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Full Length Research Paper

Vegetation community structure and diversity in swamps undergoing anthropogenic impacts in Uasin Gishu County, Kenya

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Wetlands in Kenya face continuous threat of destruction by agricultural activies, urbanization and pollution. However, their floristic compositions remain unkown since research remains restricted to wetlands of national importance because of their touristic values. A study was conducted in 2006 to determine the species composition and diversity of the vegetation in four swamps within Uasin Gishu County. Data on species composition and diversity were collected using belt transects method and analyzed using cluster analysis and analysis of variance (ANOVA). Two hundred and eighty six plant species belonging to 70 families were enumerated in the four wetlands, with Leseru swamp having the highest species number (176) and diversity (4.02). Families Poacea and Asteracea were represented by the highest number of species (41 each). The four swamps exhibited significantly different levels of human activity and impact; where Chepkongony was the most and Marula the least affected. It is recommended that the wetlands should be declared conservation areas and protected from further drainage or uncontrolled explotation.

Key words: Swamps, species composition, species diversity, Uasin Gishu, anthropogenic factors.

INTRODUCTION

There are varied types of wetlands in Kenya that cover a significant part of the land surface (MEMR, 2012). The description of wetland is adopted from the Convention on Wetlands of International Importance (Davis, 1994); UNESCO, 1976) and the Government of Kenya (draft) policy on wetland conservation and management (GoK, 2013). The vegetation cover of the wetlands range from woody species dominated swamps to herbaceous marshes. The wetlands perform critical ecological functions and provide essential livelihood products and services to local communities (Mironga, 2005a). Although the National Environmental Management Autority is charged with the management of wetlands, most of the wetlands occur on private land or are held as commons without clear regulations on how their resources can be shared or used by neighbouring communities (NEMA, 2012). Consequently their socioecological functions are not well appreciated until they are destroyed, modified, or their restoration proves expensive. Due to their vast ecological resources and potential services, swamps have many times been overexploited (Mitsch and Gosselink, 2007). Mironga, (2005b) estimated that only about 10% of the original wetland areas in Kenya remained at the time of his study.

By the years 2014, the institutional arrangements for the management of these delicate ecosystems are still inadequate (Abila et al., 2005), although NEMA (NEMA, 2012) had developed wetland asessment and monitoring protocols and the Government of Kenya was in the process of developing policy for conservation and management of the ecosystems (GoK, 2013).

Swamps in Kenya perform a range of environmental functions and provide numerous socio-economic benefits to local communities (Macharia et al., 2010; MEMR, 2012). They are facing increased pressure as socio-economic changes and population increase have aggravated a need for more agricultural land. There is also massive utilization and harvesting of vegetation from the swamps which has led to changes in species occurrence, diversity and richness (Mironga, 2005b; Abila et al., 2005; Mwakubo et al., 2007). Wetlands are a source of domestic water, food products

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of both plant and animal types, traditional medicine products, and material for shelter to the local communities (MEMR, 2012; Terer et al., 2012; A.W. Wood, University of Papua Guinea, Papua Guinea, individual communication). They also are livestock watering and grazing areas especially in the dry season. Moreover a significant number are drained and converted into agricultural land, or even used as dumping sites for liquid or solid domestic and industrial waste. Consequently there has been increased encroachment on the wetlands through the continued exploitation of the resources. However, there is limited knowledge concerning the changes in plant species composition, diversty and community structure that are occurring as a result of the human activities in these swamps (Ghabo, 2007). Therefore, it is difficult to institute the appropriate management strategies for sustainable use of these fragile, yet important ecosystems.

Anthropogenic factors have been shown to cause significant changes to floral composition in wetlands (Allen et al., 2005; Abila et al., 2008; Ruto et al., 2012). Similarly human activities have been reported to fundamentally alter the structure of both eukaryotic and prokaryotic swamp communities (Chapman et al., 2001). Burns and Schallenberg (2001) observed that agriculture, fire and livestock grazing in swamps caused greater reduction in species diversity in homogenous environments compared to heterogeneous environments.

Habitat influence by man through clearing land for cultivation, construction or draining wetlands degrades the habitat and can cause local extinction of plant species, and thus lower habitat species diversity (Primack, 1993). Odongo (1996) reported that unregulated harvesting of vegetation in swamps for fuel wood, thatch and vegetables is common in many swamps in Uasin Gishu. Human urban settlemetnts and agricultural activities are also common.

The exact nature of vegetation change as a result of human interference in Uasin Gishu swamps is not documented due to lack of previous ecological studies.

A study was carried out to assess the flora of four communal wetlands in Uasin Gishu County, Kenya. The wetlands are located in a similar ecological zone and it was hypothesized that floristic similarity among them would be marked and the flora of each wetland would be subjective to the level of human disturbance. The objective of the research was to quantify and evaluate plant species composition and diversity of the four wetlands inorder to establish their floristic dis/similarity and the consequence of anthropogenic disturbance on them.

MATERIALS AND METHODS

Study Area

Uasin Gishu County is located in mid-western Kenya and it is situated between 34^{o}55’33’’ and 36^o 38’58’’E and between 0 ^{o} 2’44’’S and 0^o 55’56’’N. (Njuguna, 1996; Odongo, 1996) (Figure 1). It has a total land area of 3218 km^2. It receives between 1100 mm and 1500 mm of rainfall per year.

