The Sinharaja-Kanneliya biodiversity corridor project: monitoring and contrast of biophysical characteristics

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- ***Introduction***

Reforestation and conservation efforts have been pivotal in slowing the rates of forest removal throughout the world. Globally, natural secondary succession has reclaimed 15% of deforested areas and 19% of all tropical and subtropical moist forests now have formal protection (Wright in press). However, the pressure on forested lands and natural resources continues to grow, especially in highly populated landscapes such as Sri Lanka. The ongoing delivery of environmental services of clean water, erosion control, nutrient cycling, habitat provision and biodiversity conservation are now threatened.

Long term initiatives to increase our understanding of complex ecosystems, improve the quality of data on which we base our decisions and encourage further development in a sustainable manner are required. Projects which are designed for positive environmental, economic and social aspects tend to have a greater chance of success. Although restoration can vary at a local and national level due to differences in funding, skill levels, cultural history and community desires, these three elements can be incorporated into any initiative.

This project attempts to initiate a baseline monitoring program to detect differences in the land use types of Analogue forestry, tea land, pinus plantation and untouched forest in the wet zone of Sri Lanka. It aims to understand the differences in species, forest structure and soils and describe the change that occurs at these sites through time. It intends to contribute to the scientific basis of analogue forestry methods and further delimit the effect of species manipulation on the various site characteristics.

This report has been completed as part of the Young Forester Award work placement supported by the Commonwealth Forestry Association (CFA). It can be considered as an interim report only, providing the base information for further study of Rainforest Rescue International (RRI) land at Hiniduma.

- ***Forest Trajectories - degradation and restoration***

The dramatic physical changes that accompany land conversion from natural rainforest to plantation or high input agriculture seem obvious, but lack of understanding still constrains restoration efforts. Evidence suggests that little reversal of the soil changes due to deforestation occurs on land that has undergone 30 years fallow followed by 10 yrs reforestation (Florentine & Westbrooke 2003). Differences in structure of eastern Australian forests along a gradient of land use have been clearly identified many years after planting, with restoration plantings and old regrowth possessing far greater complexity (Kanowski *et al* 2003). There have been several trials established and conceptual models of forest recovery developed, but overall our scientific knowledge is poor.

Later phase research into mixed plantations in the tropics is necessary (Piotto et al 2004) before theory can be fully converted into practise. Whilst secondary forest and plantations generally support less diverse pioneer plant species and limited animal life, they can provide a starting point for primary forest species to re-establish and reattain former levels of biodiversity. This is highlighted by the recruitment of an understorey of rain forest plants in pine plantations adjacent to rain forest. *Pinus cariabea* has been used as a nurse crop for the more sensitive rainforest species (Ashton et al 2001), shading out weeds to prevent excess competition and provide favourable microclimate for seedling establishment. Parrotta *et al* (1997) provide evidence that plantations can act as "successional catalysts", initiating changes in under-storey microclimatic conditions, increasing structural complexity and contributing to litter and humus layer accumulation.

Methods and obstacles to tropical forest regeneration have been documented and discussed (Holl 1999) (Florentine & Westbrooke 2003). A variety of restoration techniques are tailored to site characteristics but generally follow one of two main principles (Florentine & Westbrooke 2003). The framework species method utilizes fast growing species to provide a good canopy and suppress weeds in a short period of time. In contrast the maximum species diversity method incorporates a variety of species, including a large percentage of species from the mature phase of growth, in the initial planting and will most likely requires intensive post planting maintenance. Issues to be addressed include lack of seed due to long distance to surrounding seed sources or poor dispersal methods, competition from aggressive weeds, nutrient depletion and browsing.

Another option for restoration is Analogue forestry, which attempts to mimic the diversity and structure of a climax forest and in turn restore ecosystem function. Emphasis is placed on native species, but other high utility species may be incorporated into the design. It is assumed that analogue forestry has an advantage over single species plantation production forestry in creating a functioning system with defenses against disease, pests and pathogens and producing soil rich in macro and micro-fauna. It has the potential to create and develop local markets and provide an alternative source of income and employment for local communities (Senanayake & Jack 1998). . Anecdotal evidence suggests that by utilizing analogue forestry principles a high level of natural function can be achieved over time, yet basic scientific documentation is still required.

