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Distribution and Importance Value Index of Woody Species Under Different Successional Stages at Jello-Muktar Dry Afromontane Forest, South-eastern Ethiopia

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Abstract: The study was carried out at 8°55'N-9°05'N latitude and 40°50'E-40°51'E longitude, South-Eastern Ethiopia at Jello-Muktar dry afromontane forest to assess variations in distributions and Importance Value Index of woody species under three successional stages. We laid out a total of 90 sample plots for the three suceestional stages. For each successional stage, three sites were selected each with 10 sample plots. The average distance between the plots was 200 m and each plot have radius of 30m. In each plots, identification, counting and measurement of diameter at breast height (DBH) of all trees and shrubs (DBH≥ 10cm) was conducted. Analysis of The Importance Value Index (IVI) at different successional stages and sites was based on the frequency, density and dominance of each species at different successional stages. The result showed a gradual increase in the total number of trees and shrub species from the ES to the IS and MS succession and species of mature forests were present throughout the chrono-sequences of all stages. Species of *Vernonia amygdalina, Juniperus procera, Olea africana, Olea capensis, Hagenia abyssinica, Prunus africana, Rosa abyssinica, Discopodium penninervium* and *Premna resinosa* were found in all successional stages. In the ES succession, *Vernonia amygdalina* was the highest in terms of its IVI of 36.58 followed by *Vernonia auriculifera* (31.66) and *Hagenia abyssinic* (30.28). Species of *Hagenia abyssinica* had the highest IVI of 67 and 23 in IS and MS successions respectively. There must be conservation strategies and priorities for those species that occurred only once in one of the sites and species with low IVI in addition to the dominant ones.

Keywords: Successional Stages, Successional Sites, Dry Afromontane Forest, IVI

1. Introduction

There is a change in plant species composition within an ecological community species to be dominant while others to disappear gradually of existence. It is also true that there is change in structure and establishment of species over time the phenomenon which was initially conceived as a natural process of ecological communities [8]. In the same geographical area, Communities with different plant composition can represent distinct mature stages. The initial floristic composition model [11] suggests that species from late stages may also be present in the stands initial successional process (Collins et al, 1995). However, thenon-equilibrium hypothesis suggested that the distribution of plant species should be higher at intermediate levels of disturbance related to anthropogenic impacts [9].

Today anthropogenic impacts of agricultural land expansion put Tropical afromontane Forests under the state of secondary succession [6, 14] and changed both the structure and composition of these forests [4]. In the absence of complete transformation of tropical dry afromontane forests to pastures or fields, anthropogenic disturbances can result in a higher floristic diversity, biomass and density of woody vegetation than the original mature stages which can help to determine plant distribution at different succession [7, 17, 27]. Determination of plant distribution patterns following succssional stages is necessary in a forest ecosystem which can help to better recognize biodiversity patterns and ecological processes. The plant cover at different succession is fundamentally characterized by its density,

DBH and frequency parameters [18]. Species importance value as an index covers all of these parameters together for the determination of distribution and frequency patterns of species as well as judgments about ecological conditions that have more significance in forest succession [28]. There is very little information with respect to the distribution and importance value index of different species at different successional patterns in Tropical dry afromontane forests [32].

Most of the studies so far conducted with respect to Variations in distribution and Importance Value Index of Woody Species Following Successional Stages are from the temperate forests. Likewise, some early studies in Jello-Muktar dry afromontane were focused on diversity and socio-economic importance of Non-Timber Forest Products [24], species diversity [23], soil fertility and forest economics [21, 26, 13]. No study has been conductedwith respect to the variation in distribution and Importance Value Index of woody species under different succsessional patterns in Jello-Muktar dry afromontane. In this study comparison of sites representing different successional stages to describe changes in distribution and Importance Value Index of the woody species with diameter at breast height (DBH)≥10cm under three succession stages within the Jello-Muktar dry afromontane forest, South-Eastern Ethiopia had been conducted.

2. Materials and Methods

2.1. Study Site

The study site is situated at $8_0$55'N-$9_0$05'N latitude and $40_0$50'E-$40_0$51'E longitude, about 342kms southeast of Addis Ababa. It covers a land area of about 1710 hectares. Its altitude ranges from 1900 to over 3310 m. a. s. l, having subtropical climatic condition with mean annual temperature of 10_0C and mean rainfall of 1220mm. Its length of growing period ranges from 210-270 days [20]. It is part of the Chercher highlands in Hararghe highlands with extensive mountain range separating the Rift system from the Eastern plateau and lowlands, having numerous micro-catchments with diversified bio-physical and socio-economic environments [13, 26]. The landform feature of this sub-watershed is almost similar to Jello micro-catchment positioned on its rear side and also suited to the classification of topo-sequences: summit, shoulder, back slope, foot slope and toe slope that do not necessarily follow sequential arrangements in descending slope position & form complex landform associations [21].