The average temperature is 23°C during the wet season with a maximum of 27^0 C during the dry season and a minimum of 12°C in the coolest season. Uasin Gishu is part of the Lake Victoria basin and has many wetlands (NEMA, Undated).

The study was conducted from January to December 2006 in four permanent riverine swamps: Marula, Leseru Singilai, and Chepkongony (Figure 1). The main human activities within the study areas include small to medium scale mixed farming encompassing crop and dairy farming (Odongo, 1996). The major crops include maize (*Zea mays* L.), beans (*Phaseolus vulgaris* L.) and wheat (*Triticum aestivum* L.). Moderate level horticulture, agro-forestry, forestry and general purpose livestock rearing are also practiced in areas (Odongo, 1996).

Vegetation Sampling

Plants were sampled during the study period to characterize the species checklist. Site boundaries were taken as the upper limit of flooding or the periphery of depressions. Belt transects were placed across each swamp and sampling done in 1 m x 1 m quadrats placed at intervals of 10 meters and all the species within the quadrats were identified and counted, and the percentage cover of each visually estimated using the Braun-Blanquet cover scale. The data was used to prepare a checklist of the different species found in the swamps. Nomenclature followed Agnew and Agnew, 1994; Beentje, 1994; Ibrahim and Kabuye, 1987; Haines and Lye, 1983). Species that could not be identified on site were preserved and identified at the East African Herbarium, Nairobi.

The total cover for each species in the various swamps was used to calculate the Shannon-Weiner index using the standard equation in Ludwig and Reynold, (1988):

$$H' = \sum_{i=1}^{n} P_i (LnP_i)$$

Where: H’ = Shannon’s diversity index

P_i = the abundance of the ith species expressed as a proportion of total cover.

The frequency of plants species were calculated for each site. The spatial and temporal variation in frequency was analyzed using Kruskal Wallis test (Zar, 2001). To establish plant distribution and community structure, the percentages of species contribution were subjected to cluster analysis, and similar stations were classified in terms of plant species composition and structure. The dichotomous classification technique expressed the occurrence of plants in an ordered table, constructed

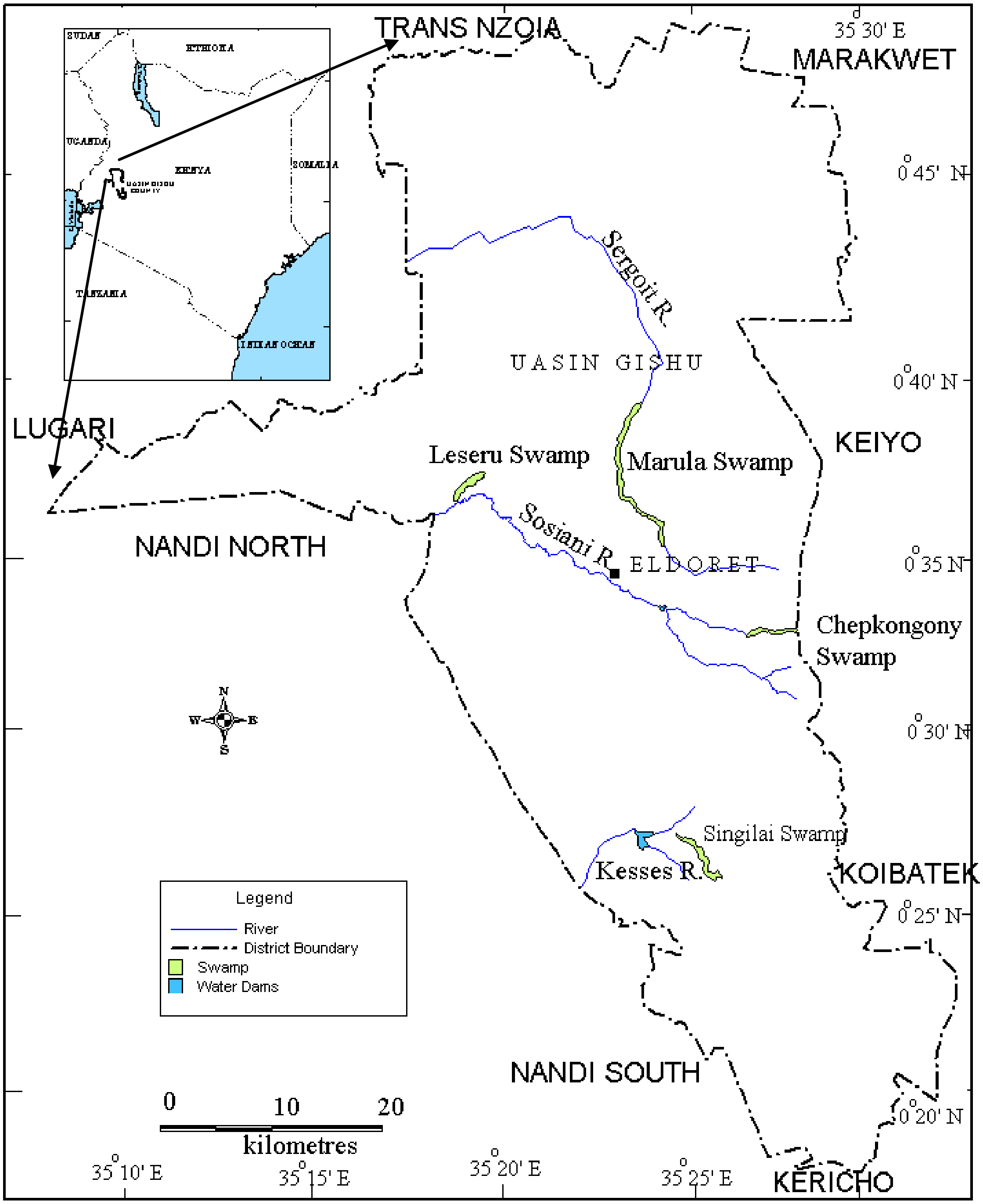

Figure 1. Map of Uasin Gishu County showing the study sites. Inset: Map of Kenya.

from site–taxa matrix. The outputs are viewed as dendrograms that illustrate sampling sites exhibiting similar species composition. For ease of comparison, the scale was reduced to percentage by dlink/dmax*100. All statistical analyses were done at 95% level of confidence.

