

# Species Composition of Natural Vegetation Associated with Water Streams of a Selected Dry Zone Forest

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## ABSTRACT

This study was conducted to assess the species composition of natural forest associated with water streams with a comparison of adjacent normal forest of Nikawewakanda forest reserve in Polpithigama divisional secretariat of Kurunegala district. Number of individual plants belonging to each species was counted using randomly selected plots. Relative Density, Relative Frequency, Relative Basal Area and Important Value Index (IVI) of each species were calculated. Altogether 43 species belonging to 22 families were identified from whole study area. The highest IVI was shown by *Drypetes sepiaria* (Weera) followed by *Croton lacciferus* (Gas kappetiya) and *Polyalthia korinti* (Ulkenda) from the vegetation associated with water streams as well as from the normal forest. Thus, *Glycosmis mauritiana*, *Tarenna asiatica* & *Tricalysia dalzellii* associated with water streams showed a significantly higher density when compared to its' density within normal forest. But, *Pterospermum canescens*, *Aphania bifoliata*, *Vitex pinnata*, *Ixora jucunda*, *Melia azadarach*, *Ficus tsiela*, *Canthium dicoccum* & *Premna tomentosa* showed a significantly higher density within normal forest, when compared to water stream associated vegetation.

**KEY WORDS:** Dry Zone, Water Streams Associated Vegetation, Species Composition, Important Value Index.

## INTRODUCTION

Since, forests play a unique role in meeting human needs at local, national and international levels and they protect local and global environments, forests are essential for a sustainable development of the country (Forestry Research Agenda, 2000). Estimated area of natural forests in Sri Lanka is 1, 582, 756 ha (Legg & Jewell, 1995). These forests represent 24% of the total land area and out of that, 60% has been occupied by dry monsoon forests which have considerable local value both for domestic use and for high value timber production (Singhakumara, 1997).

Large areas of Dry Monsoon forests have been cleared by shifting cultivation and regeneration of high value tree species is very sparse and growth rates are extremely low (Singhakumara, 1997). With the destruction of dry zone forests, water stream associated vegetation is also destroyed gradually, creating a water scarcity in catchment areas. Therefore, regeneration and rehabilitation of dry zone forests will require active silvicultural intervention (Singhakumara, 1997). To establish the plantation forests in degraded lands in dry zone, knowledge on local species is clearly insufficient (Sri Lanka forestry sector master plan, 1995). So it's recommended to strengthen the research on identifying species, varieties and provenances for dry zone planting (Neil, 1997).

This study was carried out at Nikawewakanda forest reserve (a Dry Monsoon forest) where a forest rehabilitation program is being executed by Sri Lanka - Australia Natural Resource Management Project. By this study, the species composition of natural vegetation associated with water streams was studied and compared with the vegetation associated with normal forest adjacent to it. Since there is lack of research work on dry zone forests generally and no

published research work were found on forests associated with water streams, contribution of this study to identify the dominant and adapted plant species for water stream area will be useful to rehabilitate such areas in order to conserve water reserves in dry zone.

## MATERIALS AND METHODS

### Study Site

The study was carried out from December 2004 to May 2005 at Nikawewakanda forest reserve which is situated in Polpithigama divisional secretariat of Kurunegala district, North Western province of Sri Lanka. Mean annual rainfall and temperature of the area is 1000-1800mm & 30-35°C respectively. Total extent of this forest reserve is 151 ha and the soil type is Reddish Brown Earth & Red Yellow Podsollic. There are temporary water streams along the slope of the mountain, which are covered by strip like forest patches, where this study was mainly focused on.

### Sampling and Data Collection

For this study, all the plants >10cm Diameter at Breast Height (DBH) were considered as "large trees" and the plants of a DBH 1-10cm were considered as "small trees" while plants of DBH <1cm were not included in this study.

Sampling and data collection consisted of two main steps:

Step 1: Three strips like forest patches associated with water streams were selected and ten, 50x20m plots were marked, centering the water stream in each plot as much as possible.

