

DISTRIBUTION AND ABUNDANCE OF THE EDIBLE ORCHIDS OF THE SOUTHERN HIGHLANDS OF TANZANIA

AMS Nyomora

Botany Department, University of Dar es Salaam,
P.O. Box 35060 Dar Es Salaam, Tanzania
anyomora@hotmail.com

ABSTRACT

All orchids have showy flowers and many are therefore popular as exotic houseplants as well as contributing significantly to eco-tourism. A special attribute of some orchid genera is the production of edible tubers, an attribute that can contradict eco-tourism if harvesting is not done sustainably. Such is the case in the Southern Highlands where for example, Kitulo Plateau has been gazetted to be a National Park but where edible orchid harvesting is a serious conservation problem. Botanically, unsustainable harvesting can mean the loss of important germplasm even before some species are known to exist. A field survey was undertaken for three weeks in March 2002 in the Southern Regions of Tanzania (Iringa, Mbeya, Rukwa and Ruvuma) to study aspects of the extent of the distribution, diversity and density of edible orchids. Tools for identification included structured questionnaire, on-the-spot identification as well as using herbarium voucher samples and keys. Analytical tools included Shannons' diversity index and Canonical Community Ordination (CANOCO) and ANOVA in Microsoft Excel. A total of 13 edible species of orchids were documented during the survey all of them from the genera Habenaria, Disa and Satyrium. While Tandala and Molo hills had the highest species Diversity Index (over 1.2), Kitulo Plateau showed the greatest species density of over 200/30m² quadrants. Local communities in Madaba in Ruvuma, Molo, and Mbisi in Rukwa regions used the orchids as vegetables and snacks in lieu of animal meat. The rest of the studied areas used orchids as a source of cash by selling to Zambian traders and or to their middlemen. More research is needed to monitor growth phases, reproductive/propagation studies as well as taxonomic and systematic studies preferably using molecular techniques to determine relationships amongst edible orchids and their non edible relatives.

INTRODUCTION

The Orchid family (*Orchidaceae*) represents the most advanced family in the Monocotyledoneae and is mostly adapted to the tropics (Frank 1968, Agnew and Shirley 1994). They comprise about 20,000-2500 species in several hundred genera making it one of the 3 largest families of Angiosperm. All forms of orchids are perennial epiphytes or terrestrial and occupy wide ranges of ecological habitats as well as exhibiting highly specialized morphological, structural and physiological characteristics (Dressler 1990) and most orchids have showy flowers. Some of the terrestrial types have tuberous, bulbous thickened roots that are edible. This category is addressed in this paper.

Various genera belonging to the orchid family including, *Habenaria*, *Disa* and *Satyrium* are known to form edible tubers (Davenport and Ndangalasi 2003) and *Vanilla* whose pods provide spices (Frank 1968). *Habenaria*, *Disa* and *Satyrium* are found in the Southern Tanzania (Cribb and Leedal 1982 Lovett et al. 1995 Temu and Chihongo 1998 Davenport and Ndangalasi 2003). Many economically important species of these genera that are common in Tanzania have yet to be identified.

All edible orchids are terrestrial and are characterized by stout stems arising from root tubers of various shapes. They occur in varied shapes, sizes and colours and inhabit

spectacular natural landscapes on the undulating hills and valleys that typify the Southern Highlands. Despite the differences, the flowers are typically orchidaceous i.e. having showy flowers with a corolla of 3 petals one of which is a labellum or lip that differs from the others and may be spurred as described by Kurzweil (2000). All are deciduous and the aerial stem dies back at the end of the wet season when the plant become dormant, to sprout again at the beginning of the rains from a single bud/'eye' at the apex of the storage mother tuber(s) that varies from 1-3.

Some orchids of Tanzania provide edible tubers from which a staple food known as 'Kikande', 'Chikanda' or Kinaka is made that is consumed by the Ngoni, Fipa, Nyiha and related tribes in neighbouring Zambia (Davenport and Ndangalasi 2003). Consumption in Zambia is increasing and now threatens orchid populations in Tanzania (Davenport and Ndangalasi 2003) due to over-harvesting ventures on the Tanzanian side.

None of these edible orchids have been included in the mainstream staples of Tanzania. Yet, it is known that these indigenous crops are very important in bridging the seasons of hunger to the next harvesting season and therefore can contribute to food security (Temu and Chihongo 1998).

One orchid tuber gives rise to only one plant by the vegetative means of reproduction. This coupled by a lack of information on the extent of seed viability and seedling survival, over-harvesting and the competition with pyrethrum and potato cultivation is endangering orchids. Possible domestication and conservation measures (*in-situ* and *ex-situ*) require knowledge of the

germplasm available and this represents the focus of this study, which was aimed at determining aspects of the extent of distribution of edible Orchids in the Southern Highland regions of Tanzania namely Iringa, Mbeya Ruvuma and Rukwa.

