Eth. J. Sci & Technol., Vol. VI, no.1: 33-45, 2013 *ISSN 1816-3378*

Floristic Composition and Structure of Yegof Mountain Forest, South Wollo, Ethiopia

[1]Sultan Mohammed and [2]Berhanu Abraha[*]

[*]*Corresponding Author*

[1]*Department of Biology, Woldia University, Ethiopia* [2]*Department of Biology, Bahir Dar University, Ethiopia*

Abstract

In this study, Floristic composition, diversity, population structure and regeneration status of woody plant species of Yegof Forest in South Wollo Zone, Amhara Regional State, Ethiopia were analyzed. Data were collected from 72 quadrants, each of which was 20 m × 20 m area. Sorensen's similarity coefficient was used to detect similarities and differences among different forests of Ethiopia. Shannon -Wiener diversity index was applied to quantify species diversity and richness. A total of 123 vascular plant species, representing 109 genera and 63 families were recorded. One hundred and twelve of the species collected from sample plots were used for floristic and structural analysis. The rest 11 were collected out of the sample plots but from the same forest and were used to describe the complete floristic list. Out of the total plant species which have been included in the preliminary list assessed for IUCN Red data List, 9 were found to be endemic to Ethiopia. The family Fabaceae had the highest number of species (8) followed by Asteraceae (7 species), Poaceae (6 species), Lamiaceae and Solanaceae (5 species each). The five most abundant woody plant species in the forest were *Dodonaea angustifolia*, *Myrsine africana*, *Olea europaea* subsp *cuspidata*, *Juniperus procera* and *Erica arborea*. In the forest, the overall Shannon-Wiener diversity was 3.73 and evenness of woody species was 0.79, indicating that the diversity and evenness of woody species in the forest is relatively high. Woody species density for mature individuals was 1685 stems ha^{-1}, density of saplings was 1800 stems ha^{-1} and the density of seedlings was 2089 stems ha^{-1}. Density decreased with increasing tree height and DBH classes. The basal area of the forest was 25.4 m^2/ha. We prioritized tree species for conservation using criteria such as species population structure, important value index and regeneration status. The population structure in the forest revealed that there is a need for conservation priority of woody plant with poor regeneration status. Based on the result of the study, research on the soil seed bank, population dynamics and ethno botany are recommended.

Key phrases: Floristic composition, Endemic species, IUCN Red list Phytogeographical Comparison, Population Structure, Yegof Forest

1. Introduction

The diverse topography and climatic conditions of Ethiopia led to the creation of habitats that are suitable for evolution. These have led to the occurrence of some unique plant and animal species and their assemblages. As a result, Ethiopia is one of the countries in the world with high level of genetic diversity and endemism (WCMC, 1992). The flora of Ethiopia is very heterogeneous and has a rich endemic element that is estimated to contain between 6 thousand and 7 thousand species of higher plants, of which 12 percent is endemic (Tewolde Birhan, 1990). Nevertheless, continued exploitation of natural forests without giving due consideration to their propagation, domestication and cultivation has resulted in a vicious cycle where increased forest destruction has led to increased scarcity and/or rarity of forest resources which in turn has resulted in increased demand for forest products and subsequent and further destruction (Zewge and Healey, 2001). As a result, most of the northern parts of the country, particularly Wollo has become one of the most environmentally degraded

regions in Ethiopia. At present the original vegetation is found around churches and in other isolated and protected areas, where it is forbidden to cut trees (Alemayehu *et al*., 2005). Yegof is one of these remnant forests of the area. It is one of the 58 National Forest Priority Areas (NFPAs), which was identified with the aim to introduce improved management systems. The natural vegetation of Yegof and surrounding highlands was broadly classified as *Juniperus procera* forest or "dry evergreen montane forest" with *J. procera* and/or *Olea europaea ssp. cuspidata* as dominant species (Friis, 1992).

Although Mt. Yegof has experienced a long history of deforestation, intensified deforestation of the area started around 1850 AD (Ali, 1983) and large part of the original natural forest has disappeared during the Italian occupation, 1935–1941 (Bahru, 1998). Two major forest fires also devastated it in 1923 and 1971 (Ali, 1983). Moreover, cultivation (for purposes other than forestry) and grazing were intense until the ecological rehabilitation program started in 1973, an afforestation and hillside closure scheme (Kebrom, 1998). Yegof was declared a State Forest in 1965 and some limited afforestation was carried out prior to the 1974 revolution. In fact, Bahru (1998) noted that it was one of only two out of thirty-nine State Forests in Ethiopia that had plantations before the revolution. However, human encroachment into the forest remained the major threat. It is under extreme pressure from settlement, land-use conversion for farming and grazing, excessive extraction, and neglect in terms of forest management and protection. Because of these problems the plantation is thinned on an irregular basis. In spite of the presence of 35 guards who keep the forest from human pressure, grazing and illegal logging of trees for construction, timber and fuel wood collection are still common with farmers residing inside the forest boundaries. Consequently, the most valuable indigenous tree species as well as wild animals are becoming severely affected in the area. Despite the disturbing scenario, the vegetation structure and composition of the mountain forest has not been studied except a few general botanical studies associated with the drought in Wollo. These few studies include Natural Resource Management in Post-conflict Situations by Alula Punkhurst (2001), Deforestation in Wállo by Crummey (1988) and Historical Perspective of Forest Management in Wollo by Bahru Zewde (1998).

Thus, the present study was initiated to investigate and document the floristic composition, structure and regeneration status of the forest, which could enable to properly manage and sustainably use the resources.