All statistical analyses were performed with STATIGRAPHIC 2.1 Plus and STATISTICA 6.0 (StaSoft, 2001) packages. Normality and homoscedasticity of data distribution was checked by means of the skewness and kurtosis (Zar, 2001).

RESULTS

A total of 286 plant species belonging to 70 families were encountered in the floristic survey of the four wetlands,

Table 1. Plant species distribution in the four swamps.

Swamp	Families	Species
Marula	41	122
Leseru	50	176
Singilai	40	115
Chepkongony	38	99

Table 1. Singilai swamp had the highest number of species whereas Chekongony swamp had the least. Families containing high number of species were Poaceae (41), Asteraceae (41), Pappilonaceae (23), Lamiacea (14) and Cyperacea (10) (Table 2). There were 35 families that were represented by only a single species in the swamps.The single-species families were randomly distributed in the four swamps.

There were significant differences in the plant species diversity among the four swamps ($P < 0.05$) (Table 3). Chepkongony Swamp had significantly ($p<0.05$) lower species diversity than the other four swamp; there were no significance differences among the latter three swamps.

Cluster analysis revealed that species structure in terms of species composition (Figure 2) was similar for Chepkongony, Leseru and Singilai swamps; exhibiting up to 95% similarity. However, vegetation structure in Marula swamp was significantly different ($P < 0.05$) from the three other swamps.

DISCUSSION

Species composition and abundance in any ecosystem determines the biodiversity of that habitat (Wolfgang, 2001). In the four swamps studied, the number of plant species recorded was in excess of 250 species, and distributed in over 50 families. This indicates that each family had on average 5 species. However, there was a large variability in the number of species per family with about 50% of the families per swamp having only one species.

Leseru had the highest number of species recorded probably due to the moderate levels of human disturbance experienced in the swamp. Studies conducted in nearby Saiwa Swamp recorded a much higher species composition (D.F. Kavishe, Moi University, Kenya, individual communication) whereas in Yala Swamp, which is currently under reclamation, only 72 species were recorded (Were, 2007). In the 1980's over 600 species were counted in Yala Swamp wetland (Owino and Ryan, 2007).

The low number of species recorded in Chepkongony swamp was attributed to the high level of anthropogenic disturbance through cultivation and trampling. Higher disturbances through human activities are likely to reduce the number of plant species. Disturbance events results in destruction of old vegetation, thus limiting regeneration (Mary, 1999). Raburu et al. (2012) recorded reduced species diversity at disturbed sites in Kingwal wetland and this was attributed to activities such as animal grazing and macrophyte harvesting.

Though there was a conspicuous absence of earlier data on the species checklist in these swamps, the situation in most swamps in Kenya point to loss of biodiversity due to human encroachment (Were, 2007). The species count in unprotected swamps rarely exceeds 100 because of encroachment and continuous utilization of the plants mainly for medicinal purposes, construction, and fuel wood (Were, 2007). Muasya et al. (2004) recorded only 36 species of vascular plants distributed in 13 families in Loboi swamp, Rift Valley, Kenya. This was lower than what was observed for the Uasin Gishu swamps.

Most of the species recorded in the selected swamps belonged to families Asteraceae, Papilionaceae and Poaceae. The high counts of Asteraceae species can be attributed to their effective successful dispersal mechanisms in the swamp from wind and insects (Muthuri, 1989).

Earlier studies of East African swamps (J. Gichuki, Free University of Brussels, Belgium, individual communication), show that the grasses *Vossia cuspidata, Miscanthidium violaceum* and *Loudentia phragmites,* the bulbrush *Typha*, the reed *Phragmites mauritianus* and the sedge *Cladium jamaicense* were the most common and often formed dense and extensive stands in certain places.

Species diversity index has been used to describe the structure of species in many ecosystems (Lopez et al., 2006). In the four swamps investigated, species diversity was highest at Leseru and Marula swamps and this was attributed to the moderate levels of human disturbance observed in the two swamps. The intermediate disturbance hypothesis may explain this result, which predicts that moderate levels of disturbance maximize species diversity (Huston, 1979). Conversely the low species diversity in Chepkongony could be the result of a more intensive destruction of vegetation in the swamp by the local community. Although species diversity is positively linked to habitat diversity, total species diversity increases to a certain extent with intermediate disturbance (Connel, 1978) but decreases with heavier disturbance (Lu et al., 2008; Wolfgang, 2001).

Species composition was similar in Chepkongony, Leseru and Singilai swamps, which exhibited up to 95% similarity indicating that they probably experience similar

Table 2. Flora of the four swamps during the study period.