Within each of this main plot, 5x5m three sub plots were marked as illustrated below.

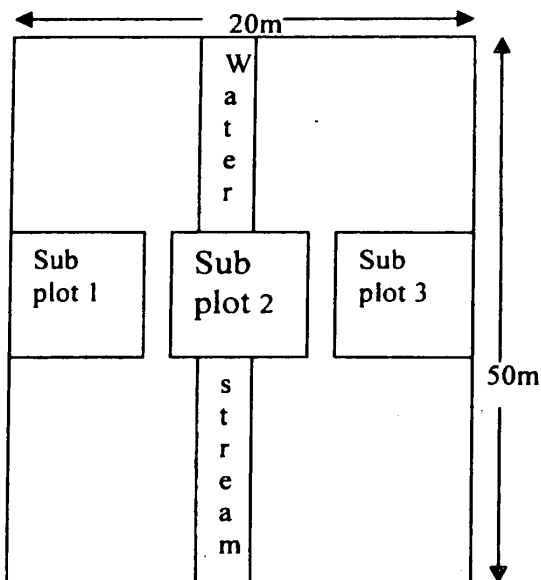


Figure 1: Field layout of a main plot with sub plots associated with water streams.

All large trees in each main plot were counted separately under their species and all small trees were counted in same manner with in each sub plot. DBH of all counted individuals were also recorded.

Step 2: Ten, 20x20m plots were marked randomly from normal forest area adjacent to water stream associated forest and, 5x5m sub plots were marked with in each main plot, as illustrated below.

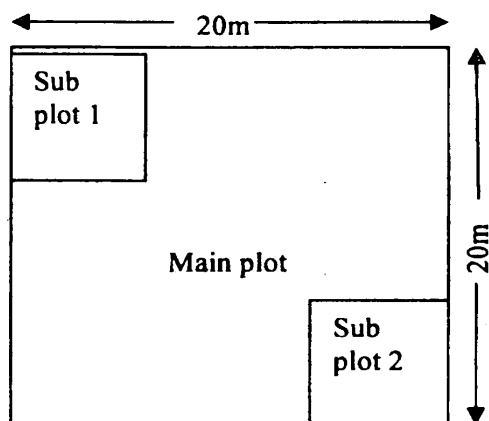


Figure 2: Field layout of a main plot with sub plots in normal forest.

All large trees found in each main plot were counted separately under their species. All small trees in each sub plot were also counted in the same manner. DBH of all counted individuals was also recorded.

Specimens from each and every species were collected and identified subsequently from the National herbarium at Peradeniya.

**Analysis of Data**

Density & Relative Density, Frequency & Relative Frequency, Basal area & Relative Basal Area and Important Value Index of each species were calculated as follows. (Curtis & Masintosh, 1958 and Singhakumara,1995).

$$\text{Density} = \frac{\text{No. of individuals of a single species}}{\text{Area sampled}}$$

$$\text{Relative Density} = \frac{\text{Density of a single species} \times 100}{\text{Density of all species}}$$

$$\text{Frequency} = \frac{\text{Number of plots within which a single species occurred}}{\text{Total No. of plots of sampled}}$$

$$\text{Relative Frequency} = \frac{\text{Frequency of a single species} \times 100}{\text{Frequency of all species}}$$

$$\text{Basal Area} = \frac{3.14 \times \text{DBH}^2 \text{m}^2}{4 \times 10000}$$

$$\text{Relative Basal Area} = \frac{\text{Basal area of a single species} \times 100}{\text{Basal area of all species}}$$

$$\text{Important Value Index} = \text{Relative Density} + \text{Relative Frequency} + \text{Relative Basal Area.}$$

These calculations were done separately for each species associated with water streams and associated with normal forest.

**RESULTS AND DISCUSSION**

Altogether 43 plant species belonging to 22 families were identified from whole study area. (Annex 1)

Plant species associated with water streams and associated with normal forest are shown separately in Annex 2 & Annex 3 respectively with their Relative Density, Relative Frequency, Relative Basal Area and Important Value Index.