Analogue forestry in Australia has not found wide acceptance, but has potential for further expansion. A pilot project at Stretham in Western Victoria was initiated by the Environmental Management Unit at Monash University. Project failure was attributed to a poor time commitment by project participants, loss of project group cohesion and an upturn in other, more traditional markets (Senanayake & Jack 1998).

- ***Monitoring approaches***

Monitoring change is essential for development and performance evaluation of programs to protect biodiversity. Without a baseline to measure against there is no way to determine if a project has been successful or further degradation to forest composition, structure and ecosystem function has occurred. Presently, monitoring of Australian restoration projects is not standardized and failure to undertake monitoring carries no consequences (Freeman 2004). Obstacles to monitoring by volunteer organizations as highlighted by Freeman (2004) are a lack of personnel, lack of experience and limited support for the benefits of long term vegetation monitoring.

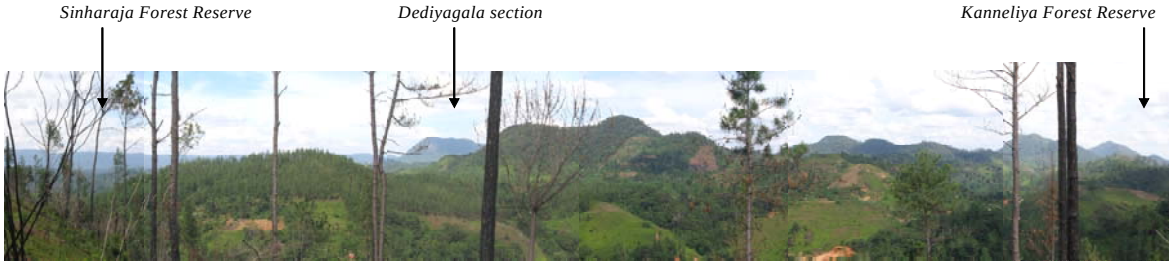
A system of monitoring vegetation change over time can take many forms. For example the USA Forest Health Monitoring System (FHM) involves approximately 4000 plots on forested land , that are assessed for rates of regeneration, survivorship, soil nutrients, erosion, crown condition, damage and mortality, lichen health and ozone bioindicators (Bellingham 2000). Alternatively the UNESCO Man and Biosphere (MAB) program has established nearly 130 one hectare plots in the tropics. For woody plants greater than 10cm diameter species, GPS coordinates, status, height and diameter are recorded every 1-5 years(Bellingham 2000). Soil type, slope, geography and present and past land uses are noted for each plot.

In Sri Lanka monitoring and research gained focus with a declared moratorium on logging in mixed the dipterocarp forests of the south west in 1989 (Ashton *et al* 2001) and the establishment of a permanent forest research station in the Sinharaja forest reserve. Under the MAB program a 25 ha plot was established in 1993 to monitor long term change to structure and function in the Sinharaja Forest Reserve (Gunatilleke et al 2004). A basic flora inventory (trees >10cm DBH, Basal area, species richness and degree of dominance for different strata) was undertaken. Findings from the Sinharaja can be adapted to smaller scale monitoring programs.

Monitoring biodiversity change requires a broad range of species to be studied, as no single group of invertebrates, larger animals or plants acts as a good indicator for the abundance of all others (Lawton *et al* 1999). Tsukamoto and Sabang (2005) found abundance of soil macro-invertebrates in a mature *Acacia mangium* plantation was similar to primary rainforest. However a single introduced earthworm species resulted in four times greater biomass and decreased species diversity in the plantation. Nakamure et al (2003) utilized the frequency scores of five taxonomic groups (ants, centipedes, millipedes, isopods and amphipods) as an indicator of restoration status. This method can provide a clear distinction of primary forest and plantation, and a ranking of the various ages of restoration plantings. Senanayake (1989) promotes the use of the tropical forest register as a quick and robust assessment of growth forms and structure characteristics. Other factors that can be used to indicate broader forest health or success of restoration plantings involve attention to the litter layer, soil macro-fauna, life forms and microbial activity of major keystone species.