FAMILY	SPECIES
Acanthaceae	(1) *Dyschoriste radicans* Nees. (2). *Hygrophylla auriculata* (Schum.) Heine (3) *Hypoestes aristata* (Vahl.) Roem & Schult (4). *Justicia anselliana (Nees.) T.Anders.* (5). *Justicia exigua* S. Moore (6) *Thurnbergia alata* Sims (7) *Thurnbergia fischeri* Engl.
Agavaceae	(1) Agave *sisalana* (Engelm) Drumm JR & Prain
Adiantaceae	(1) Pellaea *adiantoides* (Willd.) J.sm.
Alismataceae	(1) *Alisma plantago-aquatica* L.
Aloaceae	(1) *Aloe secundiflora* Engl (2) *Aloe volkensii* Engl.
Amaranthaceae	(1) *Achyranthes aspera* L. (2) *Amaranthus hybridus* L.
Amaryllidaceae	(1) *Scadoxus multiflorus* (Martyrn) Raf. (2) *Crinum makowanii* Bak.
Anacardiaceae	(1) *Rhus natalensis* Berhn. (2) *Rhus vulgaris* Meickle (3). *Schinus molle* L.
Anthericaceae	(1) *Chlorophytum subpetiolatum* (Bak.) Kativu
Apiaceae	(1) *Centella asiatica* (L.) Urb. (2) *Peucedanum aculeolatum* Engl.
Apocynaceae	(1) *Carrisa edulis* (Forsk.) Vahl.
Araceae	1)**.** *Maranta arundinacea* L.
Araliaceae	(1) *Cussonia holstii* Harms ex Engl.
Asclepiadaceae	(1) *Gomphocarpus integer* (N.E.Br.) Bullock (2) *Gomphocarpus semilunatus* A.Rich. (3) *Kanahia laniflora* (Forsk.) R.Br.
Asparagaceae	(1) Asparagus *racemosus* Willd.
Aspleniaceae	(1) Asplenium *theciferum* (Kunth.) Mett.
Asteraceae	(1) *Acanthospermum hispidum* DC. (2) *Acmella calirhiza* Del. (3) *Aspilia mossambiscensis* (Oliv.) Willd.(4) *Bidens pilosa* L.(5) *Carduus kikuyorum* R.E.Fries.(6) *Cirsium vulgare* (Savi.) Ten (7) *Conyza floribunda* H.B.K. (8) *Conyza stricta* Willd. (9) *Conyza suscaposa* O. Hoffm. (10) *Crassocephalum montuosum* (S.Moore) Milne-Redh. (11) *Crassocephalum manii (*Hook f.) Milne-Redh. (12)*Crassocephalum picridifolium* (Dc.) S. Moore. (15) *Crassocephalum* rubens (Jacq.) S. Moore. (16) *Dicrocephala chrysemifolia* D.C. (17) *Dicrocephala integrifolia* O.Kuntze. (18) *Echinops hispidus* Fresen. (19)*Emilia coccinea* (Sims.) D.Don. (20) *Erlangea cordifolia (Benth.) S. Moore*. (21) *Erlangea somalensis* O.Hoffm (22) *Galinsoga parviflora* Cav.Plate (23) *Guizotia scabra* (Vis.) Chiov. (24) *Helichrysum schimperi* Sch. Bip. (25) *Hirpicium diffusum* O.Hoffm. (26) *Hoehneria vernonioides* Schweinf. (27) *Laggera elatior* R.E.Fries. (28) *Launea cornuta* (Oliv & Hiern.) C.Jeffrey. (29) *Microglossa pyrifolia* (Lam.) O.Kuntze (30) *Sckhuria pinnata* (Lam.) O. Kuntze. (31) *Senecio hadiensis* Forsk. (32) *Sigesbeckia abyssinica* (Sch. Bip.) Oliv & Hiern. (33) *Sonchus* aper (L.) Hill. (34)*Sonchus oleracea* L. (35) *Sphaeranthus suaveolens* (Forsk.) DC. (36) *Tagetes minuta* L. (37) *Tithonia diversifolius* (Hemsl.) Gray. (38) *Tridax procumbens* L. (39) *Vernonia galamensis* R.E.Fries. (40) *Vernonia hymenolepsis* A.Rich (41) *Vernonia lasiopus* O.Hoffm (42)*Vernonia syringifolia* O.Hoffm.
Azollaceae	(1) Azolla *nilotica* Mett.
Boraginaceae	(1) *Cordia abyssinica* R.Br. (2) *Cynoglossum coeruleum* A. DC
Basellaceae	(1) *Basella alba* L.
Brassicaceae	(1) *Brassica oleracea var acephala* L. (2) *Cardamine parviflora* L. (3) *Crambe hispanica* L. (4) *Rhaphanus rhaphanistrum* L (5) *Rorippa microphylla* Boenn) Hylander. (6) *Sisymbrium officinale* (L.) Scop.
Caesalpiniaceae	(1) *Acrocarpus fraxinifolia* Wight et. Arn (2) *Cassia didymobortrya* Fres. (3) *Chamaecrista mimosoides* (L.) Greene (4) Ptelolobnium *stellatum* (Forsk.) Brenan.
Capparaceae	(1) *Cleome monophylla* L.
Cerastraceae	(1) *Maytenus senegalensis* (Lam.) Exell. (2) *Maytenus undatus* (Thunb.) Blakelock
Caryophyllaceae	(1) *Drymaria cordata* (L.) Roem & Schultes

Table 2. Cont.