Density of all plant species under water stream associated vegetation and normal forest was compared and given in Annex 4.

**Comparison of Species Composition under Different Vegetations**

**1. Water stream associated vegetation**

Out of 38 species belonging to 20 families, the highest Important Value Index (IVI) was shown by *Drypetes sepiaria* (Weera-61), followed by *Croton lacciferus* (Gas Kappetiya-36) and *Polyalthia korinti* (Ulkenda-26). Reason for the highest IVI of *Drypetes sepiaria* was mainly due to its higher basal area, but other two dominant species showed a higher IVI due to their higher density. Meanwhile, the lowest IVI were shown by *Atalantia ceylanica* (Yakinaran- 0.8) and *Cassia fistula* (Ahela- 0.8). With in the study area, 96% of individual plants were small trees (DBH=1-10cm) and their density was higher when closer to the water streams. Thus, Sapindaceae was the most abundant family, which was represented by 4 plant species and followed by Rutaceae, Sapotaceae and Verbenaceae families having 3 species in each family. The total plant density was 8463 plants / ha.

**2. Vegetation associated with normal forest**

Twenty four plant species belonging to 14 families were identified and the highest IVI of 56 was recorded from *Drypetes sepiaria*, followed by *Croton lacciferus* (45) and *Polyalthia korinti* (27). *Drypetes sepiaria* was having a higher IVI due to its higher basal area, but other two species showed higher IVI values due to their higher density. The lowest IVI was shown by *Lepisanthes tetraphylla* (Dambu-2) and

*Strychnos trichocalyx* (Thelatiyawel-2). Within the study area, 90.6% of individual plants were small trees. Thus, 4 plant species represented Family Rubiaceae, followed by Family Euphorbiaceae and Verbenaceae which were having 3 species each. The total plant density was 8080 plants/ha.

The total plant density and number of species were comparatively higher in the vegetation associated with water streams. But, percentage of the large trees (DBH>10cm) was higher in normal forest (9.4%) than the forest associated with water streams (4%). Reasons for these differences may be, the high soil moisture level closer to water streams influence the growth and development of seedlings. Therefore total plant density is higher and non adaptive plants for drought conditions can also exist associated with water streams. Further, rocky nature of the soil in normal forest retards the plant growth except which are having a strong root system and drought tolerant characteristics. Therefore, total plant density is low even though the large trees are having a comparatively higher density.

In this study, vegetation associated with normal forest and vegetation associated with water streams were considered as 2 separate categories. The IVI of each species under one category depends on the species composition within that category. Therefore, for a comparison of the species adapted for each category, plant density can be used as a parameter.

Among the species associated with water streams and normal forest area, *Glycosmis mauritiana*, *Tarenna asiatica* and *Tricalysia dalzielii* showed a significantly higher density under water stream associated vegetation, when compared to normal forest. So these species may be grown well under high soil moisture conditions. On the other hand, *Pterospermum canescens*, *Aphania bifoliata*, *Vitex pinnata*, *Ixora jucunda*, *Melia azadarach*, *Ficus tsiela*, *Canthium dicoccum* and *Premna tomentosa* showed a significantly higher density within the normal forest, when compared to the water stream associated vegetation (Annex 4). It indicates that, these species have adapted to survive in low soil moisture conditions too.

The study further revealed that, the dominant plant species of the whole study area collectively are *Drypetes sepiaria*, *Croton lacciferus*, *Polyalthia korinti*, and *Diospyros ovalifolia*. These species have special adaptations for drought tolerance. I.e: *Croton lacciferus* has hairy cuticle of the leaves, *Polyalthia korinti* has a hard cuticle of the leaves, *Drypetes sepiaria* & *Diospyros ovalifolia* have a hard cuticle of the leaves, hard cortex of the stem and a well distributed root system (Burslem, 1995).

