8	4				
Ebenaceae Diospyros ferrea	34	6	2	1				
Ebenaceae Diospyros malabarica	43	1	3		7			
Ebenaceae Diospyros montana	11	3	1		1			
Ebenaceae Diospyros ovalifolia	110	6	12	7	3			
Euphorbiaceae Acronychia pedunculata	1				1			
Euphorbiaceae Cleistanthus pallidus	34	1	4	1	1			
Euphorbiaceae Dimocarpus longan	2				1			
Euphorbiaceae Dimorphocalyx glabellus	734	3	15	12	13			
Euphorbiaceae Drypetes gardneri	10	4	1					
Euphorbiaceae Drypetes sepiaria	181	10	13	5				2
Euphorbiaceae Euphorbia antiquorum	3	1	1				1	
Euphorbiaceae Euphorbia Euphorbia hirta	2					1		
Euphorbiaceae Euphorbia hirta	4					2		
Euphorbiaceae Flueggea leucopyrus	15							4
Euphorbiaceae Macaranga peltata	4		1	1				

Taxon	Total	DMEF dry	DMEF medium	DMEF wet	RF	G	QV	S
Euphorbiaceae Mallotus rhamnifolius	66	3	12	8				1
Euphorbiaceae Mallotus sp.	3				2			
Euphorbiaceae Phyllanthus polyphyllus	50	3	8	7				4
Euphorbiaceae Suregada lanceolata	20	4	4	1				
Euphorbiaceae Trewia nudiflora	8			1	2			
Fabaceae Alysicarpus vaginalis	2					2		
Fabaceae Bauhinia racemosa	72	1	1			2		8
Fabaceae Bauhinia tomentosa	8		3	1				
Fabaceae Cassia fistula	23		4	4				6
Fabaceae Cassia roxburghii	2							1
Fabaceae Cassia tora	3					1		
Fabaceae Cynometra zeylanica	2				1			
Fabaceae Derris parviflora	67	3	7	11	10			4
Fabaceae Desmodium triflorum	7					4		
Fabaceae Entada pusaetha	1				1			
Fabaceae Mimosa pudica	13					4		
Fabaceae Painteria nitida	1	1						
Fabaceae Pongamia pinnata	3			1	2			
Fabaceae Tamarindus indica	1			1				
Fabaceae Tephrosia purpurea	8					4		
Flacourtiaceae Hydnocarpus venenata	38		1	5	7			
Hippocrateaceae Salacia reticulata	7	1		3	1			
Lauraceae Alseodaphne semecarpifolia	4			3	1			
Lauraceae Neolitsea cassia	2				2			
Lecythidaceae Barringtonia acutangula	9				2			
Linaceae Hugonia mystax	30	8	3	2	1		3	
Malvaceae Hibiscus eriocarpus	53	4	5					
Marsiliaceae Marsilia quadrifolia	2					1		
Melastomataceae 1010	1			1				
Melastomataceae Memecylon angustifolium	45				2			
Melastomataceae Memecylon capitellatum	8	4	1					1
Melastomataceae Memecylon petiolatum	111	1					5	1
Melastomataceae Memecylon umbellatum	2	1						
Melastomataceae Osbeckia aspera	1						1	
Meliaceae Dysoxylum ficiforme	12				6			
Meliaceae Walsura trifoliolata	22		3	4	4			1
Moraceae Ficus arnottiana	1						1	
Moraceae Ficus mollis	1						1	
Moraceae Ficus racemosa	1							1
Moraceae Ficus sp.	3		2		2			
Moraceae Streblus asper	3			2				
Moraceae Streblus taxoides	2			2				
Myristicaceae Myristica sp.	4			1				
Myrtaceae Eugenia bracteata	2	2						
Myrtaceae Syzygium cumini	11	1	1	1	3		1	2
Myrtaceae Syzygium zeylanicum	1				1			
Ochnaceae Ochna lanceolata	24	4	6					2
Ochnaceae Ochna obtusata	1						1	
Poaceae	2					1		
Poaceae Alloteropsis cimicina	2					2		
Poaceae Chrysopogon fulvus	6					2		
Poaceae Cyrtococcum trigonum	1					1		
Poaceae Echinochloa colona	4					3		
Poaceae Imperata cylindrica	1					1		
Poaceae Ischaemum mangaluricom	1					1		
Poaceae Ischaemum Unidentified	12					5		
Poaceae Panicum repens	2					2		
Poaceae Sporobolus diander	1					1		
Poaceae Unidentified Unidentified	40					11		
Polygonaceae Polygonum tomentosum	2					1		
Rhamnaceae Ventilago madraspatana	22		4	7				1
Rhamnaceae Ziziphus oenoplia	47	6	9	3				8
Rhizophoraceae Cassipourea ceylanica	2	1	1					
Rubiaceae Benkara malabarica	9	4	2					1
Rubiaceae Canthium coromandelicum	3	1	1					
Rubiaceae Catunaregam spinosa	46	1	3	1				7
Rubiaceae Discospermum sphaerocarpum	16	1	1	1			1	1

