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Vertebrate fauna of Morankanda-Mukalana secondary forest patch in Sri Lanka: A checklist reported from 2004-2008 survey

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Abstract. Morankanda-Mukalana is a fragmented forest patch which is located in the Galle district, Southern wet zone of Sri Lanka. Biogeography of the Morankanda is noteworthy because it is located in the middle of the transition area of forest reserves or proposed forest reserves, which includes Beraliya Mukalana. This basic field survey was carried out upon the request made by Morakanda Estate management to define vertebrate checklist in the related area with the aim of starting analogue forestry as a future practice. During the study, a total of nine freshwater fish species were recorded (including four endemics), together with 14 species of amphibians (8 endemics), 43 reptile species (20 tetrapods and 23 serpentoids incl. 16 endemics), and 26 mammals (3 endemics). Avifauna comprised of 112 species (9 migrants) with 12 endemic birds (including proposed endemics). The high vertebrate faunal diversity revealed in this study paved the way for the estate management to change their plantation practice by maintaining partially analogue forestry following conservation practices which will positively affect to improve the status of wild fauna.

Keywords. Agro-ecosystem, analogue forestry, endemic fauna, rain forests, vertebrate checklist.

1 Introduction

Sri Lanka is an island off the southern tip of India, and is a biodiversity hotspot. It has a high amount of endemic species and has highly threatened habitats such as tropical forests (Bulter 2006). As the richest areas for biodiversity coincide with those having the highest numbers of threatened species, and as these areas also have high numbers of malnourished and poor

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people (Mainka 2002), there is an inevitable threat to biodiversity via converting forests to plantations.

Morankanda Mukalana (henceforth called Morankanda) which is located in the Galle District of Southern Sri Lanka is originally a secondary lowland forest patch within inter-transmission area of three major rain forests (Fig 1). Morankanda is partly plantation and fairly analogue forest in land use. It is fragmented lowland wet forest, but even after a few decades in cultivation practices, the forest patch seems to shield high amount of tropical forest diversity, both faunal and floral. Consequently over the last two-three decades, Morakanda Estate and surrounding areas are dominated by the practices related to tea industry. Morankanda is an ideal secondary forest which can demonstrate how plantation practices affect the faunal diversity of lowland forest when it is compared to rain forest nearby.

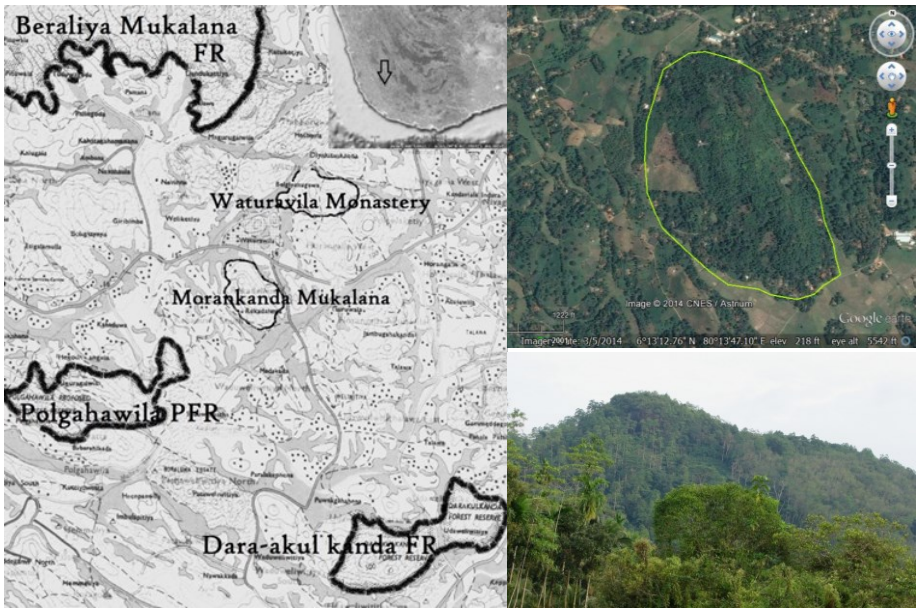

Fig. 1. Location maps of Morankanda Mukalana: Location of Morankanda scrub close to three Forest Reserves (FR) (Beraliya FR, Darakul kanda FR and Polgahawila Proposed FR (left; Modified from 1:50000 map, Survey department, Sri Lanka); Aerial view of Morankanda from 5542ft (upper-right; Google earth 2014); View from North-West side of mountain (lower-right; photo by J.M. Jayaneththi in 2006).

'Analogue forest' is a tree-dominated ecosystem that is analogous in structure and function to the original climax and sub-climax community (Liyanage *et al.*. 2009). In 1970's, initial management of Morankanda took part in rubber cultivation and then after a decade, second management had changed the focus in to tea. In the beginning of 2004, then estate management acted and decided to continue tea cultivation partly with more wildlife and nature friendly system, as an analogue forest (Senanayaka 1987; Senanayaka *et al.* 1998). This was due to future planning of economical and biological improvements to include eco-tourism purpose in land use. Initial survey was called by then management to define the checklist of flora and vertebrate fauna of estate land and related area. The present paper aims to present the checklist of vertebrate phase of the initial survey and will provide comparative basis for future surveys that will be carried out to comprehend the trends in diversity after few years of analogue forestry practices.

2 Methodology

2.1 Study area and forest type

Area of Morankanda mountain does not exceed 1.5Km^2 while the peak point is 379ft, and the main study site is centered at 6°13' 12.69" N, 80°14'0.70"E (Google earth 2014). The nearest town Elpitiya is located 10 km away from northwest and Kahaduwa, Indigahavila junctions just boundary of northeast and north sides of Morankanda. Morankanda scrub is located between the transmission area that the Beraliya, Darakul kanda Forest Reserves (FR), and Polgahawila Proposed Forest Reserve (PFR) and also Waturavila Monastery from Northeast (Fig 1). This area is located in the Ging river basin close to Nawakkada swampy forest that gets flooded several times in a year, and from south and west where the 'Ambun fall' river branch is found.