2. Materials and methods

Study site

The study was conducted in South Wollo Zone of the Amhara Regional State, on a steep mountain ridge overlooking Kombolcha town, 380 km north of Addis Ababa. The site is located between 11^0 01' to 11^0 03' North latitude and 39^0 4' to 39^0 44 East longitude with an elevation between 2000 and 3014 masl (Fig. 1). According to the closest weather station at Kombolcha town, the area has a mean annual minimum temperature of 12.7^0C and maximum of 27.1^0C while the average annual rainfall is about 1001 mm. In the forested areas of the mountain, higher rainfall and cooler temperatures prevail because of altitude. The soil pH ranges from 6.0 to 7.26 and the

texture varies from loam to clay loam with textural compositions of 19–28% clay, 32–41% silt and 27–46% sand (Zewdu, 2002).

The forest is composed of natural highland trees and plantations of fast-growing exotic trees. The natural forest, which once covered Mt. Yegof, comprised dry evergreen, mixed conifer, and broadleaved trees (Bahiru, 1988). Lower down the mountain, various plant species are evident. The place is also one of the important bird areas in Ethiopia; a survey conducted in April 1996 in the area indicated 62 bird species (Bird Life International, 2009).

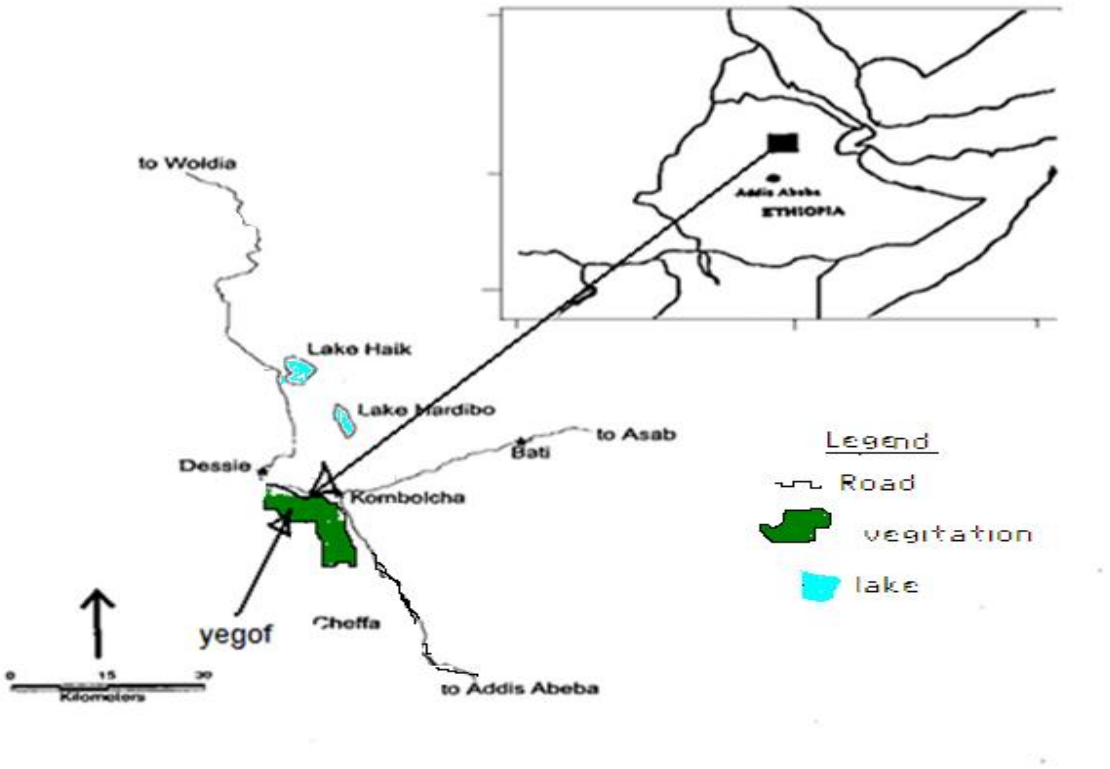


Figure 1. Map of the study site. (Source: Tesfaye Bekele, 2000 with certain modifications).

Methods

To investigate the floristic composition and structure of plants, line transects were systematically laid at the eastern face of the mountain. A total of 72 sample quadrants measuring 20 m × 20 m (2.88 ha) were used at every 100 m along transect lines and 400 m apart from each other. The same number but 1 m by 1 m nested plots were established within the center of each main quadrant to assess grasses, herbs and regeneration.

Plant species having DBH >2 cm were measured by using diameter tape and height > 2 m by hypsometer (type 65, Swedish made). Physiographic variables were recorded such as altitude by using an altimeter, longitude and latitude using GPS

and aspect by Compass. Those plant species having a height less than 2 m and DBH less than 2 cm were counted by species for floristic composition and regeneration assessments.

For the purpose of analyzing population structure of the woody species, individuals of the same species were categorized into seven diameter and eight height classes. The percent cover-abundance value for each species within the sample plot was visually estimated. The percentage frequency distribution of individuals in each class was calculated. The tree or shrub density and basal area values were computed on hectare basis. In addition, seedlings and saplings of woody species were counted and recorded.

Woody plant species outside the study quadrants were also recorded to prepare a complete checklist of plants in the area. For species that were difficult to identify in the field, their local names were recorded, herbarium specimens were collected, pressed, dried and transported to the National Herbarium at the Department of Biology in the Addis Ababa University for identification. In addition, Azene (2007) was referred for identification purposes.