Taxon	Total	DMEF dry	DMEF medium	DMEF wet	RF	G	QV	S
Rubiaceae Gardenia fosbergii	9						3	1
Rubiaceae Ixora coccinea	12		1	1	3			
Rubiaceae Ixora pavetta	5	2	1					
Rubiaceae Nauclea orientalis	6				2			
Rubiaceae Psydrax dicoccos	6	3	3					
Rubiaceae Tarenna asiatica	5	3						
Rutaceae Atalantia monophylla	3	2						
Rutaceae Chloroxylon swietenia	17	4	5	1				2
Rutaceae Glycosmis mauritiana	4			3				
Rutaceae Limonia acidissima	2							1
Rutaceae Murraya paniculata	1			1				
Rutaceae Pleiospermium alatum	31	5	6	1	1			
Sapindaceae Dimocarpus longan	130		1	11	11			
Sapindaceae Glenniea unijuga	5		2	1				
Sapindaceae Lepisanthes senegalensis	10	1	2	1				1
Sapindaceae Lepisanthes tetraphylla	39	4	10	4	1			1
Sapindaceae Sapindus emarginata	8	1	4					1
Sapindaceae Schleichera oleosa	4		1	3				
Sapotaceae Chrysophyllum roxburghii	5							3
Sapotaceae Madhuka longifolia	4				3			
Sapotaceae Manilkara hexandra	25	8	4					1
Sterculiaceae Pterospermum suberifolium	121	4	12	11	7			7
Tiliaceae Berrya cordifolia	38		2	4	6			
Tiliaceae Diplodiscus verucosus	334	9	11	2				3
Tiliaceae Grewia helicterifolia	10		2	4	1			
Tiliaceae Grewia orientalis	6			1				2
Verbenaceae Gmelina asiatica	1							1
Verbenaceae Premna tomentosa	3			1				1
Verbenaceae Vitex altissima	13	2	5	3			2	
Verbenaceae Vitex leucoxylon	1				1			
Vitaceae Cissus heyneana	5	1	3	1				
Vitex Vitex altissima	1							1