The lower part of the area can be classified as home gardens, plantations, and rural habitats, while southern and southwest areas are covered by paddy fields. Tea is the dominant cultivation of the area. Slopes are covered by scrubs and also secondary forest remaining on the upper areas (Fig 1). Natural vegetation is comprised basically of shrubs including Malabar Melastome (Sinhalese name 'Ma-Bowitiya') *Melastoma malabathricum,* 'Heen-Bowitiya' *Osbeckia aspera,* 'Bombu' *Symplocos cochinchinensis*, 'Godapora' *Schumacheria alnifolia* and Alstonia ('Hawarinuga') *Alstonia macrophylla* which were among the most abundant plants in the area. Peek of the forest is

covered with Bamboo shrubs *Davidasea attenuata* and toddy palm (or 'Kitul') *Caryota urens*, 'Waldel' *Artocarpus nobilis*, 'Ruk Mala boda' *Horsfieldia iryaghedhi*, 'Magul karanda' *Pongamia pinnata*, 'Walkaraabu' *Syzygium assimile*, and 'Goraka' *Garcinia quaesita*. Other Cultivated plants are Cinnamon *Cinnamomum verum*, Coconut *Cocos nucifera*, Papaya *Carica papaya*, and Banana plants.

2.2 Surveyed methods

The survey was carried out from November 2004 to December 2008 through observations made fortnightly (1st and 4th week) both at night and day in week days only (Monday–Friday). The vertebrate classes under survey include ichthyofauna, herpetofauna, avifauna and mammals. North, Northeast and East slope of Morankanda were surveyed with selected habitats. The habitat types surveyed in the site consists of small scale paddy-field, rubber and tea plantations, analog forest with mixed crops, secondary forest, rock-outcrop, ponds and estate garden.

2.3 Species checklist

The Ichthyofauna were documented by random spotting in habitats such as small streams, ponds and small scale paddy-fields at border areas of the estate land. Hand nets and small accessible glass tank were used respectively to capture and temporarily hold the fishes for species identification, and they were released back to same habitats. Species were identified using guides and keys provided by Deraniyagala (1952), Pethiyagoda (1991), Pethiyagoda & Kottelat (2005).

Herpetofauna observations were done by visual random spotting at all potential habitats including aquatic habitats, damp rocky surfaces, logs, bushes and also domestic habitats which were thoroughly searched for the presence of reptiles and amphibians. Some collected specimens were examined carefully and recorded before being released back into the same habitat. Herpetological keys and other guides used to identify species level included Deraniyagala (1953, 1955), De Silva (2001), Wickramasinghe & Somaweera (2003), Somaweera (2004, 2006), Das & De Silva (2005), Manamendra-Arachchi & Pethiyagoda (2005, 2006), Wickramasinghe & Munindradasa (2007), Manamendra-Arachchi *et al.* (2007), and Somaweera & Somaweera (2009), Maduwage *et al.* (2009). Comparative presentations

were done by referring to the reports on undisturbed Beraliya forest by Karunarathne *et al.* (2008) and Karunarathne & Amarasinghe (2012).

Avifauna checklist was made mainly through random visual observations done both night and day (mostly 6:00-10:00AM and 4:00-6:00PM in day time) and from their calls during the studied period. Binoculars (7x50 diameter) were used for observations, and species were identified using ornithological field guides of Kotagama & Fernando (1994), Henry (1998), Harrison (1999), and Rasmussen & Anderton (2005).

The checklist of mammals was prepared via random visual observations. Shrews and rodents were captured randomly using Sherman traps (x2) and Mist nets (Sutherland, 1997) for bats, while mammals were released after identification. Occasionally, few other mammal species were recorded from a dead specimen (*Rhinolophus beddomei*) and indirect signs such as ascertained footprints, droppings, and animal calls. Digital vernier caliper was used for taking measurements, while Mammalogical keys and guides were used to identify species level according to Macdonald (2001), Kotagama (2004), Phillips (1980) and Weerakoon & Goonatilake (2006).

In addition, visual sighting were noted by observations of stages of life cycles (i.e. eggs and tadpoles of *Nannophrys ceylonensis* and *Lankanectes corrugatus*), sloughed skin (in case of snakes), droppings, foot prints (in case of Varanids and mammals), egg shells and 'road kill' specimens following instruction of taxonomical keys and guides.

Photographic examinations of all vertebrate categories were also done by using cameras Nikon F55D, Canon EOS ELAN 7E and Sony Cyber-shot, while halogen torch (1000LM) was used occasionally for observing nocturnal fauna.

3 Results and discussion

Total of nine freshwater fish species were recorded from the study area (Table 1). But those species occurred only within the boundaries of the forest patch. Among the nine species, four were endemic to Sri Lanka (44 %). Cherry barb *Puntius titteya* (Plate 1,A) have been recorded randomly, but Walking Catfish *Clarias brachysoma* (Plate 1,C) and Werner's Killifish *Aplocheilus werneri* (Plate 1,D) are also not uncommon on the site.

Table 1. Status of ichthyofauna of Morankanda Mukalana.

Family	Common name	Binomial name	Status	Abundance
Cyprinidae	Giant Danio	*Devario malabaricus*		Very Common
	Stripped Rasbora	*Rasbora daniconius*		Very Common
	Cherry Barb	*Puntius titteya*	**E**	Random
	Silver Barb	*Puntius vittatus*		Common
Cobitidae	Common Loach	*Lepidocephalichthys thermalis*		Common
Clariidae	Walking Catfish	*Clarias brachysoma*	**E**	Common
Aplocheilidae	Werner's Killifish	*Aplocheilus werneri*	**E**	Common
Channidae	Brown Snakehead	*Channa gachua*		Abundant
	Smooth-breasted Snakehead	*Channa orientalis*	**E**	Random

Key ; E=Endemic; very common= can see all the habitatsand number of individuals high; common = Few places and number of individuals high; Random = only couple of time records; abundant= number of individuals average but not uncommon around

Table 2. Status of Amphibian fauna of Morankanda Mukalana.