Data analyses

Structural analysis of the vegetation was described based on the analysis of species density, DBH, height, basal area, frequency, and Important Value Index (IVI) for those individual species having DBH greater than 2 cm and height greater than 2 m. The Diameter at Breast Height (DBH) and tree height were arbitrarily classified into seven DBH and eight height classes. The percentage and frequency distribution of individuals in each class was calculated. The tree or shrub density and basal area values were computed on hectare basis.

The diversity and evenness of woody plants was analyzed using the Shannon-Wiener Diversity Index and Shannon's evenness (equitability) Index (Kent and Coker, 1992). Phytogeographical comparison of Yegof Forest with other dry evergreen forests in Ethiopia was carried out by using Sorensen's Similarity coefficient.

3. Results and Discussions

A total of 123 species of vascular plants representing 63 families were recorded in the study area both inside and outside the study quadrants (Appendix 1). From all the species identified in 72 quadrants, 33 species were trees, 26 species were shrubs, 24 species were trees/shrubs, 18 species were herbs, 12 species were climbers, 7 species were grasses and 3 species were epiphytes. The most diverse families were Fabaceae (8 species), Asteraceae (7species), Poaceae (6 species), Lamiaceae and Solanaceae (5 species each), Euphorbiaceae (4 species) and seven other families were represented by 3 species each.

Species Diversity

The overall Shannon-Wiener diversity of woody species in Yegof forest was 3.73 and evenness was 0.79, indicating that the diversity and evenness of woody species in the forest is relatively high. About 48.1% of woody plant species in the forest were under 1% of relative abundance and rare to find. Therefore, they fall on rare cover classes. About 46.2% of the woody species were categorized under common cover classes. Only 5.8% of woody plant species were categorized under abundant cover

classes. This clearly shows that the forest was dominated with small sized trees and shrubs, which in turn indicates that woody plants of the forest were under heavy disturbance and habitat degradation.

Density

The density (number of individuals per ha) of mature tree species of the forest was 1685 stems/ha. Of these mature plant species, *Dodonaea angustifolia* had 143 individuals ha^{-1}(8.4%), *Myrsine africana* 110 ha^{-1} (6.5%*), Olea europaea* subsp *cuspidata* 87.2 ha^{-1} (5.2%), and *Juniperus procera* 77.8 ha^{-1}(4.6%), contributed to the largest proportion of individuals per hectare. As to tree and shrub density, 557 individuals were counted per ha which measured a DBH value between 10 and 20 cm and 286 individuals per ha which had DBH greater than 20 cm. The ratio described as a/b, is taken as the measure of size class distribution (Grubb *et al.*, 1963). Accordingly, at Yegof Forest, the ratio of individuals with DBH between 10 and 20 cm (a) to DBH > 20 cm (b) was 1.95. When this value was compared with that of six other Dry afromontane forests in Ethiopia, it is comparable to Dindin forest (Simon and Girma, 2004), greater than that of Wof-Washa (Tamrat, 1993), Denkoro (Abate et *al.*, 2006) and Gedo (Birhanu, 2010) forests, but lower than those of Chilmo and Menagesha (Tamrat, 1993) forests. This indicates that the proportion of lower and medium-sized individuals is larger than the large- sized individuals, indicating that Yegof forest is at the stage of secondary regeneration.

Tree height and DBH

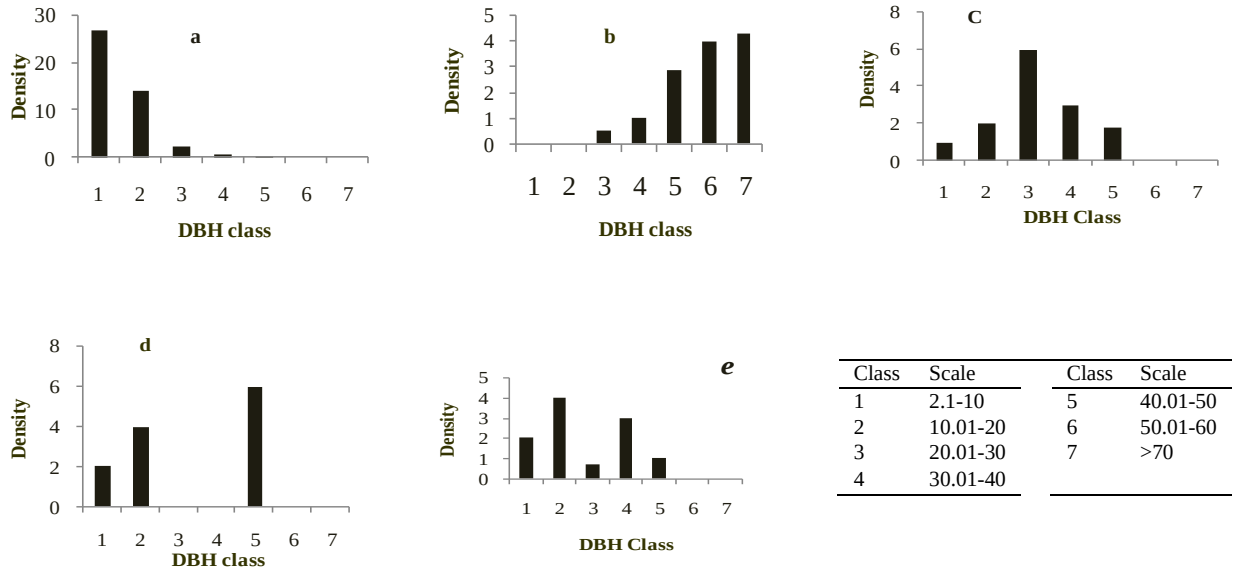
The height and DBH class distribution of the woody species showed that the majority of the tree individuals are distributed in the first height (46.5%) and DBH (49.9%) classes. As the tree height and DBH class size increases, the number of individuals gradually decreases which appears to be a regular inverted J-shaped distribution. This indicates the dominance of small-sized individuals in the forest and the good regeneration and recruitment potential status of the forest. The frequency of occurrence of woody species went in parallel to the height and DBH, and higher percentage in the number of species in the lower frequency classes and low percentage in the number of species in the higher frequency class indicated a high degree of floristic heterogeneity. The three most frequently observed species which regenerate by their own are *Juniperus procera*, *Olea europaea* subsp. *cuspidata* and *Myrsine africana.*