FISH

Taxon	Geog. Status	Cons. Status	Amban Ganga	Kalu Ganga	Kalu Streams	Mahaweli Ganga	Mahaweli Streams	Wewas	Total
Anguillidae Anguilla bicolor	I					1			1
Anabantidae Anabas testudineus	I						1	3	8
Bagridae Mystus vittatus	I		1	1	1		6	4	128
Belontiidae Belontia signata	E	NT,GLR			1				6
Belontiidae Trichogaster pectoralis	X					1		2	29
Channidae Channa gachua	I		1	1	4				12
Channidae Channa punctata	I				4		13		71
Channidae Channa striata	I						1	3	16
Cichlidae Etroplus maculatus	I		1	1					2
Cichlidae Etroplus suratensis	I		1	1		3			5
Cichlidae Sarotherodon mossambicus	X							2	7
Clariidae Clarias brachysoma	E	NT			1				5
Cobitidae Lepidocephalichthys thermalis	I		1	1	4		13		153
Cyprinidae Amblypharyngodon melletinus	I		1	1	1		8	5	1130
Cyprinidae Chela laubuca	I				1		7		184
Cyprinidae Cirrhinus mrigala	X					1			1
Cyprinidae Devario malabaricus	I		4	3	7	2	16		938
Cyprinidae Esomus thermoicos	E	NT	1	1			4		39
Cyprinidae Garra ceylonensis	E	NT	4	2	2	2	1	1	199
Cyprinidae Hypothalmichthys molirix	X					2			5
Cyprinidae Labeo dussumieri	I		1			4			20
Cyprinidae Puntius amphibius	I					2	5	2	66
Cyprinidae Puntius bimaculatus	I		3		2		1	1	73
Cyprinidae Puntius chola	I		1	2				5	37
Cyprinidae Puntius dorsalis	I					2			4
Cyprinidae Puntius martenstyni	E	NHT,GE	2	1					4
Cyprinidae Puntius sarana	E		1	1	1	2	4		153
Cyprinidae Puntius singhala	E		3	1	1	2	6		31
Cyprinidae Puntius srilankensis	E	NT	2	2	1				40
Cyprinidae Puntius ticto	I				1			2	5
Cyprinidae Puntius vittatus	I						15	1	243
Cyprinidae Rasbora caverii	I		2	2	6	2	16	3	520
Cyprinidae Rasbora daniconius	I		3	3	6	2	18	1	1035
Cyprinidae Tor khudree	I		1	2	1		2		41
Gobiidae Glossogobius giuris	I		1	3		1	1		8
Heteropneustidae Heteropneustes fossilis	I							2	3
Loricariidae Hypostomus plecostomus	X					1		1	2
Mastacembelidae Mastacembelus armatus	I			1					2
Osphronemidae Osphronemus goramy	X							1	1
Siluridae Ompok bimaculatus	I					4		1	9

HERPETOFAUNA

Taxon	Total	DMEF dry	DMEF medium	DMEF wet	RF	G	QV	S
AMPHIBIANS								
Ranidae Fejervarya limnocharis	6		1	1				
Ranidae Philautus fergusonianus	1			1				
Ranidae Philautus sp.	3		1	1				
Ranidae Polypedates cruciger	5		2	1	1			
Ranidae Polypedates maculates	1							
Ranidae Rana temporalis	1				1			
REPTILES								
Agamidae Calotes calotes	6						1	
Agamidae Calotes ceylonensis	20		1	3	3			
Agamidae Calotes versicolor	3			1	1	1		
Agamidae Otocryptis nigristigma	23		5	4	1			
Colubridae Dendrelaphis sp.	2	1						
Colubridae Dendrelaphis tristis	1				1			
Colubridae Lycodon sp.	1							
Colubridae Oligodon arnensis	1							1
Crocodylidae Crocodylus sp.	3				1			
Elapidae Naja naja	1				1			
Gekkonidae Geckoella yakhuna	1							1
Gekkonidae Hemidactylus depressus	3			1				
Gekkonidae Hemidactylus frenatus	9	1	1	1	3			1
Gekkonidae Hemidactylus leschenaultii	1				1			
Scincidae Lankascincus fallax	33	2	3	4	3		2	3
Scincidae Lygosoma punctatus	1			1				
Scincidae Mabuya carinata	5		1		1			
Scincidae Mabuya macularia	3		1					1
Scincidae Nessia sarasinorum	4			1				1
Testudinidae Geochelone elegans	2							
Typhlopidae Typhlops sp.	1			1				
Varanidae Varanus bengalensis	2		1					