#### Limitations of the Study

Since this study was carried out only in one side of the "Nikawewakanda", due to the limitation of time and resource availability, this may not reveal the overall species composition of the total forest area. Therefore, further studies on this topic will be useful to find out more information on available plant species

and their characteristics under different environmental and topographical conditions.

## CONCLUSIONS

The study revealed that, the dominant plant species under whole study area are, *Drypetes sepiaria*, *Croton lacciferus*, *Polyalthia korinti*, and *Diospyros ovalifolia* according to their IVI values. Among these 4 species, *Croton lacciferus*, *Polyalthia korinti* and *Diospyros ovalifolia* showed a higher density as well as a higher frequency, while *Drypetes sepiaria* having a higher basal area, but not the higher density or frequency.

Higher basal area is a genetical characteristic of a plant. Therefore, *Croton lacciferus*, *Polyalthia korinti* and *Diospyros ovalifolia* can be considered as the most adapted and dominant plant species both for water stream associated vegetation and the normal forest.

By comparing the two vegetation types, comparatively higher plant density could be observed from water stream associated vegetation (8463 plants/ha) than that of the normal forest (8080 plants/ha) as an effect of high soil moisture condition and species like *Glycosmis mauritiana*, *Tarenna asiatica* and *Tricalysia dalzielii* showed a higher density particularly when they are associated with water streams.

However, this water stream associated vegetation in the study area has been restricted to strip like forest patches which are 50m to 300m in length and 20m to 80m in width, mainly due to human interferences. So, further studies are necessary for this vegetation and protective & rehabilitation programs have to be implemented immediately to conserve this forest and its water resources.

## ACKNOWLEDGEMENTS

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## REFERENCES

- Anon (1995), Sri Lanka forestry sector master plan, Ministry of Agriculture, Land and Forestry, p.332.
- Anon (2000), Forestry research agenda for 21<sup>st</sup> century, p.1.
- Anon (2001), Forest research news letters, Research division, Forest Department of Sri Lanka, p.11-13.
- Burslem D.(1995), Research on rehabilitation of degraded dry zone forest under the natural forest ecology component of UP/OFI link project, p. 7- 8.
- Neil P.E.(1997), A review on forestry research in Sri Lanka, p.5.
- Ratnayake R.M.W.(2002), Undergrowth vegetation in Dry mixed evergreen forests, The Sri Lanka Forester 2002, vol.xxv, p.37-49.
- Singhakumara B.M.P.(1997), USJ link collaboration research.
- Vivekanandan K.(1987), Fifty years of forestry research, The Sri Lanka Forester, Special centenary.
- Wijesinghe Y.(1999), Checklist of woody perennial plants of Sri Lanka, Forest Department of Sri Lanka.

NATURAL VEGETATION ASSOCIATED WITH WATER STREAMS

Annex 1: Species found from whole study area.