Site description

The biodiversity corridor attempts to create a continuous tract of forested land of minimum 100m width between the Sinharaja Forest Reserve and the Kanneliya Forest Complex (comprising the Kanneliya, Dediyagala and Nakiyadeniya areas). Figure 1 illustrates the intervening land use under both private and public ownership and the sizeable nature of the task.



With the influence of British colonial immigrants, traditional land use was altered from low impact forestry and harvesting of non-timber forest products to widespread clearance of native vegetation for the introduction of agriculture such as tea, rubber, coconut and rice. As a result the ease of movement between forest patches, distribution of seed and the ability of populations to exchange genes is greatly restricted.

The study site is approximately 6.5 hectares in size and is characterized as a mixture of secondary forest, abandoned rice, riverine and harvestable tea. It is clear that the forest has regenerated following anthropogenic intervention and minimal ongoing disturbance. However, the achievement of a desirable species mix and the occurrence of regeneration on an appropriate time scale requires greater attention.

- ***Plot description and mapping***

Long term monitoring plots of 25m x 25m are to be established in different land use areas. Plot size was selected based on previous experience of program directors, skill of monitoring personnel and time and budget constraints.

- *analogue forestry/abandoned tea land*

A plot of 25m X 25m established. The boundary was temporarily cleared in order to run out a tape and the corners marked with wooden poles with yellow paints at the tip. Poles will be replaced with concrete in the analogue and lowland forest plots

- *tea land*

Due to restricted size of the tea area two half size plots of 30.4 x 10m were established, one on Rainforest Trust of Sri Lanka (RFofSL) land and the other in neighbouring private property

- *home garden*

A suitable site is still to be located within the corridor area

- *pinus*

Permission to establish a plot and enter the land immediately behind Hiniduma is to be sought from the Ministry of Forestry by Dr. Punchihava

- *untouched lowland rainforest*

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The tropical forest register was utilized to assess the plots and the broader Hiniduma site. It is an index that provides information on growth form, coverage, height and leaf characteristics (refer Appendix 1). Species within each layer contained within the plot were described accordingly. All life forms, including weeds were considered although limited access to references has delayed the identification to species level. A complete plant species list can be seen in Appendix 2.

The site boundary and the major vegetation changes have been mapped with an etrex 12 channel GPS unit. ArcGIS was used to create a working map for the site. Maps can be further refined as more work is carried out on the site as tutorials in the operation of ArcGIS were given to staff. Both GPS elevation and altimeter data are considered too inaccurate for the small scale changes that occur across the Hiniduma land.

Digital base layer information is not available from the Surveyor General's office (roads, land use categories, hydrology etc) at a scale less than 1:50,000. Altimeter data was manually rather than digitally plotted by the Surveyor General's office for most of the corridor area and is of little use for our purposes. Access to scanned aerial photographs from 1983 (83.4 exposure 218 [Line 19] and 83.7 exposure 77 [Line 20]) for the Hiniduma site has been requested from the Ministry of Defense (letter sent week of September 17th). Once confirmation is received these will need to be purchased from the Surveyor General's Office. Access to satellite data is also being investigated. If it is not available at reasonable cost purchase of aerial photographs from flight paths that cross the corridor land is recommended.

Plots will be monitored annually for changes in above ground flora and at the end of five years for all categories. Work by the Ruhunu university students (supervised by Dr Punchihava, Senior lecturer) is scheduled to begin in November pending development of a work plan and provision of funding.

Future developments

Analogue forestry combined with an ecotourism venture has the potential to fulfill economic, environmental and social requirements. Future development of the biodiversity corridor will involve further land purchase and extension work with the local and international community. An RRI extension officer will receive training in eco-tourism and accommodation for staff and visitors is close to completion. Informal consultation and involvement of the local community has already begun with a seminar on the benefits of the rainforest and RRI's school program. By establishing the lands as Hiniduma as a productive demonstration of analogue forestry, sustainable harvest levels can be identified, successful methods of regeneration observed and many skills shared.