Anthropogenic processes due to shifting cultivation and forest clearing have led to continuous removal of soil materials that strongly affected the micro-climate and soil development of the area [13]). The study area is dissected by streams due to their erosive processes for prolonged period of time. The sub-watershed is within Wabi-shebele and Rift Valley drainage systems, drained by Chiro Qela and Jello perennial streams towards the Rift system while perennial streams like Welenso and Ula Quni and seasonal streams like Rukele Arba Feno and Dingete draining towards Wabi Shebelle drainage system [12].

2.2. Selection of Sites, Plot Lay out and Vegetation Sampling

The selection of sites was made adopting [5] where nine sites each represented by three successional stages. Each succession stage was again represented by 10 sample plots each having an area of 0.283ha and the distance between each plot was 200m. In each plot, diameter at breast height (DBH) ≥10cm of all trees and shrubs was measured with diameter tape. Identification of species was made with the help of para-taxonomists. For those species difficult to identify in the field, specimens were taken to the National Herbarium, Addis Ababa University.

2.3. Data Analysis

The importance value index (IVI) of each species at the three successional stages was calculated to examine which species is ecologically significant in the forest ecosystem and this index was used to relate how important they are in providing ecosystem goods. The index was calculated by integrating the Relative Frequency (RF); Relative Density (RD) and Relative Dominance (RB) of each woody species [25] as follows:

$$IVI = (RF+RD+RB) \quad (1)$$

$$RF = (\text{Frequency of a species} / \text{Frequency of all species}) \times 100 \quad (2)$$

$$RD = (\text{Number of individuals of a species} / \text{Total number of individuals}) \times 100 \quad (3)$$

$$RB = \text{Dominance of a species} / \text{Dominance of all species}) \times 100 \quad (4)$$

3. Results and Discussion

3.1. Distribution of Woody Species at Succession Stages

The distribution of 114 woody species recorded in this study in each successional stage showed that 50, 61 and 81 species were recorded in ES, IS and MS stages respectively. Of the total number of species recorded in ES stage, the ES1 sites comprised 20 species while ES2 and ES3 sites comprised 16 and 14 species respectively (Table 1). In the IS stage forest, the sites of IS1 and IS2 each comprised 23 species while 15 species were recorded in IS3 sites. With respect to MS stage forest, 35, 30 and 16 species were

recorded in MS1, MS2 and MS3 sites respectively. There was high probability for some species to be recorded in all successional stages.

A total of 10 woody species namely; *Vernonia amygdalina, Juniperus procera, Olea africana, Olea capensis, Hagenia abyssinica, Prunus africana, Rosa abyssinica, Discopodium penninervium* and *Premna resinosa* were found in all successional stages while 44 species (36 trees and 8 shrub) including Schinus molle, Carissa edulis, Ilex mitis, Cussonia holstii, Arundinaria alpine, Jacaranda mimosifolia, Caesalpina decapetala, Delonix regia, Maytenus obscura, Diospyros abyssinica, Euphorbia abyssinica, Euphorbia pulcherrima, Acacia decurrence, Calpunia subdecandra, Entada abyssinica, Leucena leucocephala, Dovyalis abyssinica, Flacourtia indica, Hypericum revoltum, Ocotea kenyensis, Buddleja polystacha, Strychnos mitis, Morus alba, Embelia schimpri, Casuarina equisetifolia, Eucalyptus camaldulensis, Eucalyptus globules, Olina rochetiana, Erythrina brucei, Phytolaca deodecandra, Pinus radiate, Pittosporum abyssinicum, Gravelia robusta, Rhamnus prenoids, Gardenia lutea, Rytigynia neglecta, Diphasia dainelli, Fagaropsis angolensis, Teclea nobilis, Vitis vinifera, Dodonaea angustifolia, Brucea antidysenterica, Lippia adeonsis and Vepris dainellii were found only in one of sites in either of the three successional stages. These species comprised about 38.6% of all the total species recorded in this study. Even though these species were found in only one of the successional sites, it does not mean they were lower in terms of their relative frequency.