The basal area of all tree species in Yegof forest is found to be 25.4 m^2/ha. High density and high frequency coupled with high BA indicates the overall dominant species of the forest (Lamprecht, 1989). For this reason, *Juniperus procera*, *Olea europaea* subsp *cuspidata* and *Myrsine africana* are the top three dominant species of the forest since all the three are found in the top five of the ranks of basal area, relative density, relative frequency and IVI per hectare of the top ten dominant species.

Population Structure of Tree Species

From the results of the analyses five general patterns of population structure were recognized. The first group exhibited typical inverted J-shaped curves, i.e., species having many individuals at the lower diameter classes and decreasing number of individuals at successively higher diameter classes (Fig. 2a), which is an indication for good biological functions

and recruitment capacity for a species. The second pattern shows a J-shaped pattern of distribution (Fig.2b). In this pattern, DBH classes were missed from three or more lower classes and one or more higher DBH classes. Some species under this pattern have big individuals that are less competent to reproduce and hence reveal poor reproduction and weak position of regeneration. In the third pattern, lowest DBH classes have lower densities followed by an increase in the number of individuals towards the middle classes and then a progressive decrease towards the higher DBH classes which depicted a bell-shaped distribution pattern (Fig. 2c) that indicate a poor reproduction and recruitment potential. The forth pattern is characterized by having large number of individuals in the first lower DBH class and disappearing in the next two or three middle classes and finally increasing with an increase in DBH forming a U-shaped pattern (Fig. 2d) which is due to human intervention. The fifth class shows an irregular pattern (Fig. 2e) that arises from selective cutting by the local people for different purposes.



Class	Scale	Class	Scale
1	2.1-10	5	40.01-50
2	10.01-20	6	50.01-60
3	20.01-30	7	>70
4	30.01-40		

Figure 2a-e. Five representative patterns of population structure an Yegof Forest

Regeneration Status of Yegof Forest

The composition and density of seedlings and saplings of tree species in Yegof forest were counted. Accordingly, a total of 2088.9 seedlings/ha, 1799.71 saplings/ha and 1685 mature individuals/ha were recorded. From the analysis of seedlings and saplings data, the density of trees was 949.3 ha^{-1}, tree/shrubs 836.2 ha^{-1} and shrub seedlings 301.4 ha^{-1}. Similarly, the densities of trees, tree/shrub, and shrub species saplings were 804.2 ha^{-1}, 662.2 ha^{-1} and 333.3 ha^{-1} respectively (Fig. 3). The ratio of seedlings to adult individuals of woody species in the forest was 1.24:1; the ratio of seedling to saplings was 1.16: 1 and sapling to mature individuals was 1.07:1. The result shows the presence of more seedlings than saplings and saplings than mature trees, which indicates successful regeneration of forest species.

Generally, most of the seedling and sapling densities were contributed by species such as *Myrsine africana, Rhus natalensis, Olea europaea* subsp *cuspidata, Rhus glutinosa, Juniperus procera, Otostegia tomentosa, Calpurnia aurea* and *Carissa edulis*. Hence, these species have high regeneration status while others do not.

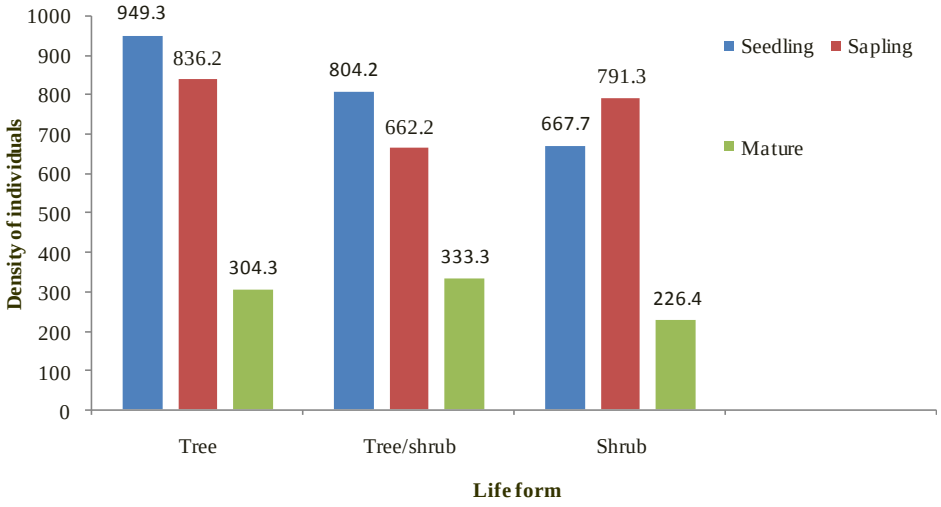


Figure 3. Seedling and sapling distribution of woody species of Yegof forest

This situation calls for conservation measures through prioritization. To ensure this, the woody species in the area were grouped into three regeneration status classes on the basis of their seedling and sapling densities per hectare (Table1). Those species that had no seedling and sapling at all were grouped under class I; others whose seedling and sapling density is between one and fifteen were categorized under class II and the remaining species were put under class III.