METHODS

Sampling and identification

A field survey was undertaken through 3-24 March 2002 in the Southern Regions of Tanzania. Visits were made to the District Forest/Natural Resources offices and selected villages in Njombe, Makete, Mbeya, Ileje, Mbozi and Sumbawanga although one of the routes from Kitulo through Iniho to Makete was not passable due to heavy rains (Figure 1).

A structured questionnaire was used to interview key informants including district and village council representatives and key players in the trade (harvesters, traders, consumers), followed by on site visits accompanied by the orchid collectors/harvesters to authenticate dialogues.

A total of 50 orchid stakeholders were interviewed including Natural Resource Officers, harvesters, and herd-persons/collectors. At each site, 3 sets of plant samples were collected for further identification. Such samples were carefully uprooted, prepared into specimen vouchers, dried and transported to the University of Dar es Salaam (UDSM) herbarium. One set was used for identification at UDSM herbarium using appropriate keys and existing comparison vouchers, one set was donated to through Ben Bytebier for names confirmation while the other was pressed and kept for future referencing.

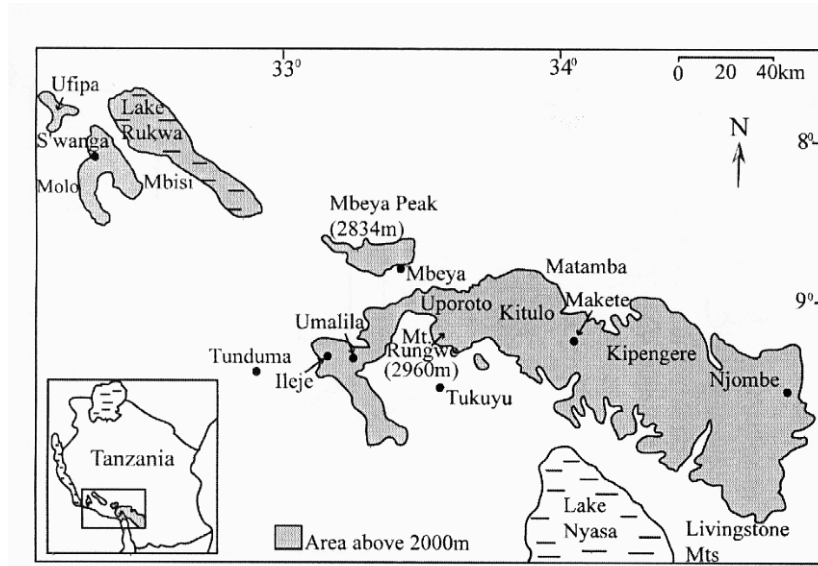


Figure 1: Map of the Southern Highlands of Tanzania (from Davenport and Ndangalasi, 2003)

Distribution and Abundance

At each representative site, 3 quadrants measuring 3m x 5m were randomly made along a 250m transect that took the landscape of the site into account. Orchid types and their numbers in each of the 3 quadrants were counted and recorded (Feinsinger 2002 Sutherland 2002). The resultant compiled data were used to calculate the species Diversity Index expressed as: $H' = -\sum P_i \ln P_i$

Where H' = diversity index; P_i = proportion of i^{th} species found at the sites.

The diversity indices from both sites were compared using a statistical test at 5% probability (Zar 1984). Plant species abundance and distribution were analyzed using CANOCO package where the data Matrix (species x sites) was prepared using Microsoft excel spreadsheet to enable CANOCO 3.10 analysis (ter Braak 1987). While using CANOCO package, Principle Component Analysis (PCA) was chosen as a technique to show differences in species abundance among study sites.

RESULTS AND DISCUSSION

It was necessary that the survey be done in February-March when some of the plants were in flower but it was not the most convenient time for accessibility to some sites.