Table 1. *Plant species Composition (DBH> 10cm) identified in nine sites, three successional stages in Jello-Muktar Dry Afro-montane forests, South-Eastern Ethiopia.*

Species	Life form	Successional Stages								
		ES			IS			MS		
		1	2	3	1	2	3	1	2	3
Dracaena steudneri	Shrub	x								x
Rhus glutinosa	Shrub								x	x
Schinus molle	Tree	x								
Acokanthera schimperi	Tree		x					x	x	
Carissa edulis	Shrub		x							
Carissa spinarum	Shrub					x		x		
Ilex mitis	Tree							x		
Cussonia holstii	Tree		x							
Polyscias fulva	Tree						x		x	
Schefflera abyssinica	Tree						x		x	
Vernonia amygdalina	Tree	x	x	X	x	x	x			x
Vernonia auriculifera	Shrub	x		X		x				
Vernonia leopoldii	Shrub					x	x		x	
Balanytus aegyptica	Tree	x								
Arundinaria alpina	Tree							x		
Jacaranda mimosifolia	Tree									x
Cordia africana	Tree		x	X					x	x
Ehretia cymosa	Tree			X			x			
Caesalpina decapetala	Tree								x	
Delonix regia	Tree									x
Chata edulis	Tree					x		x		
Maytenus addat	Tree							x	x	
Maytenus arbutifolia	Tree						x		x	x
Maytenus obscura	Tree									x
Cupressus lusitanica	Tree			X	x	x	x			
Juniperus procera	Tree		x	X	x	x		x		x
Diospyros abyssinica	Tree							x		
Erica arborea	Shrub					x		x		x
Croton macrostachys	Tree		x						x	x
Euphorbia abyssinica	Tree									x
Euphorbia pulcherrima	Tree									x
Macaranga kilimandsharica	Tree	x	x				x		x	
Sapium ellipticum	Tree							x	x	
Acacia abyssinica	Tree	x	x							x
Acacia decurrence	Tree			X						
Albizzia gummifera	Tree			X					x	x
Calpunia subdecandra	Shrub				x					
Calpurina aura	Tree		x			x			x	

Species	Life form	Successional Stages								
		ES			IS			MS		
		1	2	3	1	2	3	1	2	3
Entada abyssinica	Shrub								x	
Leucena leucocephala	Tree			X						
Dovyalis abyssinica	Shrub	x								
Dovyalis vericosa	Shrub					x	x			
Flacourtia indica	Shrub				x					
Hypericum revoltum	Tree					x				
Apodytes dimidiata	Shrub		x				x			
Ocimum lamifolium	Shrub		x		x	x	x	x		
Ocotea kenyensis	Shrub					x				
Persea americana	Tree						x	x		x
Buddleja polystacha	Tree								x	
Strychnos mitis	Tree								x	
Ekebergia capensis	Tree		x					x		x
Lepidotrichilia volkensis	Tree		x			x		x		x
Bersama abyssinica	Tree		x			x				
Ficus sur	Shrub		x				x			
Ficus thonningi	Tree	x					x			
Morus alba	Tree									x
Embelia schimpri	Tree								x	
Maesa lanceolata	Shrub					x		x		
Myrsine africana	Shrub					x				
Myrsine melanophloeos	Shrub				x	x		x	x	x
Rapanea simensis	Tree							x	x	x
Callistemon citirnus	Tree						x	x		x
Casuarina equisetifolia	Tree									x
Eucalyptus camaldulensis	Tree					x				
Eucalyptus globulus	Tree					x				
Eucalyptus saligna	Tree		x		x					
Psidium guajava	Tree		x		x					x
Sizygeem guineense	Tree						x	x	x	
Jasminum abyssinicum	Tree						x	x	x	x
Olea africana	Tree		x	X		x			x	x
Olea capensis	Tree	x	x	X	x	x			x	x
Olea europea	Tree				x	x		x	x	
Olina rochetiana	Tree				x					
Milletia ferruginea	Tree								x	x
Mimusops kummel	Tree								x	x
Sesbania sesban	Shrub	x	x							
Erythrina abyssinica	Shrub	x	x							
Erythrina brucei	Tree			X						
Passiflora edulis	Tree			X				x		
Phytolaca deodecandra	Tree					x				
Pinus patula	Shrub				x	x	x		x	x
Pinus radiata	Tree								x	
Pittosporum abyssinicum	Tree	x								
Arundo donax	Tree						x	x		x
Podocarpus falcatus	Tree						x	x	x	x
Rumex abyssinicus	Tree				x	x	x	x	x	x
Rumex nurvosus	Shrub					x				x
Gravelia robusta	Shrub	x								
Rhamnusp renoids	Tree	x								
Hagenia abyssinica	Shrub		x	X	x	x	x		x	x
Prunus africana	Tree			X	x		x	x		x
Rosa abyssinica	Tree	x	x	X	x	x	x	x	x	x
Rosmarinus offinalis	Shrub					x			x	x
Rubus apetalus	Shrub						x	x	x	
Rubus steudneri	Shrub					x			x	