Family	Common name	Binomial name	Status	Habitats Preferences
Bufonidae	Common Toad	*Duttaphrynus melanostictus*		Wider
Ranidae	Indian Skipper Frog	*Euphlyctis cyanophlyctis*		Wider
	Indian Green Frog	*Euphlyctis hexadactylus*		Wider
	Common Paddy field Frog	*Fejervarya limnocharis*		Wider
	Jerdon's Bullfrog	*Hoplobatrachus crassus*		Wider
	Bronzed Frog	*Hylarana temporalis*	**E**	Wider
	Sri Lanka Wood Frog	*Hylarana gracilis*	**E**	Wider
Nyctibatrachidae	Sri Lanka wart frog	*Lankanectes corrugatus*	**E**	Forest
Rhacophoridae	Anthropenic Shrub Frog	*Pseudophilautus hoipolloi*	**E**	Forest/ Forest edge
	Common Shrub Frog	*Pseudophilautus popularis*	**E**	Wider
	Shrub Frog	*Philautus sp.*	**E**	Tea Pl.
	Sri Lanka whipping frog	*Polypedates cruciger*	**E**	Wider
	Chunam tree frog	*Polypedates maculatus*		Wider
Dicroglossidae	Sri Lanka rock frog	*Nannophrys ceylonensis*	**E**	Forest

Key ; E= Endemic; Wider = wider spread in the site; Forest= occurs inside forest; Forest edge= occurs in edge of the forest; Tea Pl. = spread in the Tea plantation

Amphibians of Morankanda Mukalaana area consisted of 14 species of which 8 species were endemic to Sri Lanka (57%) (Table 2). Compared to Beraliya Mukalana FR (Karunarathne *et al.* 2008), Morankanda comprised 64% of amphibian species out of total number of Beraliya Mukalana FR (Fig 2, Fig 3).

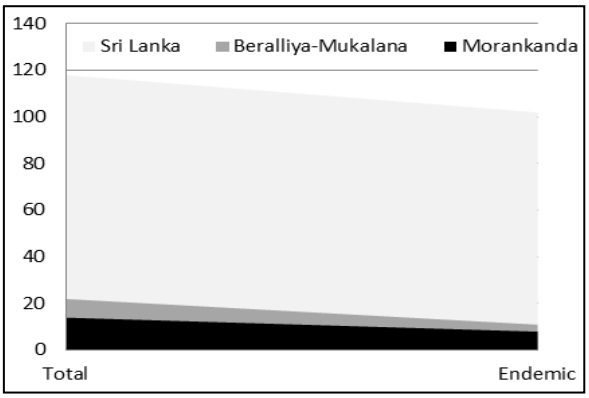

Fig. 2. Area chart comparing Amphibian diversity of Morankanda: Total number of species and endemicity among Morankanda, Beraliya mukalana FR and rest of Sri Lanka are shown.

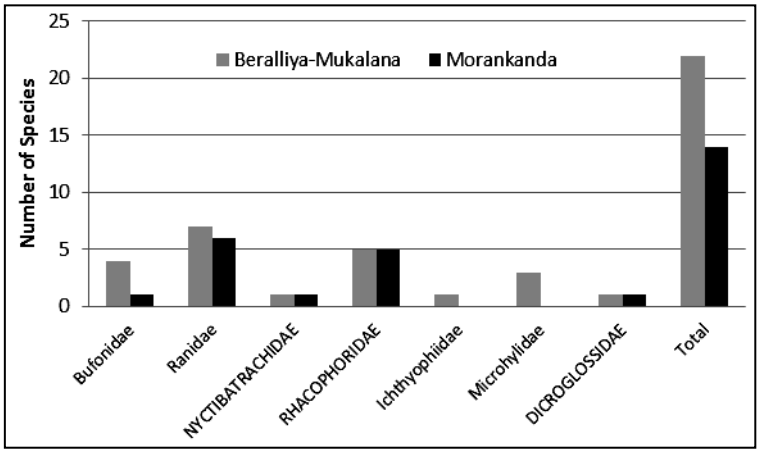

Fig. 3. Comparison of number of species of Amphibian families between Morankanda and Beraliya Mukalana FR.

Dynamic populations of *Polypedates cruciger* (Plate 1,E) and *Pseudophilautus popularis* were noted. The habitats of Anthropenic Shrub Frog *Pseudophilautus hoipolloi* (Plate 1F) were noted in forest edges, and most specimens were observed from Cinnamon *C. verum* bushes and overgrown tea *C. sinensis* bushes. Unidentified *Pseudophilautus* species was observed inside the tea bushes. Taxonomical keys confirmed Sri Lanka Wood Frog *Hylarana gracilis* (Plate 1,G) observed commonly on the site but colour pattern was slightly different from the dry zone population. Few habitats of endemic frog species such as Sri Lanka rock frog *Nannophrys ceylonensis* (Plate 1,H), Sri Lanka wart frog *Lankanectes corrugatus* (Plate 1,I) and Bronzed Frog *Hylarana temporalis* were observed in the forest.

Total of 43 reptile species were observed during the survey of which 20 were tetrapods (Table 3). Among them 16 (seven tetrapod and nine serpentoid) species were endemics (Fig 4), and 73% total reptile diversity represents the same reptilian families of Morankanda out of Beraliya figures (Fig 5). It was interesting to note that one of the commonest snake species, Green vine snake *Ahaetulla nasuta* was not recorded over the survey period.

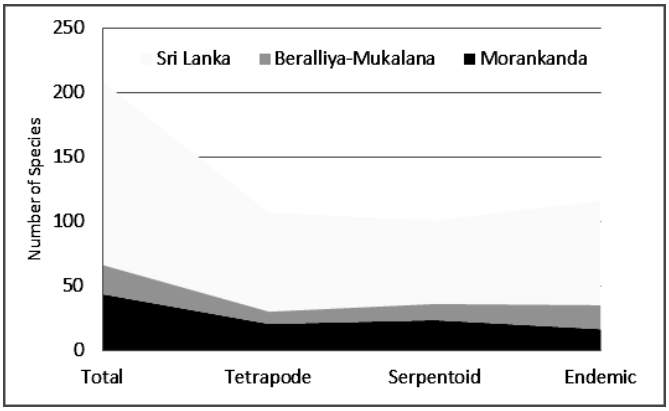

Fig. 4. An area chart comparing reptile diversity of Morankanda: Total number of species and endemicity among Morankanda, Beraliya mukalana FR and rest of Sri Lanka are shown.