Chenopodiaceae	(1) *Chenopodium album* L.
Chlorophyceae	(1) *Spyrogyra sp*
Commelinaceae	(1) *Commelina africana* L. (2) *Commelina beghalensis* L . (3) *Commelina subulata* Roth. (4)*Cyanotis longifolia* Benth (5) *Floscopa glomerata* (Schult &

Schult.f.) Hassk

Table 2. Continued.

FAMILY	SPECIES
Convolvulaceae	(1) Dichondra *repens* J.R. & G. Forst. (2) *Ipomoea arboreus* (3) *Ipomoea batatas* (L.) Lam. (4) *Ipomoea cairica* (L.) Sweet. (5) *Ipomoea tenuilostri* Choisy. (6) *Ipomoea wightii* (Wall.) Choisy.
Crassulaceae	(1) Crassula *gravinkii* Mildbr. (2) *Kalanchoe densiflora* Rolfe. (3) *Kalanchoe lanceolata* (Forsk.) Pers.
Cucurbitaceae	(1) *Cucurbita maxima* L. (2) *Cucurmis dipsaceus* Spach. (3) *Momordica foetida* Schum. (4) *Zehneria scabra* (L.f.) Sond.
Cupressaceae	(1) *Cupressus lusitanica* Miller
Cyperaceae	(1) *Cyperus ajax* C. B. Cl (2) *Cyperus rotundus* L. (3) *Cyperus papyrus* L. (4) *Fimbristylis dichotoma* (L.) Vahl (5) *Fuirena stricta* Steud. (6) *Kyllinga bulbosa* P.Beauv. (7) *Kyllinga sp.* (8) *Pycreus nitidus* Lam. (9) *Schoenoplectus corymbosus* (Roem & Schult.) J. Rayn (10) *Scirpus sp*
Dioscoreaceae	(1) *Dioschorea schimperiana* Kunth.
Dryopteridaceae	(1) *Dryopteris filixmas* (L.) Schott
Ebernaceae	(1) *Euclea divinorum* Miem.
Euphorbiaceae	(1) *Clutia lanceolata* Forst. (2) *Croton megalocarpus* Hutch. (3) *Euphorbia hirta* L. (4) Euphorbia *prostrata* Ait. (5) *Phyllanthus sepialis* Muell.arg. (6) *Ricinus communis* L. (7) *Tragia brevipes* Pax
Flacourtiaceae	(1) *Flacourtia indica* (Burm.f.) Merr
Hyacinthaceae	(1) *Scilla hyacintha* (Roth.) Alston
Hydrocharitaceae	(1) *Elodea densa* (Planch) Casp.
.Juncaceae	(1) *Juncus sp*
Lamiaceae	(1) *Aeolanthus repens* Oliv. (2) *Ajuga remota* Benth. (3) *Fuerstia africana* T.C.E.Fr. (4) *Haumaniastrum galepsiflora* Bak. (5) *Hyptis lanceolata* (L.) Poit (6) *Leonotis nepetifolia* (L.) Ait.f. (7) *Leucas calostachys* Oliv. (8) *Leucas martiniscensis* Jacq. Ait.f. (9) *Ocimum basilicum* L. (10) *Ocimum kilimandscharica* Guerke. (11) *Plectranthus caninus* Roth. (12) *Pycnostachys deflexifolia* Bak. (13) *Pycnostachys meyeri* Guerke. (14) *Salvia nilotica* Jacq.
Lemnaceae	(1) *Lemna perpusila* Turreg.
Malvaceae	(1) *Abutilon mauritianum* (Jacq.) Medc. (2) *Hibiscus canabinus* L. (3) *Pavonia urens* Cav. (4) *Sida cuneifolia* Roxb. (5) *Sida ovata* Forsk.
Meliaceae	(1) *Ekebergia capensis* (Fresen.) A. Rich.
Melianthaceae	(1) *Bersama abyssinica* Fres.
Mimosaceae	(1) *Acacia lahai* Benth. (2) *Acacia melanoxylon* R.Br (3) *Acacia seyal* Del.
Menispermaceae	(1) *Cissampelos pareira* L. (2) *Stephania abyssinica* (Dillon & A.Rich.) Walp.
Musaceae	(1) *Musa sapientum* L.
Myrtaceae	(1) *Eriobotrya japonica* (Thunb) Lindl (2) *Eucalyptus saligna* Smith (3) *Psidia guajava* L**.** (4) *Syzygium cordatum* Hochst ex Krauss. (5) *Syzygium guineensis* (Willd.) DC
Oleaceae	(1) *Olea africana* Mill.
Onagraceae	(1) *Epilobium hirsutum* L. (2) *Ludwigia leptocarpa* (Nutt.) Hara. (3) *Ludwigia stolonifera* (Guill & Perr.) Raven (4) *Oenothera sp* (5) *Rotala tenella* Hiern
Oxallidaceae	(1) Oxalis *corniculata* L..
Papilionaceae	(1) *Aeschynomene abyssinica* (A.Rich.) Vatke. (2) *Aeschynomene mimosifolia* Vatke (3) *Alysicarpus glumaceus* (Vahl.) DC. (4) *Alysicarpus rugosus* (Willd.)

Table 2. Cont.