Species	Life form	Successional Stages								
		ES			IS			MS		
		1	2	3	1	2	3	1	2	3
Coffea arabica	Shrub				x				x	
Gardenia lutea	Tree									x
Rytigynia neglecta	Tree								x	
Clausena anisata	Shrub				x	x		x		x
Diphasia dainelli	Tree							x		
Fagaropsis angolensis	Tree									x
Teclea nobilis	Tree	x								
Vepris dainellii	Tree	x								
Dodonaea angustifolia	Tree							x		
Aningeria altissima	Tree			X						x
Brucea antidysenterica	Tree			X						
Discopodium penninervium	Shrub			X		x		x	x	x
Dombeya torrida	Shrub	x			x					
Celtis africana	Tree	x	x		x		x		x	
Clerodendron myricoides	Tree			X	x			x		
Lippia adeonsis	Shrub				x					
Premna schimperi	Shrub							x		x
Premna resinosa	Shrub			x		x	x	x		
Vitis vinifera	Shrub									x

The total number of woody species that had been recorded under the three successional stages in this study is comparable to the total number of woody plants reported from elsewhere for other similar forest types in Ethiopia [15, 16, 19]. It is also comparable to the number of plant species reported from the Forest of Likouala in the Republic of Congo [31] but by far higher when it is compared to the number of woody species reported from Ades dry Afomontane forest of South-Eastern Ethiopia of the same agro-ecology the total number of species recorded at Ades dry afromontane forest of the same agro-ecology [22]. It is also higher than the number of woody plan species reported for other dry afromontane forests [29, 1, 2]. The high number of species recorded in this study is related to the demarcation of the Jello-Muktar forest as pre-requesite for conservation strategy.

3.2. Importance Value Index (IVI)

The analysis of the IVI was done for each species with >10 cm DBH under the three successional stages and nine successional sites to select the dominant species of the area as shown on the Tables below. The identification of trees and shrub species that are dominant in Jello-Muktar dry afromontane forest based on the analysis of IVI was made. Species with higher IVI are also ecologically dominant ones in the successional sites and stages as well [10].

Accordingly in the ES succession, *Vernonia amygdalina* was the highest with IVI of 36.58from the site of ES1 followed by Vernonia auriculifera (31.66) in ES1, Hagenia abyssinica (30.28) from ES3, Ficus sur, Olea africana, Dovyalis caffra, Teclea nobilis, Grevillea robusta, Rhamnus prinoides, Juniperusprocera, Croton macrostachys, Aningeria altissima, Prunus africana, Eucalyptus saligna, Schinus molle, Bersama abyssinica, Dombeya torrid, Ehretia cymosa, Sesbania sesban and Carissa edulis (Table 2).

Table 2. *The IVI of the top ten woody species in 3 sites of ES successional stage at Jello-Muktar Dry Afromotane Forest South-Eastern Ethiopia.*

Species	R. F	R D	RBA	IVI
ES1				
Vernonia amygdalina	9.8	8.44	18.3	36.58
Vernonia auriculifera	4.9	18.47	8.27	31.66
Ficus sur	6.6	2.11	19.14	27.81
Dovyalis caffra	6.6	15.3	4.39	26.25
Teclea nobilis	11.5	6.86	4.42	22.76
Grevillea robusta	9.8	4.22	8.34	22.39
Rhamnus prinoides	8.2	12.66	0.91	21.77
Schinus molle	6.6	4.22	6.82	17.6
Dombeya torrida	6.6	6.07	4.59	17.22
Sesbania sesban	6.6	8.97	1.45	16.97
ES2				
Olea africana	5	3.37	17.88	26.25
Juniperus procera	5	5.62	10.73	21.34
Croton macrostachys	4.2	5.62	10.73	20.51
Eucalyptus saligna	5.8	5.62	6.3	17.76
Bersama abyssinica	5.8	9.55	2.03	17.41
Carissa edulis	5.8	8.15	2.92	16.9
Vernonia amygdalina	3.3	8.99	3.22	15.54
Apodytes dimidiata	5.8	5.62	2.68	14.13
Sesbania sesban	5	6.18	1.31	12.49
Ekebergia capensis	5	3.37	3.15	11.52
ES3				
Hagenia abyssinica	7.77	7.42	15.09	30.28
Olea africana	7.77	7.42	11.92	27.11
Aningeria altissima	2.91	0.78	16.49	20.19
Vernonia auriculifera	6.8	12.11	0.78	19.68
Prunusafricana	0.97	0.78	17.65	19.4
Ehretia cymosa	5.83	7.81	3.46	17.1
Vernonia amygdalina	5.83	8.59	1.35	15.77
Brucea antidysentrica	6.8	7.81	1.13	15.74
Juniperus procera	2.91	1.17	11.3	15.39
Erythrina brucei	5.83	6.64	2.16	14.63