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Initial plot descriptions

Plot 1: Tea

Layer	***Species***	***Description***
Top	*Cocos nusifera*	PM6awl
	Alstonia macrophylla	RM6awl
	Pericopsis mooniana	RM6bws
	Areca catechu	PM6awl
	Persea americana	RM6awn
2	*Gini grass*	GM5ahs
	Caryota urenus	PM6awl
	Gliricidia sepium	RM5awl
3	*Camelia sinensis*	Rl3cwn
	Piper nigrum	CL3awn
4	*Neprolepis* sp.	FG2bwl
	Argyreia populifolia	FG2aws
	Osbeckia aspera	RG2aws

Plot 2. Analogue forest / home garden area

Layer	***Species***	***Description***
Top	*Alstonia macrophylla*	RU8bwn
2	*Symplocos cochinchinensis*	RU7bws
	Gliricidia sepium	RU7aws
	Macaranga peltata	RU7ase
3	*Osbeckia aspera*	RM5bws
	Callophylum sp.	RM5bws
	F14	RM5awn
	F15	RM4awe
4	*Clidemia hirta*	RL4bws
	Lygodium sp.	FL4bwe
	Vitex altissima	RL4aws
	Helipdis sp.	RL4aws
	Gini grass	GL3bws

5	F9	CG2awe
	F12	CG2awe
	Dicranopteris linearis	FG2rwe
	Neprolepis sp. .	FG2rwe
	Cinnamonum verum	RG2aws
	Macaranga peltata	RG2ase
	Maduca sp.	EG2ahs
	Pagiantha dichotoma	RG2awl

Plot 3. Neighbouring tea

Layer	***Species***	***Description***
Top	*Alstonia macrophylla*	RU8bwn
	Swietinia macrophylla	RU8awl
2	*Alstonia macrophylla*	RM7bwn
	Elaeocarpus serratus	RM7aws
3	*Gliricidia sepium*	RL5awl
	Piper nigrum	CL5bwn
	Pericopsis mooniana	RL5awl
	Caryota urens	PL5awl
	Psidium guajava	RL5aws
4	*Camellia sinensis*	RL4cwn
	Artocarpus heterophyllus	RL4awl
	Osbeckia aspera	RL4aws
Ground layer	*Mimosa pudica*	T*G28bwi
	Centella asiatica	CG8bwi
	Selaginella sp.	LGrwi
	Wal innala (S)	T*G2bwi
	H5	R*G2bws
	H4	R*G2bwi
	Ageratum conyzoides	R*G2bws
	Babila (S) – H1	R*G2aws
	Wathura gas (S) - H6	R*G2aui
	H8	GG2bws
	H7	GG2bws
	H9	FG2bwi
	H10	FG2wbl
	Neprolepis sp.	FG2wbl

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Appendix 1: Tropical forest register
(devised by Kuchlar and modified by Senanayake in 1989)
Physiognomic classification of vegetation using growth forms and structural categories according to height

A Growth Form Categories

Basic Growth forms

Woody plants

Broadleaf evergreen	R
Broadleaf deciduous	D
Needleleaf evergreen	E
Needleleaf deciduous	N
Aphyllous (no leaves)	A
Semi-deciduous (R+D)	S
Mixed (D+E)	M

Herbaceous plants

Graminoids	G
Forbs (Ferns)	F
Lichens, Mosses	L

Special Growth Forms

Climbers (lianas)	C
Stem succulents (cactus)	K
Tuft plants	T
Bamboos	B
Epiphytes	X
Palms	P
Orchids	O

* used to indicate weed

B Structural Characteristics

Height (Stratification)

Height class

1.	= greater than 35m	E
2.	= 20 - 35 m	U
3.	= 10 - 20 m	
4.	= 5 - 10 m	M
5.	= 2 - 5 m	
6.	= 0.5 – 2 m	L
7.	= 0.1 -0.5 m	
8.	= less than 0.1 m	
9.	= surface	G

