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Biological Science

MANAGEMENT AND CONSERVATION OF SPECIES DIVERSITY IN ABAYA-HAMASSA REGION, RIFT VALLEY OF ETHIOPIA

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ABSTRACT With its diverse and vibrant bio-geo terrain, Ethiopia is unique for its species diversity and uncanny dispersion of flora and fauna. In the deep south of the country lies the Abaya-Hamassa region in the banks of mighty rift valley Lake Abaya' dominated specifically by several species of disparate origin. 315 plant species representing 198 genera belonging to 59 families and over 120 varieties of animal fauna were identified in the Abaya-Hamassa natural vegetation. Six plant communities were designated and described as per the ecological conglomeration and assemblage of various species. The interaction between various communities and surrounding environment was assessed based on ecological, physiological and pedological data collected from 55 quadrates (400m^2) belonging to eight selected sites between October 2013 to June 2014. The floristic composition, animal diversity, community types and interaction among all these were investigated in association with several ecological, physical, chemical as well as biological parameters. Multivariate techniques were used to assess the species diversity. Plots grouped into clusters with the aid of the TWINSPAN program. Jaccard's coefficient of similarity was used to see the species composition turnover of the communities and species composition The Percentage of coverage, Canopy, abundance and frequency of species were estimated and converted as per the modified Brawn-Blanquet 1-9 scale.

KEYWORDS : Abaya-Hamassa, Biodiversity, Community, Floristic composition, Vegetation

Introduction

Biodiversity of life forms, their genetic diversity and their collection is obviously one of the most outstanding studies in recent times. Paul (1993) viewed species diversity in terms of species richness, species endemism, evenness and taxonomic diversity. Ecological biomes whether tundra, forests, savannahs, grasslands, deserts, lakes, rivers, wetlands, coastal communities or marine ecosystems are functionally complex that are always associated often obscure ways with the diversity of their component species. Most studies suggest that approximately 250,000 species of vascular plants exist in the world of which two-thirds of these are found in the tropics. One-sixth of the earth's diversity of plant life is found in Latin America followed by Africa. The diversity of higher plant species increases from poles to the equator. About 6000 species of higher plants were recorded in Ethiopia, Ensermu Kelbessa estimated of which nearly 10.5% are endemic.

The present study area is positioned in between Wolaita and Gamo-Gofa zones at 66°27.404'N-6°37.368'N and 6°44.042'E - 36°52.169' E, in the Southern Nations, Nationalities and Peoples' Regional State (SNNPRS) of Ethiopia. The area is located to the east of western part of Rift Valley to the west and northeast of Lake Abaya. The elevation ranges from 1184m.s.l. at the coast of Lake Abaya to 1410m.s.l. at Wanke derya. The elevation decreases towards the Lake by forming tiers in a long distance. Small rivers and streams rising from Wolaita and Chencha highlands drain to Lake Abaya and Lake Chamo. The soil along the floor of the Rift Valley and Lake Abaya are alluvial of Hare stream (Vaukasinvic, 1969) and colluvial materials and lacustrine deposits of the Pleistocene (Mohr,1971) categorized also as Fluvisols of the FAO/ UNESCO revised legend (1990). The average annual rainfall of the study area ranges from 650 to 800mm. Rainfall is bimodal occurring from March to may (short rain) and June to September (long rain). The mean monthly temperature of the area is between 22℃ to 28ºC (Wolaita Zone Agricultural Office, 2013).

Altitude, slope, aspect and position for each plot were determined respectively with an Altimeter, Suunto Clinometer, Suunto compass and GPS-48. Soil samples were collected from 5 sites in each plot (quadrat), four at the corners and one at the middle of the plot at 0-20cm. Composite soil samples weighing about 1.5 kg were brought to the soil laboratory for further analysis. The samples were air dried, sieved with a mesh size of 0.5 mm and 2 mm, were analyzed at the soil laboratory, following the methods of Jackson (1973) and Juol (1978).

Data analysis

To study the complex nature of plant communities' multivariate techniques were used. Two major approaches were followed for floristic vegetation description. These were the relevé analysis for classification and the continuum analysis for ordinates (Mueller-Dombis and Ellenberg, 1974). Classification aims at grouping individual stands into categories. The stands those were similar to one another form one class, which was separated from other classes that also consist of similar stand (Mueller-Dombois and Ellerberg, 1974). This method emanated from the belief that vegetation was composed of certain distinct and fairly discrete plant communities (the concept of community unit theory) (Whittaker, 1962 and 1967; Shimwell, 1971). Plots were grouped into clusters with aid of the program TWINSPAN. Jaccard's coefficient of similarity was computed to see the species composition turnover of the communities and species composition grades gradually or in discontinuity. Sörensen's Coefficient was calculated to analyze the species resemblance between the study areas with other natural vegetation types in different parts of the country.