Table 3. Status of Reptile fauna of Morankanda Mukalana

Family	Common name	Binomial name	Status	Habitat Preferences
Bataguridae	Parker's Black Turtle	*Melanochelys trijuga*		ML
Trionychidae	Soft Terrapin	*Lissemys punctata*		ML
Gekkonidae	Daygecko	*Cnemaspis silvula*	**E**	F
	Molligoda Daygecko	*Cnemaspis molligodai*	**E**	F
	Spotted House Gecko	*Hemidactylus parvimaculatus*		WIDER
	Common House Gecko	*Hemidactylus frenatus*		WIDER
	Slender Gecko	*Hemiphyllodactylus typus*		HH
	Scaly-finger Gecko	*Lepidodactylus lugubris*		HH
	Fourclaw Gecko-	*Gehyra mutilata*		WIDER
Agamidae	Green Garden Lizard	*Calotes calotes*		WIDER
	Whistling Lizard	*Calotes lioleps*	**E**	F/FE
	Common Garden Lizard	*Calotes versicolor*		WIDER
Ristellidae	Deraniyagal's lankaskink	*Lankascincus deraniyagalae*	**E**	Plantation / Forest
	Common lanka skink	*Lankascincus fallax*	**E**	Plantation / Forest
	Gans's lankaskink	*Lankascincus gansi*	**E**	Plantation / Forest
	Common skink	*Eutropis carinata*		WIDER
Scincidae	Bronzegreen little skink	*Eutropis macularius*		WIDER
	Three-toe snakeskink	*Nessia burtonii*	**E**	Plantation / Forest
Varanidae	Water Monitor	*Varanus salvator*		WIDER
	Land Monitor	*Varanus benghalensis*		WIDER
Typhlopidae	Common blind snake	*Ramphotyphlops braminus*	**E**	WIDER
	Jan's blind snake	*Typhlops mirus*	**E**	Plantation / Forest
	blind snake	*Typhlops* spp	**E**	Plantation / Forest
Cylindrophidae	Sri Lanka Pipe-snake	*Cylindrophis maculatus*	**E**	Plantation / Forest
Pythonidae	Rock Python	*Python molurus*		F/ML
Colubridae	Buff Stripped Keelback	*Amphiesma stolata*		ML / Plantation
	Olive keelback	*Atretium schistosum*		ML
	Sri Lanka wolf snake	*Cercaspis carinata*	**E**	F/FE/RH
	Boulenger's bronze-back	*Dendrelaphis bifrenalis*		F/FE
	Common bronze-back	*Dendrelaphis tristis*		WIDER
	Trinket snake	*Coelognathus helena*		WIDER
	Common Wolf snake-	*Lycodon aulicus*		WIDER
	Flowery Wolf snake	*Lycodon osmanhilli*	**E**	HH/ Plantation
	Shaw's wolf snake	*Lycodon striatus*		WIDER

Table 3 . Continued..

Family	Common name	Binomial name	Status	Habitat Preferences
Colubridae	Common kukri snake-	*Oligodon arnensis*		ML/HH/ Plantation
	Dumeril's kukri snake	*Oligodon sublineatus*	**E**	F/ Plantation
	Rat snake	*Ptyas mucosus*		WIDER
	Jerdon's polyodent	*Sibynophis subpunctatus*		F/ Plantation
	Checkered keelback	*Xenochrophis asperrimus*	**E**	ML
	Checkered keelback-	*Xenochrophis piscator*		ML
Viperidae	Hump-nosed Viper	*Hypnale hypnale*		WIDER
Elapidae	Sri Lankan Krait	*Bungarus ceylonicus*	**E**	F
	Cobra	*Naja naja*		WIDER

Key; ML= Marshland includes paddy field and boggy area; F= forest/ WIDER= widespread ;
HH= Human Habitats ; Plantation= Mixed cultivars and other related flora.

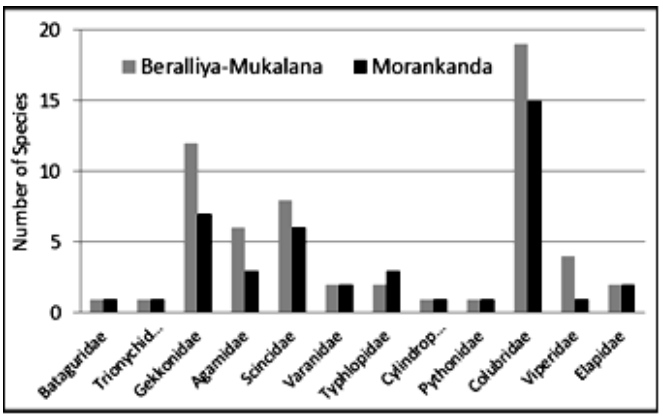

Fig. 5. **Comparison of number of species of Reptilian families between Morankanda and Beraliya Mukalana FR**.

Cnemaspis silvula (Plate 1,J) and Molligoda's Day gecko *Cnemaspis molligodai* are random species in surrounds. Slender Gecko *Hemiphyllodactylus typus* (Plate 1,K) and Scaly-finger Gecko *Lepidodactylus lugubris* (Plate 1,L) are abundant in moderately old, semi wooden buildings (detailed note done by Jayaneththi *et al.* 2015). Incubation behaviour of Rock Python *Python molurus* (Plate 2,A) has been observed during end of the 2003 to May 14th 2004. Sri Lankan Krait *Bungarus ceylonicus* (Plate 2,D), Cobra *Naja naja* and Hump-nosed Viper *Hypnale hypnale* (Plate 2,B) were

represented as highly venomous group. Buff Stripped Keelback *Amphiesma stolata* was noted with dark reddish colour pattern (Plate 2,F).

Total of 112 avifauna species noted in related area include nine migrants (8%), and 12 endemics (11%) (also including proposed endemic avifauna species by Rasmussen & Anderton in 2005) while 81% was other resident birds (Table 4). Sri Lanka Sperfowl *Galloferdix bicalcarata* was recorded indirectly by undoubted vocal calls, but not visually. Frogmouth *Batrachostomus moniliger* (Plate 2,M), Crimson fronted Barbet *Megalaima rubricapillus* (Plate 2,K), Sri Lanka Hanging Parrot *Loriculus beryllinus* (Plate 2,L) and Black-crested Bulbul *Pycnonotus melanicterus* (Plate 2,J) are not uncommon in Morankanda. Small flock (max. 8 individuals) of Sri Lanka Grey hornbill *Ocyceros gingalensis* (Plate 2,N) were observed occasionally while Banded Crake *Rallina eurizonoides* (Plate 2P) was uncommon. Noticeable event of birds are seasonally internal migrations. Obvious example around the Morankanda site is small flock of Indian Peafowl *Pavo cristatus* (dry zone Bird) recorded in dry seasons (around 4 individuals). The Spot-bellied eagle owl *Bubo nipalensis* is not difficult to observe around Morankanda area. During the period, it was visually observed many times during nocturnal animal surveys and confirmed by vocal records. Deposited waters on top of the rocky places were remarkable places for observing birds. Particularly in dry periods, there are multi species flocks gathering to hydrate and the event continued for many hours. Bulbuls (*Pycnonotidae*), Sunbirds and flower-packers (*Nectariniidae*), babblers (*Sylviidae*), Munias (*Passeridae*), and white-eyes (*Zosteropidae*) are also common in the flocks.