	DC. (5) *Crotalaria brevidens* Benth. (6) *Crotalaria lachnocarpoides* Engl. (7) *Crotalaria spinosa* Benth (8) *Glycine wightii* (Wight & Arn.) Verdc. (9) *Indigofera atriceps* Hook.f. (10) *Indigofera circinella* Bak.f. (11) *Indigofera homblei* Bam.f. & Martin. (12) *Indigofera schimperi* Jaub. & Spach (13) *Indigofera spinosa Forsk.* (14) *Parochetus communis* D.Don. (15) *Phaseolus vulgaris* L. (16) *Pisum sativum* L**.** (17) *Rhynchosia minima* (L.) DC. (18) *Sesbania sesban* (L.) Merril. (19) *Tephrosia villosa* (L.) Pers. (20)*Trifolium lugardii* Bullock. (21) *Trifolium semipilosum* Fres. (22) *Vicia faba* L. (23) *Zornia setosa* Bak.f.
Phytolacaceae	(1) *Phytolacca dodecandra* L'Herrit. (2) *Phytolacca octandra* L.
Poaceae	(1) *Andropogon abyssinica* Fresen. (2) *Aristida adoensis* Hochst. (3) *Bothriochloa insculpta* A.Rich (4) Bromus *diadrus* Roth. (5) *Brachiaria decumbens* Stapf. (6) *Chloris gayana* Kunth (7) *Chloris pycnothrix* Trin.

Table 2. continued.

FAMILY	SPECIES
	(8) *Cynodon dactylon* (L.) Pers. (9) *Cynodon plectostachyus* (K.Schum.) Pilg. (10) *Digitaria scalarum* (Schweinf.) Chiov. (11) *Digitaria velutina* (Forsk.) P. Beauv (12) *Echinochloa pyramidalis* (Lam.) Hitch & Chase. (13) *Eleusine indica* (L.) Gaetn. (14) *Eleusine jaegeri* Pilger. (15) *Eragrostis chalarothyrsus* C.E. Hubbard. (16) *Eragrostis.congesta* Oliv. (17) *Eragrostis minor* Hochst. (18) *Eragrostis tenuifolia* (A.Rich.) Steud (19) *Eriochloa fatmensis* (Hochst & Steud) W.D. Clayton. (20) *Exotheca abyssinica* (A.Rich.) anders. (21) *Harpachne schimperi* A.Rich. (22) *Hyparrhenia filipendula* (Hochst.) Stapf. (23) *Hyparrhenia hirta* (L.) Stapf. (24) *Hyparrhenia rufa* (Nees.) Stapf. (25) *Leersia hexandra* SW. (26) *Loudentia kagerensis* (K.Schum.) Hutch. (27) *Microchloa kunthii* Desv. (28) *Panicum hymeniochilum* Nees. (29) *Panicum poaeoides* Stapf. (30) *Paspalum scrobiculatum L.* (31) *Pennistum cladestinum* Chiov. (32) *Pennisetum schimperi* A.Rich. (33) *Rhyncherytrum repens* (Willd.) C.E. Hubbard. (34) *Saccharum officinarum* L. (35) *Setaria annua* (36) *Setaria plicatilis* (Hochst.) Engl. (37) *Setaria sphacellata* (Schum.) Moss (38) *Setaria verticillata* (L.) P. Beauv. (39) *Sporobolus pyramidalis* P.Beauv. (40)*Themeda triandra* Forssk. (41) *Zea mays* L.
Polygonaceae	(1) *Fagopyrum esculentum* Moench (2) *Polygonum pulchrum* Blume. (3) *Polygonum salicifolia* Willd. (4) *Polygonum sengalensis* Meisn (5) *Polygonum setosulum* A.Rich. (6) *Polygonum strigosum* R.Br. (7) *Rumex acetosella* L. (8) *Rumex bequaertii* De Willd.
Potamogetonaceae	(1) *Potamogeton schweinfurthii* A. Bennett
Proteaceae	(1) *Grevillea robusta* Cunn.
Rosaceae	(1) *Alchemilla cryptantha* A.Rich (2) *Prunus africana (*Hook.f.) Kalkm. (3) *Rubus apetala* Poir (4) *Rubus steudneri* Schweinf
Rubiaceae	(1) *Galium scioanum* Chiov.Plate (2) *Oldenlandia goorensis* DC. (3) *Psydrax schimperi* (A.Rich.) Bridson. (4) *Richardia braziliensis* Gomes. (5) *Vangueria infausta* Burchin (6) *Vangueria tomentosa* Hochst.
Rununculaceae	(1) *Ranunculus multifidus* Forsk.
Rutaceae	(1) *Teclea nobilis* Del.
Sapindaceae	(1) *Dodonaea viscosa (*L.) Jacq
Scrophulariaceae	(1) *Craterostigma pumilum* L.
Solanaceae	(1) *Datura stramonium* L. (2) *Lycopersicum esculentum* Mill (3) *Nycandra physaloides* (L.) Gaertn. (4) *Physalis peruviana* L. (5) *Solanum incanum* L. (6) *Solanum nigrum* L. (7) *Solanum sessilistellatum* Bitter. (8) *Solanum tuberosum* L. (9) *Withania somnifera* L.
Sterculiaceae	(1) *Dombeya berghessiae* Gerrard.
Tiliaceae	(1) *Grewia similes* K.Schum. (2) *Triumfetta rhoboidea* Jacq.

Table 2. Cont.