Phyto geographical Comparison

Comparison of the species diversity of one forest with other forests can give more or less a general impression of the overall species richness, diversity and phytogeographical similarity (Tadesse, 2003). In this regard, Yegof Forest is compared with five afromontane forests in the country to see the distribution pattern of woody species in the study area and to determine the relative similarity in its woody species composition (Table 2). These forests were: Menagesha Suba, Dindin, Denkoro, Biteyu and Sanka Meda. In the analysis of the data from the seven forests, Sorensen's (1948) similarity index was used.

The overall similarities indices between Yegof and the other five forests in Ethiopia ranged between 0.34 and 0.51. For all compared forests, Sorensen's similarity index which is dependent on the number of common species shared by the forests being compared indicated that Yegof forest shared significant number of species with Denkoro (51%), Menagesha Suba (48%), Dindin (40%), and Biteyu (36%) forests of Ethiopia in decreasing order.

Table 1. List of tree species under regeneration status classes.

Class I	Class II	Class III
Discopodium penninerxium	*Scolopia theifolia Gilg.*	*Hypericum revolutum*
Ekebergia capensis	*Acacia polyacantha* sub sp	*Croton macrostachyus.*
Euphorbia candelabrum	*campylacatha*	*Dombeya torrida*
Millettia ferruginea	*Hibiscus ludwigil*	*Vernonia amygdalina*
Zizyphus spina- christi	*Pinus radiata*	*Bersama abyssinica*
Podocarpus falcatus	*Eucalyptus camaldulensis*	*Buddleja polystachya*
Cordia africana	*Eucalyptus globulus*	*Caesalpina spinosa*
Olinia rochetiana	*Maytenus arbutifolia*	*Maytenus undata*
Pygeum africanum	*Acacia abyssinica*	*Euclea racemosa*
Vernonia bipontinnii		*Ximenia americana*
Euphorbia tirucalli		*Dovyalis verrucosa*
		Clerodendron alatum
		Casuarina equisetifolia
		Mytenus undata
		Galiniera saxifraga
		Cupressus lucitanica
		Combretum collinum.
		Capparis tomentosa
		Nuxia congesta
		Dodonaea angustifolia
		Osyris quadripartite
		Allophyllus abyssinicus
		Otostegia tomentosa
		Juniperus procera
		Rhus glutinosa
		Olea europaea subsp *cuspidata*

The high similarity observed between Denkoro and Yegof forest could be due to the close geographical proximity of the forests to each other and similar tradition of forest disturbance by anthropogenic factors. Lower number of species was shared between Yegof and Sanka Meda forests. The dissimilarities might have risen from the different sample sizes and methods of the study, altitudinal differences, location (far away from Yegof forest), degree of human impact, over grazing and climatic conditions.

Table 2. The floristic distribution similarity between Yegof and other five afromontane forests in Ethiopia, as calculated by Sorensen similarity index.

Forest	Altitude range	a	b	c	Ss
Yegof[0]	1900-3014	-	-	-	1
Menagesha[1]	2440-3400	44	39	55	0.48
Dindin[2]	2150-3000	32	51	45	0.40
Denkoro[3]	2300-3500	45	38	48	0.51
Biteyu[4]	2590-2890	30	53	47	0.36
Sanka Meda[5]	2400-2748	28	55	54	0.34

Key: 0. The present study, **1**.Tamrat Bekele (1993, 1994), 2. Simon Shibiru and Girma Balcha (2004), 3. Abate Ayalew *et al*. (2006), 4. Mekonnen Biru (2003), 5. Shambel Bantiwalu (2010).

4. Conclusion and recommendations

Conclusion

The results of the study indicated that the forest had high species diversity. Fabaceae was found to be the most dominant family followed by Asteraceae and Poaceae. Out of the plants identified in this study, 9 were endemic species which are included in the IUCN Red Data List.

The overall Shannon-Wiener diversity and evenness of woody species in Yegof forest was 3.73 and 0.79, respectively, indicating that the diversity and evenness of woody species in the forest is relatively high. The density of tree species in the forest decreases with increasing DBH and Height classes which shows that the forest is in the secondary state of development.

Analysis of population structure of most common species of trees and shrubs revealed high variation among species population dynamics within the forest. Accordingly, five population patterns have been observed (J-shaped, bell shaped, inverted J-shaped, irregular and U-shaped).

The assessment of regeneration status of some selected woody species based on seedling and sapling count revealed that a significant number of tree species, i.e., 11, without seedlings, 10 tree species without sapling stage and some, i.e., 6, are without seedling and sapling stage in the forest, while others are represented by all stages (seedling, spacing and mature). This shows the need for prioritized conservation strategy.