Taxonomical identification of some families such as leaf-nosed bats (Hipposideridae), horse-shoe bats (Rhinolophidae) and Pipistrelle (Vespertilionidae) were difficult to detect with the methods used. A total of 26 mammalian fauna were identified visually, which were validated to be accurate (Table 5). Among them, three species were endemic. The Sri Lanka purple-faced leaf monkey *Semnopithecus vetulus* (Plate 2, H) is noted as a common species of the site which is listed as endangered on the IUCN Red list (IUCN 2014). Moreover the Mouse-deer *Moschiola meminna* and the Sri Lanka toque monkey *Macaca sinica* (Plate 2, I) are regular endemics occurring on the site. According to the habitat survey, potentially more species can exist around the survey site. Especially habitats of the golden palm civet *Paradoxurus zeylonensis* and the red slender Loris *Loris tardigradus* are obvious but were never recorded visually or vocally.

Table 4. Status of Avifauna of Morankanda Mukalana

Family	Common name	Binomial name	Status	Abundance
Phasianidae	Sri Lanka Junglefowl	*Gallus lafaytii*	**E**	Average Abundant
	Sri Lanka sperfowl	*Galloferdix bicalcarata*	**E**	Rare / Hz
	Indian Peafowl	*Pavo cristatus*	**IM**	Random
Dendrocygnidae	Lesser Whistling-duck	*Dendrocygna javanica*		Common
Turnicidae	Barred Buttonquail	*Turnix suscitator*		Common
Picidae	Brown-capped Pigmy Woodpecker	*Dendrocopos mahrattensis*		Average Abundant
	Lesser Yellownape	*Picus chlorolophus*		Random
	Crimson-backed Flameback	*Chrysocolaptes stricklandi*	**E ?**	Common
Megalaimidae	Brown- headed Barbet	*Megalaima zeylanica*		Very Common
	Sri Lanka Yellow fronted Barbet	*Megalaima flavifrons*	**E**	Average Abundant
	Crimson fronted Barbet	*Megalaima rubricapillus*	**E ?**	Average Abundant
Bucerotidae	Sri Lanka Grey Hornbill	*Ocyceros gingalensis*	**E**	Random
Coraciidae	Indian Roller	*Coracias benghalensis*		Common
Alcedinidae	Common Kingfisher	*Alcedo atthis*		Average Abundant
	Oriental Dwarf Kingfisher	*Ceyx erithacus*		Rare
Halcyonidae	Stork –billed Kingfisher	*Halcyon capensis*		Random
	White-throated Kingfisher	*Halcyon smyrnensis*		Very Common
Meropidae	Blue –tailed Bee-eater	*Merops philippinus*	**M**	Very Common
	Chestnut-headed Bee-eater	*Merops leschenaulti*		Average Abundant
Cuculidae	Asian Koel	*Eudynamys scolopacea*		Very Common
Centropodidae	Greater Coucal	*Centropus sinensis*		Very Common
Psittacidae	Sri Lanka Hanging Parrot	*Loriculus beryllinus*	**E**	Common
	Alexandrine Parakeet	*Psittacula eupatria*		Common
	Rose-ringed Parakeet	*Psittacula krameri*		Very Common
	Plum-headed Parakeet	*Psittacula cyanocephala*		Average Abundant
	Sri Lanka Layard's Parakeet	*Psittacula calthropae*	**E**	Rare
Apodidae	Indian Suiftlet	*Collocalia unicolor*		Common
	Asian Palm Swift	*Cypsiurus balasiensis*		Very Common
	House Swift	*Apus affinis*		Common

Table 4. Continued..

Family	Common name	Binomial name	Status	Habitat Preferences
Hemiprocnidae	Crested Treeswift	*Hemiprocne coronata*		Common
Strigidae	Oriental Scops Owl	*Otus sunia*		Average Abundant
	Collared Scops Owl	*Otus bakkamoena*		Average Abundant
	Brown Fish Owl	*Ketupa zeylonensis*		Random
	Spot-bellied eagle owl	*Bubo nipalensis*		Random
	Brown Wood Owl	*Strix leptogrammica*		Rare
	Brown Hawk Owl	*Ninox scutulata*		Average Abundant
Batrachostomidae	Frogmouth	*Batrachostomus moniliger*		Average Abundant
Caprimulgidae	Jerdon's Nightjar	*Caprimulgus atripennis*		Average Abundant
Columbidae	Rock Pigeon	*Columba livia*		Common
	Spotted Dove	*Streptopelia chinensis*		Very Common
	Emerald Dove	*Chalcophaps indica*		Average Abundant
	Pompadour Green Pigeon	*Treron bicinta*		Average Abundant
	Green Imperial Pigeon	*Ducula aenea*		Very Common
Rallidae	White-breasted Waterhen	*Amaurornis phoenicurus*		Common
	Banded Crake	*Rallina eurizonoides*	**M**	Rare
Charadriidae	Black-winged Stilt	*Himantopus himantopus*		Common
	Red –wattled Lapwing	*Vanellus indicus*		Common
Laridae	Whiskered Tern	*Chlidonias habridus*	**M**	Common
Accipitridae	Brahminy Kite	*Haliastus leucogaster*		Common
	Crested Serpent Eagle	*Spilornis cheela*		Common
	Shikra	*Accipiter badius*		Common
	Changeable Hawk Eagle	*Spizaetus cirrhatus*		Average Abundant
Phalacrocoracidae	Little Cormorant	*Phalacrocorax niger*		Common
	Indian Cormorant	*Phalacrocorax fusciocollis*		Common
Ardeidae	Little Egret	*Egretta garzetta*		Common
	Purple Heron	*Ardea purpurea*		Common
	Great Egret	*Casmerodius albus*		Common
	Intermediate Egret	*Mesophoyx intermedia*		Common
	Cattle Egret	*Bubulcus ibis*		Very Common
	Pond Heron	*Ardeola grayii*		Very Common
	Black-crowned Night Heron	*Nycticorax nycticorax*		Random

Table 4. Continued..