Common name	Botanical name	Family
Ulkenda	<i>Polyalthia korinti</i>	Annonaceae
Rukaththana	<i>Alstonia scholaris</i>	Apocynaceae
Mathambala	<i>Carmonia retusa</i>	Boraginaceae
Ahela	<i>Cassia fistula</i>	Caesalpinaceae
Domba	<i>Calophyllum inophyllum</i>	Clusiaceae
Madu	<i>Cycas circinalis</i>	Cycadaeaceae
Kalumediriya	<i>Diospyros ovalifolia</i>	Ebenaceae
Kunumella	<i>Drypetes gardeneri</i>	Ebenaceae
Gas Kappetiya	<i>Croton lacciferus</i>	Euphorbiaceae
Weera	<i>Drypetes sepiaria</i>	Euphorbiaceae
Endaru	<i>Ricinus communis</i>	Euphorbiaceae
Nelli	<i>Phyllanthus emblica</i>	Euphorbiaceae
Kalawel	<i>Derris parviflora</i>	Fabaceae
Gammalu	<i>Pterocarpus marsupium</i>	Fabaceae
Giniketiawel	<i>Hugonia mystax</i>	Linaceae
Kaduru	<i>Strychnos nux-vomica</i>	Loganiaceae
Thelatiyawel	<i>Strychnos tricalyx</i>	Loganiaceae
Kohomba	<i>Azadirachta indica</i>	Meliaceae
Pitasiviya	<i>Melia azadarach</i>	Meliaceae
Ahatu	<i>Ficus tsiela</i>	Moraceae
Geratiya	<i>Chionanthus zeylanica</i>	Oleaceae
Embul Korakaha	<i>Chionanthus alibidiflora</i>	Oleaceae
Tharana	<i>Tarenna asiatica</i>	Rubiaceae
Galseru	<i>Tricalysia dalzielii</i>	Rubiaceae
Godarathmal	<i>Ixora jucunda</i>	Rubiaceae
Galkaranda	<i>Canthium dicoccum</i>	Rubiaceae
Wal Karapincha	<i>Micromelum minutum</i>	Rutaceae
Bolpana	<i>Glycosmis mauritiana</i>	Rutaceae
Yakinaran	<i>Atalantia zeylanica</i>	Rutaceae
Koon	<i>Schleichera oleosa</i>	Sapindaceae
Dambu	<i>Lepisanthes tetraphylla</i>	Sapindaceae
Yakadamaran	<i>Aphania bifoliata</i>	Sapindaceae
Mora	<i>Dimocarpus longana</i>	Sapindaceae
Kos Eta Lavulu	<i>Chrysophyllum cainito</i>	Sapotaceae
Mee	<i>Madhuca longifolia</i>	Sapotaceae
Palu	<i>Manilkara hexandra</i>	Sapotaceae
Welan	<i>Pterospermum canescens</i>	Sterculiaceae
Boradamuna	<i>Grewia rothii</i>	Tiliaceae
Godakirala	<i>Holoptelea integrifolia</i>	Ulmaceae
Guluhulu Kappetiya	<i>Callicarpa tomentosa</i>	Verbenaceae
Milla	<i>Vitex pinnata</i>	Verbenaceae
Seru	<i>Premna tomentosa</i>	Verbenaceae
Kale Beli	<i>Clerodendrum paniculatum</i>	Verbenaceae

Annex 2: Species associated with water streams

Species	Relative Density	Relative Frequency	Relative Basal Area	Important Value Index
Weera	3.8637	7.1428	50.3508	61.3573
Gas Kappetiya	27.9333	7.1428	0.7771	35.8532
Ulkenda	20.0401	5.7142	0.0042	25.7585
Kalumediriya	13.1986	7.1428	2.7954	23.1368
Bolpana	19.0594	3.5714	0.1738	22.8046
Galseru	1.8196	7.1428	7.8120	16.7744
Boradamuna	1.3588	7.1428	7.0452	15.5468
Tharana	6.7706	5.0000	0.1886	11.9592
Seru	0.0708	1.4285	6.8167	8.3160
Milla	0.0708	3.5714	2.9422	6.5844
Yakadamaran	0.4608	3.5714	1.9970	6.0292
Pitasiviya	0.0708	2.8571	1.8611	4.7890
Dambu	0.7207	2.8571	1.1297	4.7075
Kalawel	1.4179	2.8571	0.0088	4.2838
Godakirala	0.0354	1.4285	2.4171	3.8810
Kaduru	0.0945	2.1428	1.6129	3.8502
KosEta Lavulu	0.0945	2.1428	1.4863	3.7236
Endaru	0.3072	2.1428	1.1504	3.6004
Geratiya	0.3544	2.1428	0.2940	2.7912
Ahatu	0.0472	1.4285	1.2184	2.6941
Welan	0.0472	1.4285	1.0401	2.5158
Rukaththana	0.0354	1.4285	0.9717	2.4356
Thelatiyawel	0.6262	1.4285	0.0290	2.0837
Mee	0.0236	1.4285	0.6042	2.0563
Palu	0.0354	0.7142	1.1820	1.9316
Domba	0.0118	0.7142	1.0529	1.7789
Godarathmal	0.0236	1.4285	0.2477	1.6998
Mathambala	0.1654	1.4285	0.1029	1.6968
Koon	0.0236	1.4285	0.2029	1.6550
Galkaranda	0.0472	0.7142	0.7697	1.5311
Wal Karapincha	0.7916	0.7142	0.0172	1.5230
Madu	0.0118	0.7142	0.4599	1.1859
Mora	0.0236	0.7142	0.3974	1.1352
Guluhulu Kappetiya	0.0118	0.7142	0.2713	0.9973
Embul Korakaha	0.1536	0.7142	0.0034	0.8712
Kunumella	0.1536	0.7142	0.0014	0.8692
Ahela	0.0118	0.7142	0.0797	0.8057
Yakinaran	0.0118	0.7142	0.0650	0.7910