BIRDS

Family	Genus	Species	Geog. status	Cons. status	Opportunistic	Number of quadrats within which species were recorded in each habitat type								Prior Records
						TOTAL [N=80]	DMEF-Dry [N=10]	DMEF-medium [N=15]	DMEF-wet [N=12]	RF [N=14]	G [N=14]	Q [N=5]	S [N=10]	
Accipitridae	*Accipiter*	*badius*	I			7							1	✓
Accipitridae	*Buteo*	*buteo*	M		1	1								
Accipitridae	*Elanus*	*caeruleus*	I			6						1		✓
Accipitridae	*Haliaeetus*	*leucogaster*	I			11				3				
Accipitridae	*Haliastur*	*Indus*	I			9				1				
Accipitridae	*Hieraaetus*	*kienerii*	I		1	1								
Accipitridae	*Ichthyophaga*	*ichthyaetus*	I	NT	7	7								
Accipitridae	*Ictinaetus*	*malayensis*	I		3	3								
Accipitridae	*Pernis*	*ptilorhyncus*	I			2						1		
Accipitridae	*Spilornis*	*cheela*	I			19				1				
Accipitridae	*Spizaetus*	*cirrhatus*	I		5	5								
Alaudidae	*Alauda*	*gulgula*	I		1	1								
Alaudidae	*Eremopterix*	*grisea*	I		1	1								
Alaudidae	*Mirafra*	*assamica*	I			44					8		2	✓
Alcedinidae	*Alcedo*	*atthis*	I			24			2	4				✓
Alcedinidae	*Ceyx*	*erithacus*	I			9			1	3				
Anhingidae	*Anhinga*	*melanogaster*	I	NT	6	6								
Apodidae	*Apus*	*affinis*	I		3	3								✓
Apodidae	*Cypsiurus*	*balasiensis*	I			17	1	1			2	1	2	✓
Ardeidae	*Ardea*	*cinerea*	I		6	6								✓
Ardeidae	*Ardea*	*purpurea*	I		7	7								✓
Ardeidae	*Ardeola*	*grayii*	I		3	3								✓
Ardeidae	*Bubulcus*	*ibis*	I		3	3								✓
Ardeidae	*Casmerodius*	*albus*	I		5	5								✓
Ardeidae	*Egretta*	*garzetta*	I		6	6								✓
Ardeidae	*Mesophoyx*	*intermedia*	I		7	7								✓
Batrachostomidae	*Batrachostomus*	*moniliger*	I		3	3								
Bucerotidae	*Anthracoceros*	*coronatus*	I	NT		20			1	1				✓
Bucerotidae	*Ocyceros*	*gingalensis*	E			60	1	2	1	2				✓
Caprimulgidae	*Caprimulgus*	*asiaticus*	I		1	1								
Caprimulgidae	*Caprimulgus*	*atripennis*	I		1	1								✓
Caprimulgidae	*Caprimulgus*	*indicus*	I		1	1								✓
Centropodidae	*Centropus*	*sinensis*	I			69			1				2	✓
Cerylidae	*Ceryle*	*rudis*	I		4	4								
Charadriidae	*Charadrius*	*alexandrinus*	I		2	2								
Charadriidae	*Charadrius*	*dubius*	I		1	1								✓
Charadriidae	*Vanellus*	*indicus*	I		22	22								✓
Charadriidae	*Vanellus*	*malabaricus*	I		2	2								
Ciconiidae	*Ciconia*	*episcopus*	I		2	2								✓
Ciconiidae	*Leptoptilos*	*javanicus*	I	VU	2	2								✓
Ciconiidae	*Mycteria*	*leucocephala*	I	NT	3	3								✓
Cisticolidae	*Cisticola*	*juncidis*	I			4					1			✓
Cisticolidae	*Prinia*	*hodgsonii*	I			9							1	✓
Cisticolidae	*Prinia*	*inornata*	I			10					1			✓
Cisticolidae	*Prinia*	*sylvatica*	I			18					1			✓
Columbidae	*Chalcophaps*	*indica*	I			64			5	2				✓
Columbidae	*Ducula*	*aenea*	I			59	1		2	3	2		1	✓
Columbidae	*Streptopelia*	*chinensis*	I			260	4		1		11		2	✓
Columbidae	*Treron*	*bicincta*	I			26					2		1	✓
Columbidae	*Treron*	*pompadora*	I			48	2	4	1	2	1	1	2	✓
Coraciidae	*Coracias*	*benghalensis*	I		3	3								✓
Corvidae	*Aegithina*	*tiphia*	I			216	7	10	7	5	6		3	✓
Corvidae	*Coracina*	*macei*	I			5			1	1				✓
Corvidae	*Coracina*	*melanoptera*	I			51	2				3		1	✓
Corvidae	*Corvus*	*macrorhynchos*	I			25				2	3			
Corvidae	*Corvus*	*splendens*	I		1	1								
Corvidae	*Dicrurus*	*caerulescens*	I			9	1		1					✓
Corvidae	*Dicrurus*	*paradiseus*	I			57		1	3	1	1			✓
Corvidae	*Hypothymis*	*azurea*	I			75	3	4	8	11	1	1	2	✓
Corvidae	*Oriolus*	*xanthornus*	I			76	3	3	2	1	1		3	✓