Family	Common name	Binomial name	Status	Habitat Preferences
Ciconidae	Asian Openbill	*Anastomus oscitans*		Random
Pittidae	Indian Pitta	*Pitta brachyura*	**M**	Common
Irenidae	Blue-winged Leafbird	*Chloropsis cochinchinensis*		Common
	Golden-fronted Leafbird	*Chloropsis aurifrons*		Average Abundant
Laniidae	Brown Shrike	*Lanius cristatus*		Common
Tephrodornithidae	Sri Lanka woodshrike	*Tephrodornis affinis*	**E ?**	Average Abundant
Corvidae	House Crow	*Corvus splendens*		Very Common
	Large –billed Crow	*Corvus macrorhynchos*		Very Common
	Ashy Woodswallow	*Artamus fuscus*		Common
	Black-hooded Oriole	*Oriolus xanthornus*		Common
	Black-headed Cuckooshrike	*Coracina melanoptera*		Common
	Small Minivet	*Pericrocotus cinnamomeus*		Common
	Scarlet Minivet	*Pericrocotus flammeus*		Common
	Bar-winged Flycatcher-shrike	*Hemipus picatus*		Average Abundant
	White-browed Fantail	*Rhipidura aureola*		Common
	White-bellied Drongo	*Dicrums caerulescens*		Very Common
	Asia Paradise-flycatcher	*Terpsiphone paradisi*	**M**	Average Abundant
	Common Iora	*Aegithina tiphia*		Common
Muscicapidae	Asian Brown Flycatcher	*Musciapa dauurica*		Common
	Tickell's Blue Flycatcher	*Cyornis tickelliae*		Common
	Oriental Magpie Robhin	*Copsychus saularis*		Very Common
	Indian Robin	*Saxicoloides fulicat*		Very Common
Monarchidae	Black-Naped Blue Monarch	*Hypothymis azurea*		Random
Sturnidae	Common Myna	*Acridotheres tristis*		Very Common
	Hill Myna	*Gracula religiosa*		Random
Hirundinidae	Barn Swallow	*Hirundo rustica*	**M**	Very Common
	Red-rumped Swallow	*Hirundo hyperythra*	**E?**	Common
Pycnonotidae	Black-crested Bulbul	*Pycnonotus melanicterus*	**E**	Average Abundant
	Red-vented Bulbul	*Pycnonotus cafer*		Very Common
	White-browed Bulbul	*Pycnonotus luteolus*		Very Common
Cisticolidae	Jungle Prinia	*Prinia sylvatica*		Common
	Plain Prinia	*Prinia inornata*		Common
Zosteropidae	Oriental White-eye	*Zosterops palpebrosus*		Common

Table 4. Continued..

Family	Common name	Binomial name	Status	Habitat Preferences
Sittidae	Velvet-fronted Nuthatch	*Sitta frontalis*		Rare
Sylviidae	Common Tailorbird	*Orthotomus sutorius*		Very Common
	Booted Warbler	*Hippolais caligata*	**M**	Rare
	Sri Lanka Brown-capped Babbler	*Pellorneum fuscocapillum*	**E**	Common
	Tawny-bellied Babbler	*Dumetia hyperythra*		Common
	Dark-fronted Babbler	*Rhopocichla atriceps*		Common
	Yellow-billed Babbler	*Turdoides affinis*		Very Common
Nectariniidae	Pale billed Flowerpecker	*Dicaeum erythrorynchos*		Very Common
	Purple-rumped Sunbird	*Nectarinia zeylonica*		Very Common
	Purple Sunbird	*Nectarinia asiatica*		Very Common
	Loten's Sunbird	*Nectarinia lotenia*		Very Common
Passeridae	House Sparrow	*Passer domesticus*		Very Common
	Forest Wagtail	*Dendronanthus indicus*	**M**	Common
	Yellow Wagtail	*Motacilla flava*	**M**	Average Abundant
	Paddyfield Pipit	*Anthus rufulus*		Common
	Streaked Weaver	*Ploceus manyar*		Average Abundant
	White-rumped Munia	*Lonchura striata*		Very Common
	Scaly-breasted Munia	*Lonchura punctulata*		Very Common

Key: E= Endemic; E?= Proposed Endemic; M= Migrant; IM= Internal Migrant or Inter Zones Migrants; very common= spared around most habitats and number of individuals high; common = Number of individuals high; Rare= less than 2 records; Random = only records; Average Abundant = number of individuals average but not uncommon in the site; Hz= Vocal records only

Table 5. Status of Mammal fauna of Morankanda Mukalana

Family	Common name	Binomial name	Status	Abundance
Oricidae	Common musk shrew	*Suncus murinus*		Very Common
Hipposideridae	Bicoloured leaf-nosed bat	*Hipposideros ater*		Common
	Schneider's leaf-nosed bat	*Hipposideros speoris*		Common
Pteropdidae	Short-nosed fruit bat	*Cynopterus sphinx*		Common
	Flying fox	*Pteropus giganteus*		Very Common
	Fulvous fruit bat	*Rousettus leschenaulti*		Very Common
Rhinolophidae	Lesser woollyhorse-shoe bat	*Rhinolophus beddomei*		Average Abundant
Vespertilionida	Pigmy pipistrelle	*Pipistrellus tenuis*		Very Common

Table 5. Continued..