Recommendations

The present study was limited to floristic composition and structure of woody plants. This requires further studies on soil seed bank, seed physiology, and land use management system of the area. Moreover, detailed ethnobotanical studies are necessary to explore the wealth of indigenous knowledge on the plant community and its conservation. This could be considered as part of the integrated efforts for the implementation of the rules of conservation and sustainable use of forest resources. Further, the species in the first and second priority classes for conservation should be given appropriate attention and should be conserved *in-situ* through the collaboration of local communities, the District Agriculture and Rural Development Office, other interested individuals and stakeholders. The forest is a good recreational area and real live teaching site for the community and

university students in and around the area. Especially, it has interesting sites for recreation during weddings and holiday celebrations. Therefore, establishment of roads, hotels, and tourism is beneficial.

References

Abate Ayalew, Tamirat Bekele and Sebsebe Demissew (2006). The Undifferentiated afromontane forest of Denkoro in the central highland of Ethiopia: A floristic and Structral Analysis. *SINET: Ethiop. J. Sci*., 29(1): 45-56.

Alemayehu Wassie, Demel Teketay and Powell, N. (2005). Church forests in North Gondar Administrative Zone, northern Ethiopia. *Forests, Trees and Livelihoods* 15: 349-374.

Ali Abate (1983). Aspects of the political history of Wello: 1872–1916.MA Thesis Addis Ababa University, Addis Ababa.

Azene Bekele (2007). Useful Trees and Shrubs for Ethiopia. Identification, Propagation and Management for 17 Agro climatic zones. Technical manual, pp.550, (Tengnas,B.,Ensermu Kelbessa, Sebsebe Demissew and Maundu, P. eds). *World Agroforestry*

Bahru Zewde (1998). Forests and forest management in Wollo, in historical perspective. *Journal of Ethiopian Studies* 31(1):87-122.

Bird Life International (2009). *Important Bird Area fact sheet: Yegof forest*, Ethiopia. Downloaded from the Data Zone at http://www.birdlife.org,accessed on 6/10/2010.

Birhanu Kebede (2010). Floristic Composition and Structural Analysis of Gedo Dry Evergreen Montane Forest, West Shewa Zone of Oromia National Regional StateCentral Ethiopia. MSc. thesis (Unpublished). Addis Ababa University. Addis Ababa.

Friis, I. (1992). Forest and Forest Trees of Northeast Tropical Africa: their natural habitats and distribution pattern in Ethiopia, Djibouti, and Somalia. *Kew. Bull. Add. Ser*. 15: 396.

Grubb, P. J. Lloyd, J. R., Penigton, J. D. and Whimore, J. C. (1963). A comparison of montane and lowland rain forests in Ecuador. *J. Ecol*. 51: 567 – 601.

Kebrom Tekle(1998). Ecological rehabilitation of degraded hill slopes in southern Wello Ethiopia. Doctoral Thesis. Uppsala University, Uppsala, Sweden

Kent, M. and Coker, P. (1992). *VegetationD escription and Analysis*: *A practical approach.* Belhaven press London.

Lamprecht, H. (1989). *Silverculture in Tropics*. Tropical Forest Ecosystems and their Tree Species-Possibilities and Methods of their Long-term Utilization. T2-Velagsgesells chaft GmbH, RoBdort, Germany.

Mekonnen Biru (2003). An Ecological Study of Biteyu Forest, Gurage Zone, Southern Nations, Nationalities Peoples Region. Unpublished M.Sc. Thesis, Addis Ababa University, Addis Ababa.

Shambel Bantiwalu (2010). Floristic composition, structure and regeneration status of plant species in Sanka Meda forest,Guna District,Arsi Zone of Oromia Region, South east Ethiopia. M.Sc. Thesis, Addis Ababa University.Addis Ababa.

Simon Shibru and Girma Balcha (2004). Composition, Structure and regeneration status of woody species in Dindin Natural Forest, Southeast Ethiopia: An implication for conservation. *Ethiop. J. of Biol. Sci.* (1) 3:15-35.

Tadesse Woldemariam (2003). Vegetation of the Yayu forest in Southwest Ethiopia: Impacts of human use and Implications for In situ conservation of Wild Coffea arabica L. populations. *Ecology and Development Series* No. 10. Center for Development Research, University of Bonn.

Tamrat Bekele (1993). Vegetation and ecology of Afromontane forests on the central plateau of Shewa, Ethiopia. *Acta phytogeorgr*. Suec. 79.

Tamrat Bekele (1994). Phyosociology and Ecology of Humid Afromontane Forest on the Central plateau of Ethiopia. *J. Veg. Sci.*, 5:87-98.

Tewolde Brhane Gebre Egziabher. (1990). *Diversity of Ethiopian flora.* In: Engles, J.M.M.,Hawkes, J.G and Melaku Worede (eds.), *Plant genetic resources of Ethiopia*, Cambridge University Press, Cambridge, pp.75-81.

WCMC (World Conservation Monitoring Center) (1992). *Global Biodiversity:status of the earth's living resourceces*. Champman and Hall, London.

Zewdu Eshetu (2002). Historical C3-C4 Vegetation Pattern on Forested Mountain Slopes: It's Implication for Ecological Rehabilitation of Degraded Highlands of Ethiopia. *Journal of Tropical Ecology*, Vol. 18, No. 5 pp. 743-758P: Cambridge University Press.USA.

Zewge Teklehaimanot & Healey, J. (2001). Biodiversity conservation in ancient church and Monastery Yards in Ethiopia. In: *Proceedings of a workshop on biodiversity conservation.* Ethiopian Wild life and Natural History Society, Addis Ababa, Ethiopia.