Coverage

Coverage class

Continuous (over 75 %)	c
Interupted (50 – 75 %)	l
Patchy (25 – 50 %)	p
Rare (6 – 25 %)	r
Sporadic (1 - 6 %)	b
Almost absent (<1%)	a

Leaf characteristics

Hard (sclerophyll)	h
Soft	w
Succulent	u
Mesophyll (over 12.7 cm)	l
Notophyll (7.6-12 cm)	n
Microphyll (2.5-7.6 cm)	s
Nannophyll (under 2.5 cm)	i

Special growth forms

Climbers (lianas)	C
Stem succulent (Catus)	K
Tuft plants	T
Bamboos	B
Epiphyte	X
Palms	P
Orchids	O

Appendix 2. Complete Plant List

Botanical name	Family	Common name	Specimen	Location	Quick plant features	Comment
Mangifera indica	*Anacardiaceae*	Mango (E), Amba(S)	N/A	Analogue forest	Leaves lanceolate, long pointed ends, dark green and leathery	
Semecarpus walkeri	*Anacardiaceae*	Badulla (S)	C18	Analogue forest	Tree, leaves oblong, acuminate apex, lateral veins almost at right angles, pedicle at swollen corky	
Alstonia macrophylla	*Apocynaceae*	Hawari nuga (S)	N/A	Analogue forest	Tree, leaves in whorls of 3-4, cuneate base, abruptly short acuminate apex, margins entire	check no. whorls of greater leaf number
Pagiantha dichotoma	*Apocynaceae*	Divi-kaduru (S)	N/A	Analogue forest	Small tree, leaves oblong to elliptic base tapering, rounded to very short acuminate apex, lateral veins obscure, petiole base with rudimentary rim of stipules, trunk latex milky white and poisonous, fruit orange when ripe, fleshy	
Tabernaemontana divaricata	*Apocynaceae*	Crepe Jasmine (E), Wathu sudda (S)	N/A	Analogue forest	Leaves elliptic, flowers white, terminal but often overtopped by branches	
Hemidesmus indicus	*Asclepiadaceae*	Iramusu (S)	B22	Analogue forest	Small narrow leaves, medicinal	
Ageratum conyzoides	*Asteraceae*	Hulan thala (S), Goat weed (E)	H2	Widespread	Often strongly branched herb, decurrent with ascending or erect branches, 30 - 120 cm tall with a strong taproot and fibrous roots at base. Leaves - simple, opposite, ovate to rhomboid - ovate	
Ananas comosus	*Bromeliaceae*	Pineapple(E), Anarsi(S)	N/A	Amalogue forest		
Callophyllum mooni	*Clusiaceae*	Domba-keena (S)	B3	Analogue forest	Leaves large opposite, acute apex, lateral veins parallel, leathery, midrib raised,	
Garcinia quaesiata	*Clusiaceae*	Goraka(S)	B4	Analogue forest	Leaves variable, midvein prominent, fine lateral parallel veins	Need flower to confirm, possibly terpnophylla
Wedella trilobata	*Compositae*	Arundel (S), Daisy (E)		Tea	Yellow flower, leaves opposite decussate, creeping	
Argyreia populifolia	*Convolulaceae*	Girri-thillia (S)	C4	Analogue forest	Creeper with tendrils, rounded leaf	
Dillenia indica	*Dilleniaceae*	Hondapara (S)	B13	Analogue forest	Small tree, leaves closely placed, very large oblong lanceolate, acute apex, margins sharply serrate, lateral veins numerous, petioles deeply channeled above, swollen at base	
Elaeocarpus serratus	*Elaeocarpaceae*	Titta weralu (S)	to collect	Analogue forest	Leaves lanceolate, acute base and tapering apex, margins coarsely serrate, lateral veins beneath, prominently oblique glandular pits in axils	Need to compare *glandulifer* with *amoenus* (differing periole characteristics?)
Croton armomaticus	*Euphorbiaceae*	Wel-keppitea (S)	C7	Analogue forest	Shrub, leaves ovate, subcordate base, margins irregularly scalloped, ld leaves red, aromatic, petiole apex has pair of small circular glands	
Macaranga peltata	*Euphorbiaceae*	Kenda (S)	N/A	Analogue forest	Tree, leaves very large, broad peltate base, acuminate, acute apex, veins prominent beneath, petiole very long, branches conspicuously leaf scarred	
Manihot esculenta	*Euphorbiaceae*	Manioc (E), Manyokka (S)	N/A	Analogue forest	Leaves palmately lobed, dark green, each lobe obanceolate with an acute apex, petiole long, leaf scars prominent, stems slender	
Davidsea attenuata	*Gaminaceae*	Bamboo (E) bata(S)	N/A	Riverine	Shrub, apex leaf sheath slightly hairy	Look closer to determine species
Dicranopteris linearis	*Gleicheniaceae*	Giri - thilla	A8	Widespread	Fern, dichotomous branching	
Davidsea attenuata	*Gramineae*	Bamboo (E), Bata (S)	F21	Riparian	Leaves - lanceolate	