Family	Genus	Species	Geog. status	Cons. status	Opportunistic	Number of quadrats within which species were recorded in each habitat type								Prior Records
						TOTAL [N=80]	DMEF-Dry [N=10]	DMEF-medium [N=15]	DMEF-wet [N=12]	RF [N=14]	G [N=14]	Q [N=5]	S [N=10]	
Corvidae	*Pericrocotus*	*cinnamomeus*	I			13	1		2					✓
Corvidae	*Pericrocotus*	*flammeus*	I			5			2					✓
Corvidae	*Rhipidura*	*aureola*	I			6					1			✓
Corvidae	*Tephrodornis*	*pondicerianus*	I			29	1	1			3			✓
Corvidae	*Terpsiphone*	*paradisi*	I			72	3	3	8	8	2		1	✓
Cuculidae	*Cacomantis*	*passerinus*	M		7	7								✓
Cuculidae	*Clamator*	*coromandus*	M		1	1								✓
Cuculidae	*Clamator*	*jacobinus*	I		10	10								✓
Cuculidae	*Cuculus*	*micropterus*	I		1	1								✓
Cuculidae	*Eudynamys*	*scolopacea*	I		25	25								✓
Cuculidae	*Phaenicophaeus*	*pyrrhocephalus*	E	VU		5				1				✓
Cuculidae	*Phaenicophaeus*	*viridirostris*	I			6			1					✓
Cuculidae	*Surniculus*	*lugubris*	I		1	1								✓
Dendrocygnidae	*Dendrocygna*	*javanica*	I		3	3								✓
Halcyonidae	*Halcyon*	*capensis*	I			24			1	1				✓
Halcyonidae	*Halcyon*	*smyrnensis*	I			70			2	6	1			✓
Hemiprocnidae	*Hemiprocne*	*coronata*	I			51	4	2	2		3		2	✓
Hirundinidae	*Hirundo*	*daurica*	I		7	7								✓
Hirundinidae	*Hirundo*	*rustica*	M		1	1								✓
Irenidae	*Chloropsis*	*aurifrons*	I		3	3								✓
Irenidae	*Chloropsis*	*cochinchinensis*	I			23	1	1	2	4	1			✓
Jacanidae	*Hydrophasianus*	*chirurgus*	I		5	5								✓
Laniidae	*Lanius*	*cristatus*	M		2	2								✓
Megalaimidae	*Megalaima*	*haemacephala*	I			163		1			3		1	✓
Megalaimidae	*Megalaima*	*rubricapilla*	I			130	1		3			1		✓
Megalaimidae	*Megalaima*	*zeylanica*	I			231	1	5	2	1	1		3	✓
Meropidae	*Merops*	*leschenaultia*	I			48		4	2	5	1	1	1	✓
Meropidae	*Merops*	*orientalis*	I			68	1	1		6	4		2	✓
Muscicapidae	*Copsychus*	*malabaricus*	I			195	8	10	7	3	3		3	✓
Muscicapidae	*Copsychus*	*saularis*	I			16	1	3		1	1		1	✓
Muscicapidae	*Cyornis*	*tickelliae*	I			34		1	6	3	1			✓
Muscicapidae	*Muscicapa*	*daurica*	M		1	1								✓
Muscicapidae	*Saxicoloides*	*fulicata*	I			33			2		5		1	✓
Nectariniidae	*Dicaeum*	*agile*	I			7			1		1	1	1	
Nectariniidae	*Dicaeum*	*erythrorhynchos*	I			103	7	7	5	4	8	2	9	✓
Nectariniidae	*Nectarina*	*asiatica*	I			149	8	8	7	3	11	2	8	✓
Nectariniidae	*Nectarina*	*lotenia*	I			22		1	2	2	2	2		✓
Nectariniidae	*Nectarina*	*zeylonica*	I			136	2	4	5	6	10		7	✓
Passeridae	*Anthus*	*godlewskii*	M		1	1								
Passeridae	*Anthus*	*rufulus*	I			14					4			✓
Passeridae	*Dendronanthus*	*indicus*	M		2	2								✓
Passeridae	*Lonchura*	*malabarica*	I			4					1		1	
Passeridae	*Lonchura*	*malacca*	I			3		1		1				✓
Passeridae	*Lonchura*	*punctulata*	I			8					2		1	✓
Passeridae	*Lonchura*	*striata*	I			10			2		1		1	✓
Passeridae	*Ploceus*	*philippinus*	I		1	1								✓
Pelecanidae	*Pelecanus*	*philippensis*	I	VU	1	1								✓
Phalacrocoracidae	*Phalacrocorax*	*carbo*	I		2	2								✓
Phalacrocoracidae	*Phalacrocorax*	*fuscicollis*	I		4	4								✓
Phalacrocoracidae	*Phalacrocorax*	*niger*	I			7				1				✓
Phasianidae	*Galloperdix*	*bicalcarata*	E		20	20								✓
Phasianidae	*Gallus*	*lafayetii*	E			101		1	1					✓
Phasianidae	*Pavo*	*cristatus*	I		9	9								✓
Picidae	*Celeus*	*brachyurus*	I		1	1								
Picidae	*Chrysocolaptes*	*lucidus*	I		6	6								✓
Picidae	*Dendrocopos*	*mahrattensis*	I		4	4								
Picidae	*Dendrocopus*	*nanus*	I		1	1								✓
Picidae	*Dinopium*	*benghalense*	I			53	1	1		1				✓
Pittidae	*Pitta*	*brachyura*	M		2	2								✓
Psittacidae	*Loriculus*	*beryllinus*	E			6						2	1	✓
Psittacidae	*Psittacula*	*calthropae*	E		2	2								