Appendix 1. Species list collected from Yegof Forest, South Wollo, Ethiopia

Scientific name	Family name	Vernacular name (Amhric)	Habit
Acacia abyssinica Hoechst. ex Benth	Fabaceae	Yabesha grar	Tree
Acacia polyacantha Wild sub sp *campylacatha*	Fabaceae	Nech grar	Tree
Acacia seyal Del	Fabaceae	Key grar	Tree
Achanthus sennii chiove.	Acanthaceae	Kosheshela	Shrub
Achranths aspera L.	Amaranthaceae	Telenji	Shrub
Agrocharis sp.	Apiaceae	Chegogot	Herb
Allophyllus abyssinicus	Sapindaceae	Embis	Tree
Aloe spp. (*Aloe vera* L.)	Liliaceae	Erret	Shrub
Anthoxanthum aethopicum I. hedberg	Poaceae	Yekok sar	Grass
Arisaema shimperianum schott.	Araceae	Amoch	Herb
Asparagus africanus Lam.	Liliaceae	Yeset-qest	Shrub
Asplenium aethopicum (Burm.f.) Becherer	Aspleniaceae	Amsa Anketkit	Herb
Bersama abyssinica Fresen	Melianthaceae	Azamir	Tree/shrub
Bidens bitenata L	Asteraceae	Aday Ababa	Herb
Bidens pilosa L.	Compositae	Yesytan-merfie	Herb
Brucea antidysenterica J.F.Mille*r*	Simaroubaceae	Yedega Abalo	Tree/shrub
Buddleja polystachya Fresen.	Buddlejaceae	Anfar	Tree
Cadaba farinose Forssk.	Malvaceae	Dengay-seber	Shrub
Caesalpina spinosa (Molina) Kuntze	Caesalpinioideae	Konter	Tree/shrub
Calpurnia aurea (Alt.) Benth	Fabaceae	Zegeta	Tree/Shrub
Capparis tomentosa Lam.	Capparidaceae	Gemero	Tree/shrub
Carissa edulis (Forssk.) Vahl	Apocynaceae	Agam	Tree/shrub
Cassia siamea (Senna siamea)	Caesalpinioideae	Yeferenji Zegeta	Shrub
Casuarina equisetifolia L	Casuarinaceae	Shewashewe	Tree
Cerastium octandrum A. Rich.	Caryophyllaceae	Chegof Sar	Grass
Cissus qudrangularis L.	Vitaceae	Yezhon Anjet	Shrub
Clematis simensis Fresen.	Ranunculaceae	Tero hareg	Climber
Clerodendron alatum Gurke	Verbenaceae	Bujite	Tree/Shrub
Clerodendrum myricoides (Hochst.) R. Br.	Umbelliferae	Missiritch,	Shrub
Clutia abyssinica Jaub & Spach	Euphorbiaceae	Feyelefej	Shrub
Combretum collinum Fres.	Combretaceae	Tinjut	Tree/shrub
Commelina africana L.	Commelinaceae	Weha-ankur	Herb
Convolvulus kilimandschari Engl.	Convolvulaceae	Yeayt Areg	Herb
Cordia africana Lam.	Boraginaceae	Wanza	Tree
Crinum abyssinicum	Amarlyllidaceae	Yejib shinkurt	Herb
Croton macrostachyus Del.Hochest. ex. Del.	Euphorbiaceae	Bisana	Tree
Cupressus lucitanica Miller	Cupressaceae	Yeferenj Tid	Tree
Cyathula cylindrica Moq.	Amaranthaceae	Kundo sar	Grass
Cynodon dactylon (L.) Pers.	Poaceae	Serdo	Grass
Datura stramonium L.	Solanaceae	Etse-faris	Herb
Delphinium dasycanslon Fresen.	Ranunculaceae	Gedel admik	Climber
Desmodium repandum (Vahl) DC.	Fabaceae	Yeayt Misir	Herb
Diplolaphium africanum Fresen.	Apiaceae	Dog	Shrub
*Discopodiumpenninerxium*Hochst.	Solanaceae	Ameraro	Tree/shrub
Dodonaea angustifolia L.f	Sapindaceae	Kitketa	Tree/Shrub
Dombeya torrida (J.F. Gmel) P.Bamps	Sterculiaceae	Wulkefa	Tree
Dovyalis verrucosa (Hochst.)Warb.	Flacourtiaceae	Koshim	Tree/shrub
Echinops giganteus	Acanthaceae	Kosheshela	Shrub
Ekebergia capensis Sparrm.	Asteraceae	Sembo	Tree
Erianmthemum dregei (Eckl.& Zeyh.) V. Tiegh.	Loranthaceae	Yembis-teketela	Epiphyte
Erica arborea L.	Ericaceae	Asta	Tree/shrub