The ES was characterized by high species dominance. This pattern is typical of disturbed plant communities where

pioneer species have high values of relative importance in relation to other species. It was also reported that there is asymptotical increase in total number of large sized individuals with forest age [17]. Few seedlings of different species that manage to colonize the unfavorable conditions determined the recruitments forests in the ES succession.

In the IS successional stage, *Hagenia abyssinica* was the tree with highest IVI (67.0) from the IS2 sites followed by *Sizygeem guineense* (23), *Podocarpus falcatus* (17. 57) and *Vernonia amygdalina* (17.38) all from IS3 sites (Table3). *Hagenia abyssinica* was again the tree species with highest IVI in all sites of the IS successional sites. The Analysis of IVI values could best be unraveled the relative ecological significance and/or dominance of tree species in a forest ecosystem [10]. The results of the calculation of IVI in this study thus helped to identify the dominant tree species in Jello-Muktar Dry afromontane forest of southeastern Ethiopia. The Index was also calculated to examine which species were ecologically significant in the forest ecosystem and this index was used to relate how important they were in providing ecosystem goods.

Table 3. *The IVI of the top ten woody species in 3 sites of the IS successional stage at Jello-Muktar Dry Afromotane Forest South-Eastern Ethiopia.*

Species	R F	R D	RBA	IVI
IS1				
Hagenia abyssinica	*3.9*	*4.87*	*13.21*	*21.98*
Prunus africana	*1.95*	*2.17*	*12.06*	*16.18*
Eucalyptus saligna	*2.6*	*3.25*	*8.81*	*14.65*
Acacia decurrence	*1.95*	*2.71*	*8.35*	*13.01*
Embelia schimpri	*5.84*	*4.87*	*2.11*	*12.83*
Vernonia amygdalina	*3.25*	*5.05*	*4.4*	*12.7*
Olina rochetiana	*3.9*	*3.61*	*4.8*	*12.3*
Dombeya torrida	*4.55*	*3.25*	*3.91*	*11.71*
Calpunia subdecandra	*3.9*	*5.42*	*1.63*	*10.94*
Juniperus procera	*4.55*	*2.53*	*3.68*	*10.76*
IS2				
Hagenia abyssinica	4.88	6.23	55.89	67
Vernonia amygdalina	4.27	5.34	4.54	14.14
Juniperus procera	3.66	4.15	3.89	11.7
Phytolacca dedocandra	4.27	6.38	0.49	11.14
Barsama abyssinica	3.05	6.53	1.12	10.7
Hypericum revoltum	3.66	5.79	1.23	10.67
Olea africana	5.49	3.41	1.04	9.94
Myrsine africana	4.27	4.45	0.94	9.66
Maesa lanceolata	2.44	3.86	3.28	9.57
Vernonia auriculifera	4.27	5.34	4.54	14.14
IS3				
Sizygeem guineense	5.6	4.99	13.1	23.73
Podocarpus falcatus	4	4.08	9.5	17.57
Vernonia amygdalina	4	6.8	6.6	17.38
Apodytes dimidiata	6.4	7.71	3.2	17.26
Hagenia abyssinica	5.6	3.4	7.4	16.41
Schfflera abyssinica	4.8	5.22	6.1	16.12
Prunus africana	3.2	2.27	9.2	14.69
Ehretia cymosa	6.4	4.99	3.1	14.48
Polyscias fulva	4.8	3.85	4.5	13.17
Ficus sur	0.8	0.91	9.3	10.98

Species with high IVI were considered to have more ecolological importance than those with low IVI. The presence of continuity of succession resulted in chance for the coexistence of large number of trees and shrubs in the IS that could later be shifted in the MS succession by trees and shrubs of larger sizes resulting in the reduction of plant densities [5].