Family	Genus	Species	Geog. status	Cons. status	Opportunistic	Number of quadrats within which species were recorded in each habitat type								Prior Records
						TOTAL [N=80]	DMEF-Dry [N=10]	DMEF-medium [N=15]	DMEF-wet [N=12]	RF [N=14]	G [N=14]	Q [N=5]	S [N=10]	
Psittacidae	*Psittacula*	*cyanocephala*	I		2	2								✓
Psittacidae	*Psittacula*	*eupatria*	I			40		2	1		1			✓
Psittacidae	*Psittacula*	*krameri*	I			152	3	4	3	4	5	1	1	✓
Pycnonotidae	*Hypsipetes*	*leucocephalus*	I		5	5								✓
Pycnonotidae	*Iole*	*indica*	I			4		1	2					
Pycnonotidae	*Pycnonotus*	*cafer*	I			178	6	5	6	5	7	2	3	✓
Pycnonotidae	*Pycnonotus*	*luteolus*	I			346	9	11	7	7	7		6	✓
Pycnonotidae	*Pycnonotus*	*melanicterus*	I			73	1	3	8	6	2	1	3	✓
Rallidae	*Amaurornis*	*phoenicurus*	I		4	4								✓
Rallidae	*Porphyrio*	*porphyrio*	I		4	4								✓
Scolopacidae	*Actitis*	*hypoleucos*	M		1	1								✓
Strigidae	*Bubo*	*nipalensis*	I		1	1								
Strigidae	*Strix*	*leptogrammica*	I		1	1								
Sturnidae	*Acridotheres*	*tristis*	I			101	3	5	2	3	5			✓
Sturnidae	*Gracula*	*religiosa*	I		16	16								✓
Sylviidae	*Orthotomus*	*sutorius*	I			132	6	5	4	6	4		3	✓
Sylviidae	*Pellorneum*	*fuscocapillum*	E			33		1					1	✓
Sylviidae	*Phylloscopus*	*magnirostris*	M		1	1								✓
Sylviidae	*Phylloscopus*	*nitidus*	M		1	1								✓
Sylviidae	*Pomatorhinus*	*horsfieldii*	E			29			3					✓
Sylviidae	*Rhopocichla*	*atriceps*	I			37		3	4	4	2		2	✓
Sylviidae	*Turdoides*	*affinis*	I			28					3		1	✓
Threskiornithidae	*Threskiornis*	*melanocephalus*	I	NT	7	7								✓
Trogonidae	*Harpactes*	*fasciatus*	I		1	1								✓
Turnicidae	*Turnix*	*suscitator*	I			1					1			✓
Upupidae	*Upupa*	*epops*	I		1	1								
Zosteropidae	*Zosterops*	*palpebrosus*	I			6	2	2						✓