Typhaceae	(1) *Typha domingensis* Pers. (2) *Typha latifolia* L.
Verbenaceae	(1) *Clerodendrum myricoides* (Hochst.) Vatke. (2) *Lantana camara* L. (3) *Lantana trifolia* L. (4) *Lippia javanica* (Burm.f.) Spreng. (5) *Verbena bonariensis* Bitter.
Vitaceae	(1) *Cyphostemma adenocaule* (A.Rich.) Willd (2) *Cyphostemma nodiglandulosum* (Th.Fr.Jr.) Desc. (3) *Cyphostemma orondo* (Gilg & Bened) Desc. (4) *Rhoicissus tridentate* (L.f.) Willd & Drum.

Table 3. Shannon-Weiner diversity Index (H') of plant species occurrence in the Marula, Leseru, Singilai and Chepkongony Swamps during the study period.

Swamp	Species diversity (H')
Marula	3.83±0.38[a]
Leseru	4.02±0.21[a]
Singilai	3.82±0.19[a]
Chepkongony	2.43±0.15[b]

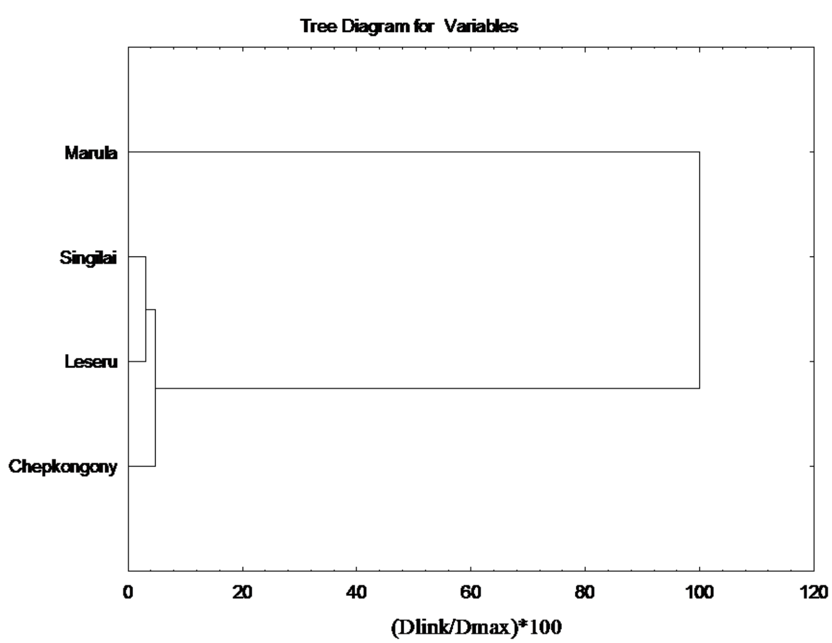

Figure 2. Dendrogram showing similarity of four swamps in Uasin Gishu County generated from cluster analysis on the basis of plant species composition.

environmental factors, including anthropogenic disturbances. A clear variation in species composition was observed in Marula swamp despite its nearness to the others. This could be attributed to higher habitat diversity in this wetland (Wolfgang, 2001). A complex micro topography creates a great variety of environment conditions that favour the unique requirements of many different species of wetland plants and it plays a great role in determining species composition of wetlands (Lu et al., 2008). *Cyperus papyrus* was only recorded in this swamp and its association with species not found in the other three swamps could have contributed to the observed floristic difference.

The four swamps in Uasin Gishu have high species composition and diversity. However, the spatial distribution of the plant species suggests that human impact has fundamental influence on the vegetation in these swamps. The wetlands should be given adequate and effective protection from anthropogenic disturbance such as harvesting and farming. For more realistic protection, the stakeholders should be enlightened on the need to preserve the wetlands, and perhaps integrate them in the protection activities.

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REFERENCES

Abila R, Rasowo JO, Manyala J (2005). Biodiversity and Sustainable Management of a Tropical Wetland Lake Ecosystem: A Case study of Lake Kanyaboli, Kenya. http://iodeweb1.vliz.be/odin/bitstream/1834/2126/1/WLCK-205-209.pdf.

Abila R, Salzburger W, Ndonga MF, Owiti DO, Barluenga M, Meyer A (2008). The Role of the Yala Swamp Lakes in the Conservation of Lake Victoria Region *Haplochromine cichlids*: Evidence from Genetic and Trophic Ecology Studies. Lake Reserv. Manage. 13: 95-104.

Agnew ADQ, Agnew S (1994). Upland Kenya Wild Flowers.A Flora of the Ferns and Herbaceous Flowering Plants of Upland Kenya, 2nd edn. East African Natural History Society, Nairobi.

Beentje HJ (1994).Kenya Trees,Shrubs and Lianas.National museum of Kenya, Nairobi, p. 722.

Burns CW, Schallenburg M (2001).Short-term Impacts of Nutrients on Microbial Food Webs on an Oligotrophic and Eutrophic Lake. New Zeal J. Mar. Fresh.35: 695-710.

Chapman LJ, Balirwa J, Bungenyi FWB, Chapman C, Crisman TL (2001). Wetlands of East Africa: Biodiversity, Exploitation, and Policy Perspectives. In: Biodiversity in Wetlands: Assessment, Function and Conservation (Ed. B. Gopal, W. J. Junk & J. A. Davis). Volume 2 Backhuys Publishers, Leiden, The Netherlands, pp. 101-131.

Connel JH (1978). Diversity in Tropical Rainforests and Coral Reefs.Science 199:1303-1309.

Davis TJ (1994). The Ramsar Convention Manual: A guide for the Convention on Wetlands of International Importance especially as waterfowl habitat. Ramsar Convention Bureau, Gland, Switzerland.p. 20.