Orchid types

As presented in Table 1 and 2, a total of 13 edible orchid species belonging to the genus *Habenaria* (4 species), *Satyrium* (4 species) and *Disa* (5 species) were observed and identified during the ethnobotanical survey. These were *Harbenaria cornuta* Lindl., *H. praestans* Rendle, *H. adolphii* Schltr., *H. Humilior* Reichb.f.; ; *Satyrium sacculatum* (Rendle) Rolfe, ; *S. crassicaule* Rendle, *S. chlorocorys* Rolfe and *S. breve* Rolfe; *Disa walleri* Reichb.f.; ; *D. erubescens* Rendle, *D. leucostachys* Kraenzl., ; *D. tanganyikensis* Summarch., and *D. aequiloba* Summarh. This may represent only about 15% of the edible orchid species found in the area (Davenport and Ndangalasi 2003). That all the orchid species found belonged to genus *Habenaria*, *Satyrium* and *Disa* is in agreement with the

work of Leedal (1975), Cribb and Leedal (1982) whose general emphasis on all orchid species speculated as many as 200 species as well as Davenport and Ndangalasi (2003) whose study on the orchid trade in the Southern Highlands showed that over 4 million tubers are harvested each year and

that as many as 85 species from these three genera are being harvested. Also found were 2 non-edible orchid species later identified as *Pteroglossaspis eustachya* Reichb.f. and *Holothrix longiflora* Rolfe. No vernacular names were given by the interviewee for these non-edible orchid species.

Table 1: Orchid species identified at visited locations in the Southern Highlands

COLL # FMM/AN	Species Name	Vernacular Name	Locality of collection
2286	<i>Disa walleri</i> Reichb.f.	Chikanda	Mbeya (Umalila, Ilembo)
2287	<i>Disa erubescens</i> Rendle	Chikanda	Ileje-Vwawa road
2288	<i>Harbenaria cornuta</i> Lindl.	Chikanda	Ileje-Vwawa road
2289-90	<i>Habenaria praestans</i> Rendle	Chikanda	Mbeya (Umalila, Izonzo)
2292	<i>Habenaria adolphii</i> Schultr.	Vinying'inya	Songea (Madaba LITI & Mgendagenda village)
2293	<i>Satyrium sacculatum</i> (Rendle) Rolfe	Kikande, MaseheleseheleVikan dokando	Songea (Makimbija and Wino)
2294	<i>Disa walleri</i> Reichb.f.	Masekelesekele	Njombe (Kifanya)
2295	<i>Satyrium sacculatum</i> (Rendle) Rolfe	Chikanda	Njombe (Makoga village)
2296	<i>Disa erubescens</i> Rendle	Chikanda	Kipengere
2297	<i>Disa tanganyikensis</i> Summach	Chikanda	Makete (Tandala)
2298	<i>Disa erubescens</i> Rendle	Chikanda	Makete (Tandala)
2299	<i>Satyrium crassicaule</i> Rendle	Kikande	Makete (Tandala)
2300	<i>Satyrium chlorocorys</i> Rolfe	Chikanda	Makete (Kitulo Plateau)
2301	<i>Disa leucostachys</i> Rolfe	Chikanda	Kipengere grassland
2302	<i>Satyrium breve</i> Rolfe	Chikanda	Kipengere
2303	<i>Satyrium sacculatum</i> (Rendle) Rolfe	Chikanda	Tandala
2304	<i>Satyrium chlorocorys</i> Rolfe	Chikanda	Makete (Kitulo Plateau), Matamba
2305	<i>Habenaria adolphii</i>	Chikanda	Matamba
2306	<i>Satyrium crassicaule</i> Rendle	Chikanda	Makete (Kitulo Plateau)
2307	<i>Disa walleri</i> Reichb.f.	Chikanda/ Chechela	Rukwa (Molo hills Msandamuungano)
2308	<i>Satyrium chlorocorys</i> Rolfe	Chikanda Jike	Rukwa (Molo hills)
2309	<i>Pteroglossaspis eustachya</i> Reichb.f.	-	Rukwa, Msandamuungano
2310	<i>Habenaria humilior</i> Reichb.f.	Chikanda	Rukwa (Molo hills)
2311	<i>Habenaria adolphii</i> Schult.	Chikanda	Rukwa (Molo hills)
2312	<i>Disa walleri</i> Reichb.f.	Chikanda/Dume	Rukwa (Mbizi hills)
2313	<i>Satyrium chlorocorys</i> Rolfe	Chikanda jike	Rukwa (Mbizi hills)
2314	<i>Satyrium sacculatum</i> (Rendle) Rolfe	Chikanda	Mbozi (Kisitu, Kapele)
2315	<i>Pteroglossaspis eustachya</i> Reichb.f.	-	Mbozi (Chipumpu Ndalambo)
2316	<i>Disa erubescens</i> Rendle	Masekendi	Mbozi (Chipumpu)
2318	<i>Disa equiloba</i> Summarch.	Chikanda	Mbozi (Chipumpu Ndalambo, Kapele)

Collectors: FMM = Frank Mgala Mbago; AN = Dr. Agnes Nyomora

Table 2: Field observation and interview's remarks on edible orchids found in their localities