Botanical name	Family	Common name	Specimen	Location	Quick plant features	Comment
Cinnamonum verum	*Lauraceae*	Cinnamon (E)	N/A	Analogue forest	Evergreen tree, broad laminated green leaves, palmate venation, leaves opposite, spirally arranged	
Ncolitsea cassia	*Lauraceae*	Dawul kurundu (S)	G3	Analogue forest	Small tree, leaves lanceolate, tapering ends, margin undulate	
Gliricidia sepium	*Leguminaceae*	Weta hiriya (S)	N/A	Analogue forest, tea	Tree, leaves pinnate, leaflets paired with terminal, shade tree	
Pericopsis mooniana	*Leguminoceae*	Nadun (S)	G5	Tea land	Tree, leaves - pinnate, leaflets alternate to sub-opposite with terminal, ovate - elliptic. Round base	
Mimosa pudica	*Leguminosae*	Touch-me-not (E)	N/A	Widespread	Weed, leaves close when touched, pink flower	
Lycopodium obscurum	*Lycopodiaceae*	Tree clubmoss (E), Badalhaussa (S)?	B7	Rice	Similar to small, finely branched pine tree	
Clidemia hirta	*Melastomataceae*	Kark-bowitia (S)	C20	Widespread	Like *osbeckia* but hairier, invasive species after major flooding	
Osbeckia aspera (L.)	*Melastomataceae*	Bowitiya (S)	N/A	Analogue forest, widespread	5 prominent veins, rounded base with slightly twisted apex, hairy both sides	
Azadirachta indica	*Meliaceae*	Margosa (E), Kohomba (S)	N/A	Analogue forest	Tree, leaves crowded, pinnate leaflets paired with terminal, lanceolate of sickle shaped, very unequal sided, margins coarsely dentate, see field book	
Coscinium fenestratum	*Menispermaceae*	Weni-wal (S) Veni-vel-gata (S)	B5	Analogue forest	Creeper, leaves large , palmate venation	
Ficus hispida	*Moraceae*	Kota-dimbula (S)	C3	Analogue forest	Tree, Leaves opposite, oblong-elliptic acuminate apex, base cordate, 4-9 pairs of curved ascending lateral veins, rough, pale brown hairs, gland on petiole, twigs hollow	
Olex zelanica	*Olacaceae*	Mella (S)	G2	Analogue forest	Leaves are ovate - oblong, acute base, apex. Trunk - young branches yellow, acutely angled, finely ridged, glabrous	
Areca catechu	*Palmae*	Beetlenut (E), Puwak (S)	N/A	Analogue forest, tea	Tree, leaves pinnate, leaflets numerous, linear and parallel veined, trunk straight	
Caryota urens	*Palmae*	Kitul palm (E) Kitul (S)	N/A	Analogue forest	Tree, leaves badinage, arched drooping dark green, fish tail like leaflets in clusters or alternate, margins irregularly serrate, flowers are a large drooping spadix	
Cocos nucifera	*Palmae*	Coconut palm (E), Pol (S)	N/A	Analogue forest	Tree	
Phoenix farinifera	*Palmae*	Wild date palm(E), Indi(S)	F19	Analogue forest	Leaves - pinnate, one or more leaflets, Trunk mostly horizontal and under ground	
Pandanas ceylanicus	*Pandanaceae*	O-keyiya (S)	C9	Riparian	Shrub, leaves linear, prickly margin	
Piper nigrum	*Piperaceae*	Gum-miris(s), Pepper	N/A	Tea	Climber	
Zizyphus napeea	*Rhamnaceae*	Eranimiya (S)	F18	Analogue forest	Small herb	
Carallia brachita	*Rhizophoraceae*	Dawata (S)	B1	Analogue forest	leaves - broadly elliptic, tapering base, paler underneath with scattered black dots	Possibly quaesita
Hedyotis fruticosa	*Rubiaceae*	Weraniya (S)	A16	Analogue forest	Narrowly lanceolate leaves, base tapered, long pointed apex, dark green above, pale whitish green beneath, twigs quadrangular	