Sources of information for prior records: DWC (1998)

MAMMALS

Family	Genus	Species	Geog. status	Cons. Status - national	Cons. Status - global	Opportunistic	Number of quadrats within which species were recorded in each habitat type								Prior Records
							TOTAL [N=80]	DMEF-Dry [N=10]	DMEF-medium [N=15]	DMEF-wet [N=12]	RF [N=14]	G [N=14]	Q [N=5]	S [N=10]	
Bovidae	*Bos*	*indicus*	X			1						1(1)			
Bovidae	*Bubalus*	*arnee*	I			8		1				4(1)			
Bovidae	*Bubalus*	*bubalis*	X			1						1(1)			√
Canidae	*Canis*	*aureus*	I			3									√
Cercopithecidae	*Macaca*	*sinica*	E		VU	5	(1)	(1)	(1)						√
Cercopithecidae	*Semnopithecus*	*priam*	I			1									√
Cercopithecidae	*Trachypithecus*	*vetulus*	E	TR	EN	3			(1)						√
Cervidae	*Axis*	*axis*	I			27	(1)						(1)		√
Cervidae	*Cervus*	*unicolor*	I			15	2	1				1		2	√
Cervidae	*Muntiacus*	*muntjak*	I			2									√
Elephantidae	*Elephas*	*maximus*	I	TR	EN	52	5(1)	5			8	8	1	3	√
Felidae	*Panthera*	*pardus*	I	TR	EN	3	2		1						√
Felidae	*Prionailurus*	*rubiginosus*	I	TR	VU	1									
Felidae	*Prionailurus*	*viverrinus*	I	TR	VU	1									
Herpestidae	*Herpestes*	*edwardsii*	I			2									√
Herpestidae	*Herpestes*	*smithii*	I			16									√
Herpestidae	*Herpestes*	*brachyurus*	I												
Hipposideridae	*Hipposiderus*	*ater*	I			1									
Hystericidae	*Hystrix*	*indica*	I			5	2		2				1		√
Leporidae	*Lepus*	*nigricollis*	I			28		2	3			5		1	√
Muridae	*Rattus*	*rattus*	I			15	2(2)		4(4)		3(3)		1(1)	1(1)	
Muridae	*Tatera*	*indica*	I			15							1(1)	1	
Muridae	*Vandeleuria*	*oleracea*	I			1					1(1)				
Mustelidae	*Lutra*	*lutra*	I	TR	VU	4		1			2(1)				√
Pteropodidae	*Cynopterus*	*sphinx*	I			33		2(2)				1(2)			
Rhinolophidae	*Rhinolophus*	*beddomei*	I			2									
Rhinolophidae	*Rhinolophus*	*rouxii*	I			3		1(1)				1(1)			
Scuridae	*Funambulus*	*palmarum*	I			5			2(2)		1(1)				√
Scuridae	*Funambulus*	*sublineatus*	I			2							1(1)		
Scuridae	*Ratufa*	*macroura*	I		VU	2					1(1)				√
Soricidae	*Suncus*	*murinus*	I			1					1(1)				
Suidae	*Sus*	*scrofa*	I			9		1			1		1	1	√
Tragulidae	*Moschiola*	*meminna*	E			10		1(1)							√
Ursidae	*Melursus*	*ursinus*	I	TR	VU	17	3	3	5		1	1	2		√
Vespertilionidae	*Murina*		I	TR		1									
Vespertilionidae	*Pipistrellus*	*affinis*	I	TR		2							1(1)		
Vespertilionidae	*Pipistrellus*	*tenuis*	I			1					1(1)				
Viverridae	*Paradoxurus*	*hermaphroditus*	I			10									√
Viverridae	*Paradoxurus*	*zeylonensis*	E	TR		1									√
Viverridae	*Viverricula*	*indica*	I			2									

The values show the numbers of quadrats in which a species was recorded; values in parentheses show those based on direct observations, based on trapping or sightings.

Sources of information for prior records: DWC (1998), Green and Gunawardena (1997)