The highest IVI in MS sites were exhibited by Species of *Hagenia abyssinica, Juniperus procera and Olea africana, from* MS2 sites followed by *Podocarpus falcatus* from MS1 sites respectively*, Podocarpus falcatus* was again tree species with highest IVI in both MS1 and MS3 sites (Table 4). *Hagenia abyssinica*, *Prunus africana, Podocarpus falcatus* and *Juniperus procera* were species which are those tree species prohibited from cutting in Ethiopia having higher IVI in Jello-Muktar Dry Afromontane Forest. This could be due to the establishment of Participatory Forest Management established which gave due attention for conservation of such species.

Table 4. *The IVI of the top ten woody species in 3 sites of MS successional stage at Jello-Muktar dry afromotane forest South-Eastern Ethiopia.*

Species	R F	R D	RBA	IVI
IS1				
Podocarpus falcatus	2.06	2.84	13.38	18.27
Sizygeem guineense	2.58	1.79	9.92	14.28
Maesa lanceolata	4.12	6.27	2.66	13.05
Hagenia abyssinica	3.09	2.99	6.9	12.98
Arundinaria alpina	2.58	8.36	1.58	12.51
Juniperus procera	2.06	2.09	7.69	11.84
Diospyros abyssinica	3.61	3.13	4.21	10.95
Ekebergia capensis	3.09	2.54	4.55	10.18
Prunus africana	2.58	1.94	4.7	9.22
Ilex mitis	3.09	3.28	2.48	8.85
MS2				
Hagenia abyssinica	4.592	5.2	13.38	23.18
Juniperus procera	4.592	5.71	11.53	21.83
Olea africana	5.102	5	9.44	19.55
Podocarpus falcatus	2.041	1.63	8.91	12.59
Sizygeem guineense	2.551	2.14	6.16	10.85
Prunus africana	2.041	1.43	6.07	9.54
Milletia ferruginea	3.061	3.47	2.91	9.44
Croton macrostachys	2.041	2.24	4.53	8.81
Polyscias fulva	2.551	2.86	3.17	8.58
Schfflera abyssinica	2.551	2.86	2.9	8.31
MS3				
Podocarpus falcatus	3.55	3.53	9.21	16.29
Olea africana	4.14	3.82	7.83	15.79
Hagenia abyssinica	4.73	4.26	5.23	14.23
Milletia ferruginea	3.55	4.41	5.87	13.84
Maytenus obscura	4.14	3.97	3.73	11.84
Aningeria altissima	2.37	1.91	6.85	11.13
Prunus africana	2.96	2.79	4.67	10.42
Ekebergia capensis	2.96	3.53	3.64	10.13
Vernonia amygdalina	2.37	4.71	1.69	8.77
Croton macrostachys	3.55	2.94	2.26	8.75

The overall IVI in this study is in line with other studies reported from Borana Lowlands, southern Ethiopia [33] and a moist semi-deciduous forest [3]. It has been reported that that IVI value of tree species in stands with only one species can reach a maximum of 300 [25]. This value is higher when compared with the mean IVI reported for Ades forest [22]. It was reported that some species could be dominance while others are lower in their abundance under a given ecosystem due to their variation in survival mechanism (Kent and Coker, 1992) and the properties of species themselves and the environmental factors can affect the spatial distribution

and dominance of species [30].

4. Conclusion and Recommendation

The Analysis of IVI values could best be unraveled the relative ecological significance and/or dominance of tree species in a forest ecosystem. The results of the calculation of IVI in this study thus helped to identify the dominant tree species in Jello-Muktar Dry afromontane forest of southeastern Ethiopia. The Index was also calculated to examine which species were ecologically significant in the forest ecosystem and this index was used to relate how important they were in providing ecosystem goods. Species with high IVI were considered to have more ecolological importance than those with low IVI. The IVI rank species in a way as to give an indication on which species come out as important element of the Jello-Muktar dry afromontane forest trees. Variation was also observed in IVI between successional stages and among the sites. Those tree species which were officially declared endangered at the national level in Ethiopia were found to have higher IVI in Jello-Muktar dry Afromontane forest. In this case *Hagenia abyssinica, Olea africana, Junipurus procera* and *Podocarpus falcatus* were tree species that are endangered and prohibited not to be cut but with higher IVI in the study area.

There must be conservation strategies and priorities for those species that occurred only once in one of the sites and species with low IVI in addition to low dominant ones.

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