Botanical name	Family	Common name	Specimen	Location	Quick plant features	Comment
Mussaenda frondosa	*Rubiaceae*	Mussenda (ES)	N/A	Analogue forest	Shrub climbing by roots tendrils etc, leaf green, ovate to lanceolate, below inflorescence, veins prominent beneath, finely velvety, one sepal conspicuously enlarged and creamy white in colour	
Toddalia asiatica	*Rutaceae*	Kudu-miris (S)	B10		Tree, thorny branches, leaves small, spirally arranged	Better sample required
Dimocarpus longan	*Sapindaceae*	Mora (S)	B14	Analogue forest	Rachis finely hairy, leaflets oblong-lanceolate, base pointed and unequal, wavy margins	
Manicara hexendra	*Sapotaceae*	Wathu palu (S)	N/A	Widespread	Leaves paired, palmate venation, cordate base	What about manilkara hexendra the tree. Is this species spelt correctly?
Lygodium scandenes	*Schizaceae*	Pamba(S)	B9	Analogue forest	Fern, spores along centre margin,	Need better book reference
Symplocos cochinchinensis	*Symplocaceae*	Bombu (S)	B2	Analogue forest	Leaves broadly to narrowly elliptic, base tapered, apex blunt, margins wavy to dentate, lateral veins 6-10 pairs, glabrous	
Camelia sinensis	*Theaceae*	Tea (E), The (S)	N/A	Analogue forest, tea	Shrub, leaves elliptic, tapered base, long pointed apex, margins serrate, bright green, thick leathery, rarely exceeding 1.5m in height but over 2m in abandoned tea area	
Terma orientalis	*Ulmaceae*	Gedumba (S)	G6		Leaves - two ranked pointed apex, silvery adpressed hairs	
Clerodendrum infortunum	*Verbaceae*	Pinna(S)	C19	Analogue forest		
Stachytrapheta indica	*Verbanaceae*	Balunaguta (S)	F3	Analogue forest	Herb, small purple flowers emerging from sheath, opposite leaves at base only, serrated margin, see field book	
Lantana camara var. *aculeata* (L.)	*Verbenaceae*	Lantana (E), Ganda Pana (S)	N/A	Analogue forest	Leaves opposite, ovate to oblong, margin serrate to scalloped, sparsely brown pilose beneath, flowers yellow to rose	
Vitex altissima	*Verbenaceae*	Milla (S)	F5		Leaves - opposite, trifoliate; leaflets unequal, base pointed, elliptic. Trunk - grey with yellow - brown, hard, branches drooping	
Clemantis giganteum			N/A	Pinus, burnt	Creeper, leaf margin wavy, petiole twisted	
PARTIAL IDENTIFICATION ONLY (refer to field book)						
Ferns						
Neprolepis sp.	*Nephorolepidaceae*	Paththara (S)	A2	Analogue forest	Large frond, leaflets alternate, spores single row closer to margin than midvein	
Selaginella sp.	*Selaginellaceae*	Moses (E), Parsi (S)		Widespread, moist areas	Groundcover	Looks more like apoda then rupestris but stem still not completely covered by leaves, collect again
			C1		Growing on rock or tree in tuft	Phymatosorus sp.?
			A3		Symmetrical single leaf	
			A4	Analogue forest		
			B8		Finely serrated leaflets, fine venation, see field book	
			C2		Spores along outer margin	