Annex 3: Species associated with normal forest

Species	Relative Density	Relative Frequency	Relative Basal Area	Important Value Index
Weera	4.9504	5.9701	45.3516	56.2721
Gas Kappetiya	34.1584	7.4626	3.1785	44.7768
Ulkenda	18.3168	7.4626	0.9198	26.6992
Kalumediriya	15.3465	7.4626	1.8816	24.6907
Godarathmal	1.9801	5.9701	11.8292	19.7794
Yakadamaran	3.9603	7.4626	2.8532	14.2761
Kale Beli	3.7128	7.4626	2.6134	13.7897
Pitasiviya	0.7425	4.4776	7.7673	12.9874
Ahatu	0.4950	2.9850	8.1755	11.2100
Kohomba	0.7425	2.9850	6.1844	9.9119
Giniketiyaewel	3.4653	5.9701	0.4480	9.8834
Boradamuna	1.2376	4.4776	0.6909	6.4061
Bolpana	2.4752	2.9850	0.1234	5.5836
Nelli	1.7326	2.9850	0.4241	5.1417
Seru	0.2475	1.4925	3.1997	4.9397
Welan	1.4851	2.9850	0.2907	4.7608
Galseru	0.9900	2.9850	0.0398	4.0148
Galkaranda	0.4950	1.4925	1.7820	3.7695
Milla	0.2475	1.4925	1.2743	3.0143
Kalawel	0.9900	1.4925	0.0796	2.5621
Tharana	0.9900	1.4925	0.0696	2.5521
Gammalu	0.2475	1.4925	0.7028	2.4428
Thelatiyaewel	0.4950	1.4925	0.0995	2.0870
Dambu	0.4950	1.4925	0.0219	2.0094

Annex 4: Densities of all plant species (plants / ha)

Species	Water stream associated	Normal forest
Ulkenda	1696	1480
Mathambala	14	0
Ahela	1	0
Domba	1	0
Madu	1	0
Kalumediriya	1117	1240
Kunumella	13	0
Gas Kappetiya	2364	2760
Weera	327	400
Guluhulu Kappetiya	1	0
Endaru	26	0
Nelli	0	140
Kalawel	120	80
Gammalu	0	20
Kaduru	8	0
Giniketiyaewel	0	280
Thelatiyaewel	53	40
Kohomba	0	60
Ahatu	4	40
Geratiya	30	0
Tharana	573	80
Galseru	154	80
Godarathmal	2	160
Galkaranda	4	40
Rukaththana	3	0
Wal Karapincha	67	0
Bolpana	1613	200
Yakinaran	1	0
Koon	2	0
Dambu	61	40
Yakadamaran	39	320
Mora	2	0
Kos Eta Lavulu	8	0
Mee	2	0
Palu	3	0
Welan	4	120
Boradamuna	115	100
Godakirala	3	0
Pitasiviya	6	60
Embul Korakaha	13	0
Milla	6	20
Seru	6	20
Kale Beli	0	300
Total	8463	8080