Vegetation

The semi-arid climatic condition is survived by a number of woodland and bush land resources in the study area. The natural vegetation is under threat due to the combined forces of resources exploitation and forest degradation as a result of frequent burning, extension of grazing and cultivation lands. In order to suggest the mechanisms to maintain and restore these resources on a sustainable basis, a clear understanding on vegetation structure, floristic composition and faunal association is crucial for proper management. The mechanism to involve the local human settlements to safeguard the richness of community and species diversity is also a challenging aspect in the present study. This is because knowledge about vegetation and species composition provides insight about the potential ways for maintenance and conservation practices.

The semi-arid regions in Ethiopia having vegetation types of *Acacia* woodland, bush-land and tickets, types belonging to open grasslands (Coppock,1994). White (1983) classified the vegetation of Ethiopia under the Sudanian Regional Center of Endemism, Somalia-Massai Regional Center of Endemism, Afro-montane Regional Center of Endemism and Afro Alpine Archipelago-like Regional Center of Endemism. The present study area can be plunged in the Somalia-Massai Regional Center of Endemism but if based on the broad categorization of the vegetation, the study area was mainly small–leaved deciduous woodland type. Some sort of *Acacia-commiphora* woodland was found mainly between altitudes of 500-1900 m.s.l. with an average annual temperature of 18ºC to 27ºC and rainfall between about 410-820 mm. This woodland area had traditionally been a grazing land (Ensermu Kelbessa *et al.,* 1992).

The plant communities were named by the dominant attribute species, occuring in each group, using the relative magnitude of mean cover as well as frequency of abundance. The mean cover abundance of major species in the community type was determined. Based on the TWINSPAN output and ecological evaluations in field, six ecologically meaningful community types (clusters) designated as I, II, III, IV, V and VI were identified and named after two or three of the dominant species (Eyasu & Patnaik, 2016).

Six specific communities were designated in the following way.

Community I. *Canthium setiflorum – Acacia hockii – Pappea capensis* type.

Community II. *Commiphora africana – Acacia Senegal – Balanites aegyptiaca* type.

Community III. *Chltbeum - Commiphora habessinca – Grewia villosa* type.

Community IV. *Acalypha fruticosa – Acacia nilotica teclea nobilis – Indigofera schimperi* type.

Community V. *Maerua triphylla – Diospyros abyssinica – Olea cpensis type.Tamarindus indica-Carissa spinarum-Eucleadivinorum types*

Community VI. *Croton zambesicus – Harrisonia abyssinica – Diospyros abyssinia type. Salacia congolensis-Syzygium guineense-Acalypha fruticosa type.*

Table showing Abaya–Hamassa vegetation with diagnostic species, high cover value and dominant species (indicated in bold, Eyasu & Patnaik, 2016).

Community type cluster size	**I 11**	**II 17**	**III 5**	**IV 11**	**V 6**	**VI 5**
Canthium setiflorium	**1.8**	0.0	0.0	0.0	0.0	0.0
Acacia hockii	**1.3**	0.0	0.2	0.0	0.0	0.3
Pappea capensis	**1.3**	0.2	0.3	0.0	0.0	0.0
Acacia brevispica	**1.4**	0.9	0.6	2.0	1.9	0.7
Grewia bicolor	**1.3**	1.0	0.6	1.5	0.0	0.4
Combretum molle	**1.9**	0.2	1.3	1.7	0.2	0.6
Commiphora Africana	0.5	**4.1**	0.2	0.0	0.1	0.0
Rhus natalensis	1.3	**4.0**	1.6	0.5	0.1	0.0
Acacia Senegal	0.5	**2.6**	0.0	0.0	0.0	0.0
Harrisonia abyssinica	1.0	**2.0**	0.7	0.1	1.6	4.0
Balanites aegyptiaca	0.2	**1.2**	0.0	0.0	0.0	0.0
Ximenia Americana	0.6	**1.1**	0.0	0.0	0.0	0.0
Ziziphus mucronata	0.3	**1.5**	0.4	0.0	0.6	1.3
Dicrosttachys cineria	0.0	**1.4**	0.4	0.7	0.1	0.0
Terminalia brownie	0.5	0.2	**3.4**	0.8	0.7	0.4
Zanthozylon chalybeum	0.3	0.0	**1.8**	0.0	0.0	0.0
Commiphora habessinica	0.0	0.2	**1.5**	0.0	0.0	0.0
Boswellia rivae	0.6	0.4	**1.9**	0.1	0.0	0.0
Mystroxylon aethiopicum	0.0	0.8	**1.3**	0.6	0.0	0.0
Sansevieria ehrenbergii	0.3	0.9	**1.3**	0.2	0.0	0.0
Grewia villosa	0.0	0.7	**1.2**	0.0	0.2	0.0
Acalypha fruticosa	1.0	1.0	0.0	**2.9**	0.7	0.3
Teclea nobilis	1.0	0.2	0.1	**2.6**	2.8	1.0
Baphia abyssinca	0.0	0.0	0.2	**2.4**	4.3	3.0
Croton zambesicus	0.2	0.0	1.3	**1.9**	1.6	4.6
Euphorbia tirucalli	0.0	0.0	0.3	**1.8**	0.8	2.6
Acacia nilotica	0.2	0.6	0.0	**1.7**	0.1	0.0
Indgofera schimperi	0.1	0.1	0.0	**1.5**	0.2	0.0
Lecniodiscus fraxinifolius	0.0	0.0	0.6	**1.2**	2.4	0.2
Maerua triphylla	0.8	0.2	0.5	0.5	**3.6**	0.0
Diospyros abyssinica	0.0	0.0	0.7	0.7	**3.8**	3.2
Olea capensis	0.0	0.0	0.0	0.5	**3.0**	1.3
Grewia velutina	O.8	0.7	0.9	0.4	**2.7**	0.4
Tamrindus indica	0.0	0.0	1.0	0.0	**2.1**	0.0
Dodonaea angustifolia	0.0	0.4	0.0	0.1	**1.9**	0.2
Allophylus rubifolius	0.0	0.1	0.1	0.0	**1.3**	0.0
Euclea divinorum	0.0	0.0	0.0	0.2	**1.3**	0.0
CarissaSpinarum	0.0	0.0	0.0	0.0	**1.3**	0.1
Acokanthera schimperi	0.0	0.0	0.1	0.1	**1.3**	0.3
Syzygium guineense	0.0	0.0	0.0	0.0	0.8	**1.8**
Olea europaea	0.0	0.0	0.0	0.0	0.9	**1.6**
Acalypha rasemosa	0.0	0.0	0.0	0.0	0.3	**1.4**
Slacia congolensis	0.0	0.0	0.0	0.0	0.0	**1.2**