Botanical name	Family	Common name	Specimen	Location	Quick plant features	Comment
			F12		No spores visible, growing in tuft on rock, finely serrated leaf edges	
			F16	Riverine	Twice cut leaflets,	
Other trees, shrubs and creepers						
	Acanthaceae		B6	Riparian	Small white flower, leaves opposite and whorled	
Legenandra sp.	*Araceae*		A1	Riverine	Leaf entire approx 30cm	
	Euphorbiaceae		E1			*Bridelia sp?*
Sauropus sp.	*Euphorbiaceae*		F22	Analogue forest	Small shrub, leaves - obtuse base, acute apex, nearly sessile, whitish beneath	
Desmodium sp	*Fabaceae*	Udupiyaliya (S)	D1	Marsh area	Creeper	
	Fabaceae		F15	Analogue forest	Vine, Leaves - entire, alternate, acute apex, obtuse base, small	
	Fabaceae		C12	?	Leaves alternate, obtuse, venation broadly arched	
	Fabaceae	Oondo(S)?	B12		Climber, axil swollen, large round leaf	
	Lauraceae	Dahbu (S)	C13			
Hibiscus sp.	*Malvaceae*	Wadha (S)	C11	Monsoon forest	Large leaves, roundish cordate base, palmately 3 lobed, lobes acute, margins coarsely dentate and hairy, thorny rachis	Looks very much like hibiscus eriocarpus but the petiole is too long and stem is throny. Weed?
Anamirta sp.	*Menispermaceae*		B20	Analogue forest	Climber, single leaf on long petiole, obtuse base	
	Menispermaceae		C8	Pinus	Creeper, flower white in leaf axil, zygomorphic	
Passiflora sp.	*Passifloraceae*	Kakirri (S)?	C5	Pinus, unburnt	see field notes, fruit covered by network of fine tendrils, leaf 3 lobed	
Rhizophora sp.	*Rhizophoraceae*	Kapol (S)	G1	Analogue forest	Prop roots, leaves broadly ovate with acute base	
Helipdis sp.	*Rubiaceae*		F8	Riparian		
	Rutaceae	Gal perah (S)?	C17			
Cissus sp.	*Vitaceae*		D2	Analogue forest	Vine, leaf acuminate, margins crenate, strongly arched venation, 7 buds per umbel	
Maduca sp.		Gammbi (S)	F20	Riparian	Tree, leaves - lanceolate	
		Gadu (S)	G7			
Pyrosid piloselloides			D3			
			F14	Analogue forest	Small tree, young leaves light green color and different texture, leaves alternate, venation broadly arched, wavy leaf margin	
			F17	Analogue forest	Tree, leaves elliptic, margin dentate	Not canarium zeylenicum
			F23	Analogue forest	Tree, leaves - pinnate, leaflets paired with terminals, margins finely serrate	
			F4		Tree, leaves - lanceolate, acute apex and base, opposite	

Botanical name	Family	Common name	Specimen	Location	Quick plant features	Comment
			J1	Analogue forest	Leaves - fleshy green, alternate, centre margin prominent beneath, stipules large	
			F9		Wine with tendril attachment, distinct petiole covering	
		Wild Diticana (E)	N\A	Pinus, burnt	Shrub, bipinnate leaf, flower orange	
Weeds and grasses						
	Asteraceae		B11	Tea land	Herb, creeping, leaves alternate, pink flower, leaf margin undulate	
Eupatorium sp.	*Asteraceae*		J2	Widespread	Weed	
Cathium sp.	*Oleaceae*		G6	Widespread	Weed	
	Poaceae		A15		Herb, grass	
	Poaceae	Thanakola(S)	F24		Grass species with leaf width less than 2 cm	
	Poaceae		H7		Herb, weed	
	Poaceae		H8		Herb, weed	
			H4	Widespread, tea	Flowers purple/pink, leaves in threes with two facing each other and the terminal leaf facing out	
			H5		Herb, weed	

Information unable to be added to the table until further identification complete