Family	Common name	Binomial name	Status	Abundance
Cercopithecida	Sri Lanka toque monkey	*Macaca sinica*	**E**	Random
	Sri Lanka purple-faced leaf monkey	*Semnopithecus vetulus*	**E**	Average Abundant
Canidae	Jackal	*Canis aureus*		Average Abundant
Felidae	Fishing cat	*Prionailurus viverrinus*		Rare
Herpestidae	Brown mongoose	*Herpestes brachyurus*		Common
	Grey mongoose	*Herpestes edwardsii*		Average Abundant
	Ruddy mongoose	*Herpestes smithii*		Average Abundant
Viverridae	Palm-cat	*Paradoxurus hermaphoditus*		Average Abundant
Suidae	Wild boar	*Sus scrofa*		Common
Tragulidae	Mouse-deer	*Moschiola meminna*	**E**	Random
Hystricidae	Porcupine	*Hystrix indica*		Common
Muridae	Mole rat	*Bandicota bengalensis*		Very Common
	Malabar bandicoot	*Bandicota indica*		Very Common
	Indian field mouse	*Mus booduga*		Common
	Common house rat	*Rattus rattus*		Very Common
Sciuridae	Palm squirrel	*Funambulus palmarum*		Very Common
	Giant squirrel	*Ratufa macroura*		Random
Leporidae	Black-naped hare	*Lepus nigricollis*		Common

Key: E= Endemic ; very common= spared around most habitats and number of individuals high ; common = Number of individuals high; Rare= less than 2 time records/ Random = only couple of time records; Average Abundant = number of individuals average but not uncommon in the site.

Number of causes against fauna was identified by the survey. Illegal cultivation methods, slope lands clearance, poaching, hunting of wild animals and illegal sand mining were common events happening in the area. Wild boar and porcupine are common targets for hunting. Fertilizer and pesticide use is uncontrolled due to lack of awareness, which may be threatening to animals. Plantation practices exposed soils and erosions affected clear waters.

Considering geographical position, Morankanda is biogeographically important to the fauna to use as inter-transmission forest vegetation between three major forest reserves, Beraliya-mukalana FR, Dara-akulkanda FR and Polgahavila PFR. It is significant to introduce analogue forests practices in to the intermediate lands such as plantations and home gardens to bring their

ecological distinctiveness with economic benefits. When an ecosystem is designed to mimic the native climax state as an analogue forest, the efficiency and dynamics of the natural processes can be replicated (Liyanage *et al*. 2009). There are few examples for well-established analogue forests which already exist nearby western border of Beraliya-mukalana FR named as 'Bangamu-kande' (80^{o} 16' 25.9" E - 06^{o}20' 45.5" N / 80^{o} 16' 39.9" E - 06^{o} 20' 15.7" N), and 'Liyanagama-kande' (80^{o} 16' 53.9" E 06^{o} 19' 86.2" N / 80^{o} 16' 41.6" E 06^{o} 20' 17.5" N) (Liyanage *et al.* 2013). According to the results and highlights of the vertebrate fauna reported by current survey, high level of diversity in the forest patch is obvious, thus conservation practices should be adapted to preserve remaining biodiversity without impacting on economic benefits. Measures like converting to analogue forestry practice may be applicable in this perspective to improve quality of wild habitats in future agro ecosystem plans amended by Morakanda Estate management. Similar kind of survey will be important to assess the outcome benefits subsequent to adopting the ecosystem friendly agro-ecosystem practices.

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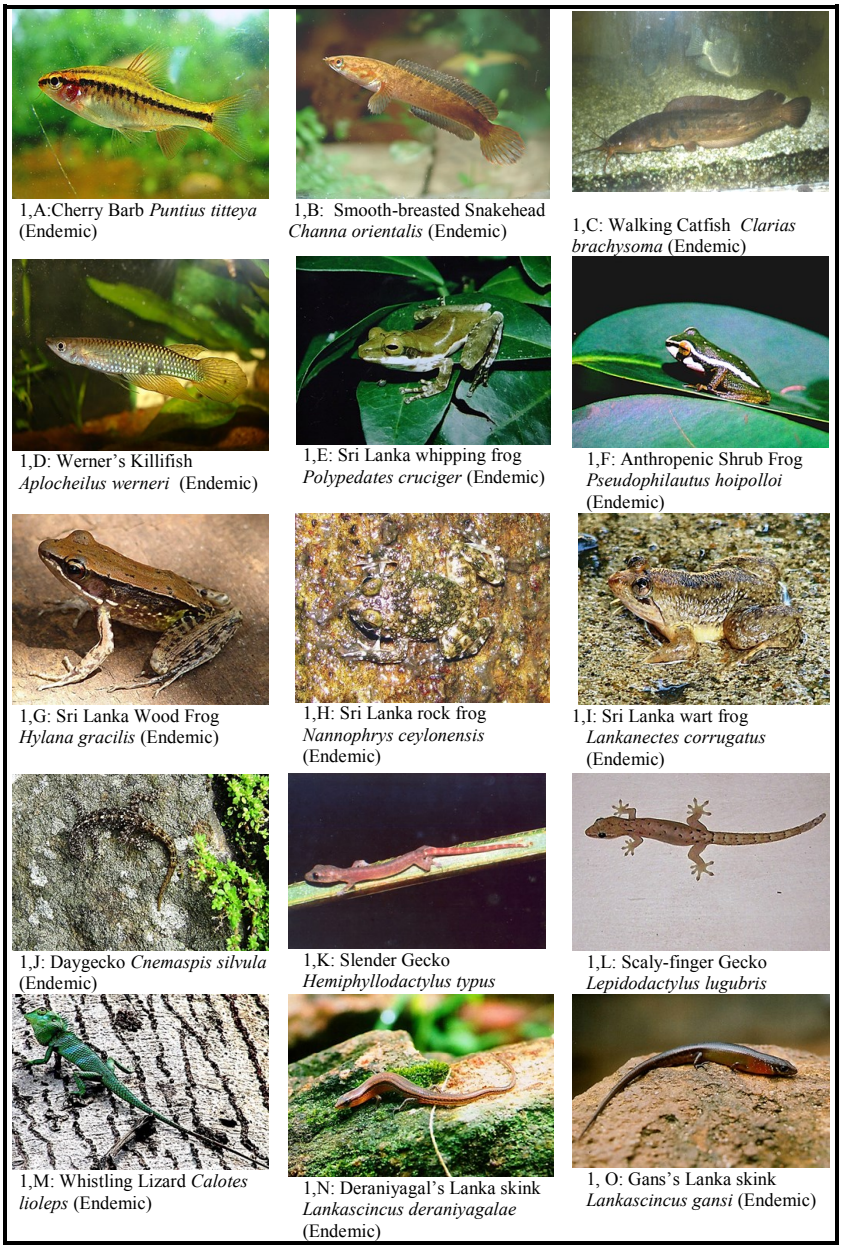
Plate 1. Images of selected vertebrate fauna (fishes, amphibians and reptiles) at Morankanda (All photos by H.B. Jayaneththi).