Ghabo AA (2007). Wetlands Characterization; Use by Local Communities and Role in Supporting Biodiversity in the Semiarid Ijara County, Kenya.Terra Nuova East Africa. Wetlands in drylands. pp. 11-12

GoK (2013). Draft National Wetlands Conservation and Management Policy.Republic of Kenya, Nairobi.

Haines RW, Lye K A (1993).The Sedges and Rushes of East Africa. East African Natural History Society, Nairobi, p. 404

Huston M (1979).A general hypothesis of species diversity. Am. Nat. 113:81-101.

Ibrahim MK,Kabuye CHS (1987).An Illustrated Manual of Kenya Grasses, F. A. O.Rome, p. 765.

Lopez-Pujol J, Zhang FM, GES (2006). Plant biodiversity in China: richly varied, endangered, and in need of conservation. Biodivers Conserv. 15: 3983-4026.

Lu T, MA K, NI H, FU B, Zhang J, LU Q (2008).Variation in species composition and diversity of wetland communities under different disturbance intensity in the Sanjiang plain. Acta Ecol. Sin. 28(5): 1893-1900.

Ludwig JA, Reynolds JF (1988). Statistical Ecology.A Primer on Methods and Computing. New York, US: John Wiley & Sons INC, p. 337.

Macharia JM, Thenya T, Ndiritu GG(2010). Management of highland wetlands in central Kenya: the importance of community education, awareness and eco-tourism in biodiversity conservation. Biodiversity. 11 (1 & 2):85-90

Mary RM (1999). Theoretical Ecology. Principles and Applications.Sinauer Associates, Sunderland. MA.

MEMR (2012). Kenya Wetlands Atlas.Ministry of Environment and Mineral Resources,Nairobi.

Mironga JM (2005a). Effects of farming practices on wetlands of Kisii district, Kenya. AEER. 3(2):81-91.

Mironga JM (2005b). Conservation Related Attitudes of Wetland Users in Kisii County, Kenya. AJEAM. 10:25-32.

Mitsch WJ, Gosselink JG (2007). Wetlands. 4thedn, John Wiley & Sons, Hoboken, NJ.

Muasya AM, Hover V, Ashley GM, Owen RB, Goman MF, Kimeli M (2004). Diversity and distribution of macrophytes in freshwater wetland, Loboi Swamp (Rift Valley) Kenya. JEANH 93:39-47.

Muthuri F (1989).Classification and Vegetation of Freshwater Wetlands. Wetlands of Kenya. Proceedings of the KWWG Seminar on Wetlands of Kenya. (Eds. S. A. Crafter, S. G. Njuguna & G. W. Howard). IUCN. pp. 91-98.

MwakuboSM, Obare GA, Birungi P, Rono PK, Karamagi I (2007). Status and challenges of wetlands management towards livelihood improvement: the case of Lake Victoria wetlands. Wetlands Ecol. Manage. 15(6):521-528.

NEMA (Undated). Uasin Gishu District Environment Action Plan; 2009-2013, Nairobi.

NEMA (2012). Wetland Assessment and Monitoring Strategy for Kenya; National Environment Management Authority, Nairobi.

Njuguna PK (1996).Building an inventory of Kenya's Wetlands: a Biological Inventory of Wetlands of Uasin Gishu District of Kenya. WWWG. Nairobi. pp. 2-35.

Odongo OR (1996).Building an Inventory of Kenya's Wetlands: An Ethnobotany Study of Wetland Plants of Uasin Gishu District of Kenya. KWWG. Nairobi. pp.2-35.

Owino AO, Ryan PG (2007). Recent papyrus swamp habitat loss and conservation implications in western Kenya. Wetlands Ecol Manage. 15:1-12.

Primack RB (1993).Essentials of Conservation Biology. Sinauer Associates Inc. Publishers. p. 564.

Raburu PO, Okeyo-Owuor JB, Kwena F (2012). Community based approach to the management of Nyando Wetland, Lake Victoria Basin, Kenya. Nyando Wetland Utility Resource Optimization Project,VIRED-UNDP.

Ruto WKS, Kinyamario JI, Ng'etich NK, Akunda E, Mworia JK (2012). Plant species composition of two wetlands in the Nairobi National Park, Kenya. J. Wet. Eco. 6:07-15

STATSOFT INC (2001) Statistica for Windows. Tulsa. Ok: StatSoft Inc. http://www.statistica.com.

Terer T, Muasya AM, Dahdouh-Guebas F, Ndiritu, GG, Ludwig T (2012). Integrating local ecological knowledge and management practices of an isolated semi-arid papyrus swamp (Loboi, Kenya) into a wider conservation framework. J. Environ. Manage. 93:71-84

UNESCO (1976).Convention on wetlands of international importance especially as waterfowl habitat. Concluded at Ramsar, Iran, on 2 February 1971.

Were MO (2007). Plant species composition, diversity and productivity of Yala Swamp. Paper presented to the 4th Annual Conference in Kenyatta University, Kenya. April, 4th 2007.

Wolfgang JJ (2001). Tropical/subtropical wetland biodiversity: status of knowledge, threats and sustainable management. http://www.globalwetlands.org/ConferenceBotswana/docs/3%20Keynotes/Junk%20Keynote.doc.

Zar JH (2001). Biostatistical Analysis. 2nd edn. Prentice-Hall, Englewood Cliff.New Jersey, p. 718.