Faunal diversity

The distribution of animal fauna is also assorted in this part of world. Mostly dominated by middle order mammals, marginal population of herbivores and scanty number of marginal. The carnivores in the region recorded were 15 followed by herbivores about 14 and scavangers in the sense that they can intake dead animals as their food were 03. The appearance of small number of herbivores is alarming, however here small herbivores such as rodents were not taken into consideration (except *Tachyoryctes*) for systematic study.

The alarming increase of carnivore population, the herbivores get effected imparting pressure on food chain obviously that leads to an increase in the demand for natural resources, including arable land, water, wood and energy. With the increase in human population and expansion of commercial and subsistence farming, significant pressure on woodland vegetation in the Rift Valley region of Ethiopia has grown. In last few decades, a large amount of the natural vegetation had been converted into crop fields for undertaking intensive farming activities that lead to deforestation. In addition to this the demand for charcoal had decimated the local vegetation (WCMC,1991).

Table showing Animal data collected from Abaya-Hamassa, Rift valley in Ethiopia.

No	**Scientific Name**	**Feeding habit**	**Family**
1	*Sylvicapra grmmia*	Herbivore	*Tragelaphines*
2	*Phacochoerus africanus*	Herbivore	*Suidae*
3	*Hippopotamus amphibious*	Herbivore	*Tragelaphines*
4	*Felis lybica*	Carnivore	*Felidae*
5	*F. serval*	Carnivore	*Felidae*
6	*F. lybica*	Carnivore	*Felidae*
7	*Panthera pardus*	Carnivore	*Felidae*
8	*Panthera leo*	Carnivore	*Felidae*
9	*Crocuta crocuta*	Scavenger	*Hynidae*
10	*Proteles cristatus*	Scavenger	*Hynidae*
11	*Hyaena hyaena*	Scavenger	*Hynidae*
12	*Canis aureus*	Carnivore	*Canidae*
13	*Genetta feline*	Carnivore	*Viverridae*
14	*G. tigrina*	Carnivore	*Viverridae*
15	*G. abyssinica*	Carnivore	*Viverridae*
16	*Civettictis civetta*	Carnivore	*Viverridae*
17	*Ichneumia albicauda*	Carnivore	*Herpestidae*
18	*Mellivora capensis*	Carnivore	*Mustelidae*
19	*Papio Anubis*	Herbivore	*Order Primates*
20	*Chlorocebus aethiops*	Herbivore	*Order Primates*
21	*Cerocopithecus mitis*	Herbivore	*Order Primates*
22	*Tragelaphus imberbis*	Herbivore	*Tragelaphines*
23	*T. scriptus*	Herbivore	*Tragelaphines*
24	*Alcelaphus buselaphus*	Herbivore	*Tragelaphines*
25	*Gazella soemeringi*	Herbivore	*Tragelaphines*
26	*Litocranius walleri*	Herbivore	*Tragelaphines*
27	*Madoqua saltiana*	Herbivore	*Tragelaphines*
28	*M. guentheri*	Herbivore	*Tragelaphines*
29	*M. piacentini*	Herbivore	*Tragelaphines*
30	*Canis mesomelas*	Carnivore	*Canidae*
31	*C.simensis*	Carnivore	*Canidae*
32	*Orycteropus afer*	Carnivore	*Proboscidae*
33	*Tachyoryctes macrocephalus*	Herbivore	*Order Rodentia*
34	*Cercopithecus aethiops*	Herbivore	*Order Primates*
35	*Oreotragus oreotragus*	Herbivore	*Tragelaphines*
36	*Ourebia ourebi*	Herbivore	*Tragelaphines*
37	*Lepas habesinicus*	Herbivore	*Order Lagomorpha*
38	*L. habesinicus*	Herbivore	*Order Lagomorpha*

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