Eucalyptus camaldulensis Dehnh	Myrtaceae	Key bahirzaf	Tree
Eucalyptus globulus Labill	Myrtaceae	Nech bahir-zaf	Tree
Euclea racemosa subsp *schimperi*	Ebenaceae	Dedeho	Tree/shrub
Euphorbia candelabrum Kotschy.	Euphorbiaceae	Kulkual	Tree
Euphorbia tirucalli L	Euphorbiaceae	Kinchibt	Tree/shrub
Ficus sur Forssk	Moraceae	Sholla	Tree
Foeniculum vulgare Mill.	Umbelliferae	Ensilal	Herb
Galiniera saxifrage	Rubiaceae	Yetota buna	Tree
Galium asparinoides Forssk.	Rubiaceae	Ashket	Herb
Gladiolus candidus L	Araceae	Milas golgul	Climber
Guizotia scabra (Vis.)Chiov	Asteraceae	Mech	Herb
Hibiscus ludwigil Eckl & Zeyha	Malvaceae	Nacha	Tree/shrub
Himpocrata africana (Willd.) Loes.	Acaliaceae	Ye-ayit hareg	Climber
Hyeperrhinia antchisteriodes	Poaceae	Quaya sar	Grass
Hypericum revolutum Vahl	Clusiaceae	Amja	Tree/shrub
Hyperrhenia variabilis	Poaceae	Senbelate	Herb
*Jasminum abyssinicum*Hochstex.DC.	Oleaceae	Nech hareg	Climber
Jasminum grandiflorm L.	Oleaceae	Tembelel	Climber
Juniperus procera Endl	Cupressaceae	Yabesha Tid	Tree
Justicia schimperana (Hochst ex Nees)	Acanthaceae	Sensel	Shrub
Kalanchoe petitiana A. Rich.	Crassulaceae	Indahula/Bosoqe	Herb
Laggera tomentosa Sch. - Bip.	Asteraceae	Alashume	Shrub
Lippia adoensis Hochst.ex Walp.	Verbenaceae	Kesse	Shrub
Maesa lanceolata Forsk	Myrsinaceae	Abaye/debebosh	Tree
Maytenus arbutifolia (Hochst ex. A. Rich.) Wilczex	Celastraceae	Atat	Tree/shrub
Maytenus addat (Loes.) Sebsebe	Celastraceae	Geram Atat	Tree/shrub
Millettia ferruginea (Hochst.) Bak	Fabaceae	Birbira	Tree
Myrica salicifolia A.Rich.	Myricaceae	Shinet	Tree/shrub
Myrsine africana L.	Myrsinaceae	kechemo	Tree/shrub
Mytenus undata(A.D.C)f.wheat	celastraceae	Checho	Tree/shrub
Nuxia congesta R. Br. Ex Fresen	Loganiaceae	Asquar	Tree
Ocimum basilicum Hochst. Ex Benth.	Lamiaceae	Besobila	Herb
Ocimum lamiifolium Hochst. ex Benth.	Lamiaceae	Dama kessie	Shrub
Olea europaea subsp *cuspidata (*Wall. ex DC.*)* Cifferri	Oleaceae	Weyra	Tree
Olinia rochetiana A. Juss.	Oliniaceae	Beye/tife	Tree/shrub
Opuntia ficus-indica (L) Miller	Cactaceae	Beles Kulkual	Tree
Osyris quadripartite Deen.	Santalaceae	keret	Tree/shrub
Otostegia integrifolia Benth.	Lamiaceae	Tinjut	Shrub
Otostegia tomentosa A. Rich	Lamiaceae	Yeferes Zeng	Shrub
Otostegia tomentosa subsp *ambigiens* (chiov.) Sebald	Lamiaceae	Nechelo	Tree/shrub
Partentum misterophonus	Asteraceae	Kinche arem	Herb
*Phragmanthera regularis (*Sprague) M. Gilbert	Loranthaceae	Yequamo-teketela	Epiphyte
Phytolacca dodecandra L. Her	Phytolacaceae	Endod	Climber
Pinus patula L.	Pinaceae	Pachula	Tree
Pinus radiata D. Don.	Pinaceae	Radiata	Tree
*Podocarpus falcatus (*Thun) M*irb.*	Podocarpaceae	Zigba	Tree
*Pteroloblum stellautm (*Forssk.) Brenan.	Fabaceae	Kentefa	Climber
Pygeum africanum Hook. f.	Rosaceae	Tikur-inchet	Tree
Rhus glutinosa Hochst. ex A. Rich	Anacardiaceae	Qamo	Tree
Rhus natalensis A.Rich.	Anacardiaceae	Takuma	Tree
Rosa abyssinica Lindley	Rosaceae	Kega	Shrub
Rubia discolor Turcz	Rubiaceae	Enchibrr	Shrub
Rubus aethiopicus R.A.Grah.	Rosaceae	Injorie	Shrub
*Rumex nervosus (*Vahl*)*	Polygonaceae	Embacho	Shrub

Rytidosperma grandiflora (Hochst.ex A. Arich.) S.M. Phillips	Poaceae	Ginchire sar	Grass
Scolopia theifolia Gilg.	Flacourtiaceae	Wanaye	Tree
Senna singuenana	Fabaceae	Gonfa	Shrub
Sida ovata Forsk	Malvaceae	Chifreg	Shrub
Solanum giganteum Jacq.	Solanaceae	Embuway (Whiteleaf)	Shrub
Solanum indicum L.	Solanaceae	Embuway	Shrub
Solanum nigrum L.	Solanaceae	Teqr-awete	Climber
Tapinanthus globiferus (A.Rich) Tiegh.	Loranthaceae	Teketela red	Epiphyte
Thymus schimperi Ron.	Labiatae	Tossigne	Herb
Trifolium schimperi A. Rich.	Poaceae	Washma	Grass
Urera hypselodendron (A.Rich.)Wedd.	Urticaceae	Lankuso	Climber
Verbascum sinaiticum Benth.	Scrophulariaceae	Ketetina	Shrub
Vernonia amygdalina Del. In Caill.	Asteraceae	Sete Gerawa	Tree
Vernonia bipontinnii Vatke.	Asteraceae	Mechela	Tree
Ximenia americana L.	Apocynaceae	Inkoy	Tree
Zehneria scabra (L. fil) sonder	Cucurbitaceae	Areg-ressa	Climber
Zizyphus spina- christi (L.)Wild	Rhamnaceae	Kurkura	Tree