1,A:Cherry Barb *Puntius titteya* (Endemic)

1,B: Smooth-breasted Snakehead *Channa orientalis* (Endemic)

1,C: Walking Catfish *Clarias brachysoma* (Endemic)

1,D: Werner's Killifish *Aplocheilus werneri* (Endemic)

1,E: Sri Lanka whipping frog *Polypedates cruciger* (Endemic)

1,F: Anthropenic Shrub Frog *Pseudophilautus hoipolloi* (Endemic)

1,G: Sri Lanka Wood Frog *Hylana gracilis* (Endemic)

1,H: Sri Lanka rock frog *Nannophrys ceylonensis* (Endemic)

1,I: Sri Lanka wart frog *Lankanectes corrugatus* (Endemic)

1,J: Daygecko *Cnemaspis silvula* (Endemic)

1,K: Slender Gecko *Hemiphyllodactylus typus*

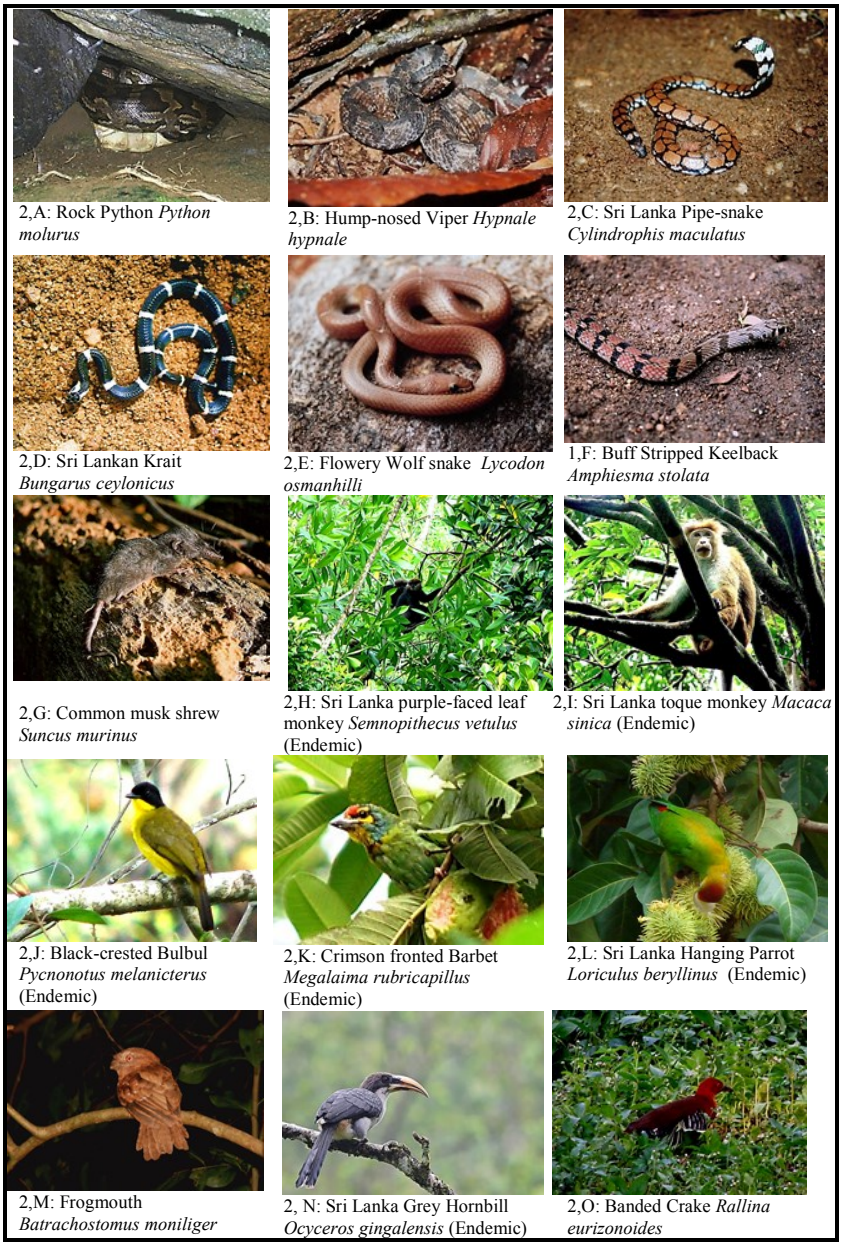
1,L: Scaly-finger Gecko *Lepidodactylus lugubris*

1,M: Whistling Lizard *Calotes lioleps* (Endemic)

1,N: Deraniyagal's Lanka skink *Lankascincus deraniyagalae* (Endemic)

1, O: Gans's Lanka skink *Lankascincus gansi* (Endemic)

Plate 2. Images of selected vertebrate fauna (snakes, mammals and birds) at Morankanda (all photos by H.B. Jayaneththi; except 2A by G. Chathuranga, 2L by J.M. Jayaneththi and 2N by H. Pitumpe).



2,A: Rock Python *Python molurus*

2,B: Hump-nosed Viper *Hypnale hypnale*

2,C: Sri Lanka Pipe-snake *Cylindrophis maculatus*

2,D: Sri Lankan Krait *Bungarus ceylonicus*

2,E: Flowery Wolf snake *Lycodon osmanhilli*

1,F: Buff Stripped Keelback *Amphiesma stolata*

2,G: Common musk shrew *Suncus murinus*

2,H: Sri Lanka purple-faced leaf monkey *Semnopithecus vetulus* (Endemic)

2,I: Sri Lanka toque monkey *Macaca sinica* (Endemic)

2,J: Black-crested Bulbul *Pycnonotus melanicterus* (Endemic)

2,K: Crimson fronted Barbet *Megalaima rubricapillus* (Endemic)

2,L: Sri Lanka Hanging Parrot *Loriculus beryllinus* (Endemic)

2,M: Frogmouth *Batrachostomus moniliger*

2, N: Sri Lanka Grey Hornbill *Ocyceros gingalensis* (Endemic)

2,O: Banded Crake *Rallina eurizonoides*