Village	Orchid type/ Vernacular name	Description	Interviewee's remarks
Mgendagenda/ Madaba	Vinying'inya (<i>Habenaria adolphii</i> Schultr.)	Two opposite oval leaves pressed to the ground with a long inflorescence bearing white orchidaceous flowers enclosed in bracts. Two tubular tubers (current year and a shriveled previous year	Not commercialized, tubers harvested by women and youth in the dry season for local consumption
Makimbija/ Wino	Kikande Masehelesehele Vikandokando (<i>Satyrium sacculatum</i> (Rendle) Rolfe)	Stout stems with alternate leaves clinging to the stem. Small white flowers enclosed in larger green bracts. Two globular tubers (old and new	Not currently eaten by the locals. Youth harvested and sold tubers to middlemen coming from Mbinga district at (40,000/sac) from collectors starting from May through October
Kifanya hills/ Kifanya	Masekelesekele (<i>Disa walleri</i> Reichb.f.)	Purplish-maroon coloured orchidaceous flowers on a longish inflorescence originating from labrous leaves	Not currently eaten. Youth harvested and sold tubers to middlemen coming from Mbinga district at TzSh. 40,000/sac. It is a commercial venture.
Matwaki/Kipe ngere	Maseke	Bright orange flowers on a flower inflorescence overlapped by broad alternating leaves	Not eaten but youth and women harvest and sell tubers to middlemen from Njombe district. Seedlings seemed to colonize an area around mother plants indicative of seed germinability/viability. The montane grassland on these hills was not as thick as the one found over the Kitulo plateau
Tandala (Mangoto, Ibaga)	Maseke	Same as above	One female had planted some in her shamba and were yet to give tubers. Maroon coloured orchids tended to colonize a patch where found around older mother plant
Kitulo plateau East Njombe district	Chikanda/Ligosi	Bracts exposed orange coloured compact inflorescence Yellow coloured were named 'ligosi' white coloured orchids tended to colonize	The white coloured were too many to be accounted for only by mother-plants alone, probably had higher viability than others. Major collectors were women, old folks and youths, sold to traders from Tunduma

Kitulo plateau East Njombe district	Chikanda	As above	As above
Molo, Msanda- Muungano Sumbawanga district	Chechela (male) (<i>Satyrium chlorocorys</i> <i>Rolfe</i> Chikanda (female) <i>Satyrium chlorocorys</i> <i>Rolfe</i>	Two labrous leaves around an inflorescence bearing yellow flowers As above but red flowers	They used to be more than what was found today, more sought for
Mbisi hills Sumbawanga district	As above	As above	Eaten as food at home, eaten as snacks and sold to middlemen from Zambia
Chimpumpu Kapele (3 km from Zambia) Sumbawanga district	Chikanda-Selela Kalunyimbwa Champanda Masekendi (<i>Disa erubescens</i> Rendle)	Many tubers Yellow free flowers Split tubers into 2 hands Not elastic when cooked	Too many harvesters from Zambia, they should be stopped! Swampy/marshy locations preferred more

Ecology/Habitat

No orchids were observed from Mbeya southward towards Santilya possibly due to intensive cultivation. Could also be that they flowered during different season since many terrestrial orchid species, including *Disa*, *Satyrium* and *Habenaria* may flower at times other than March. Some orchids were observed around Ilembo in Umalila mountain range where it was learnt that it was becoming more and more difficult to get edible orchids in those mountains due to over-harvesting. Except for the occasional *H. adolphii* (Fig. 2a), the merging montane grassland from Umalila into miombo woodlands towards Mbozi was without much edible orchids. Edible orchids later identified as *H. adolphii* Schltr., were observed in the miombo woodland off-Chimala escarpment towards Uwanji.

The Kitulo Plateau from Matamba through DAFCO farm and Ipelele was clothed with mixed coloured orchids from white, yellow,

and maroon orange to brick red (Fig 2b). The route taken through Bulongwa did not show orchids possibly due to the prevalence of thick forests and intensive cultivation up to Makete. From Makete, orchids were visible in the montane grassland 10 km from Tandala towards Kipengere, Makoga and Njombe. The Makambako to Njombe stretch was without edible orchids up to Kifanya where again edible orchids were observed through Wino to Madaba in Songea. Edible orchids appeared to flourish much more in montane than the savannah grassland, miombo woodlands and thickets as well as the riverine habitats that abounds the region. Few orchids were found deep into the dense tropical forests habitats that occasion the plateau in the Southern Highlands (Bulongwa and Mbisi hills). The orchids found in Rukwa region (South-west Mbozi, Molo, and Mbisi hills) were the same as those found in Kipengere (Figure 2c,d,e).

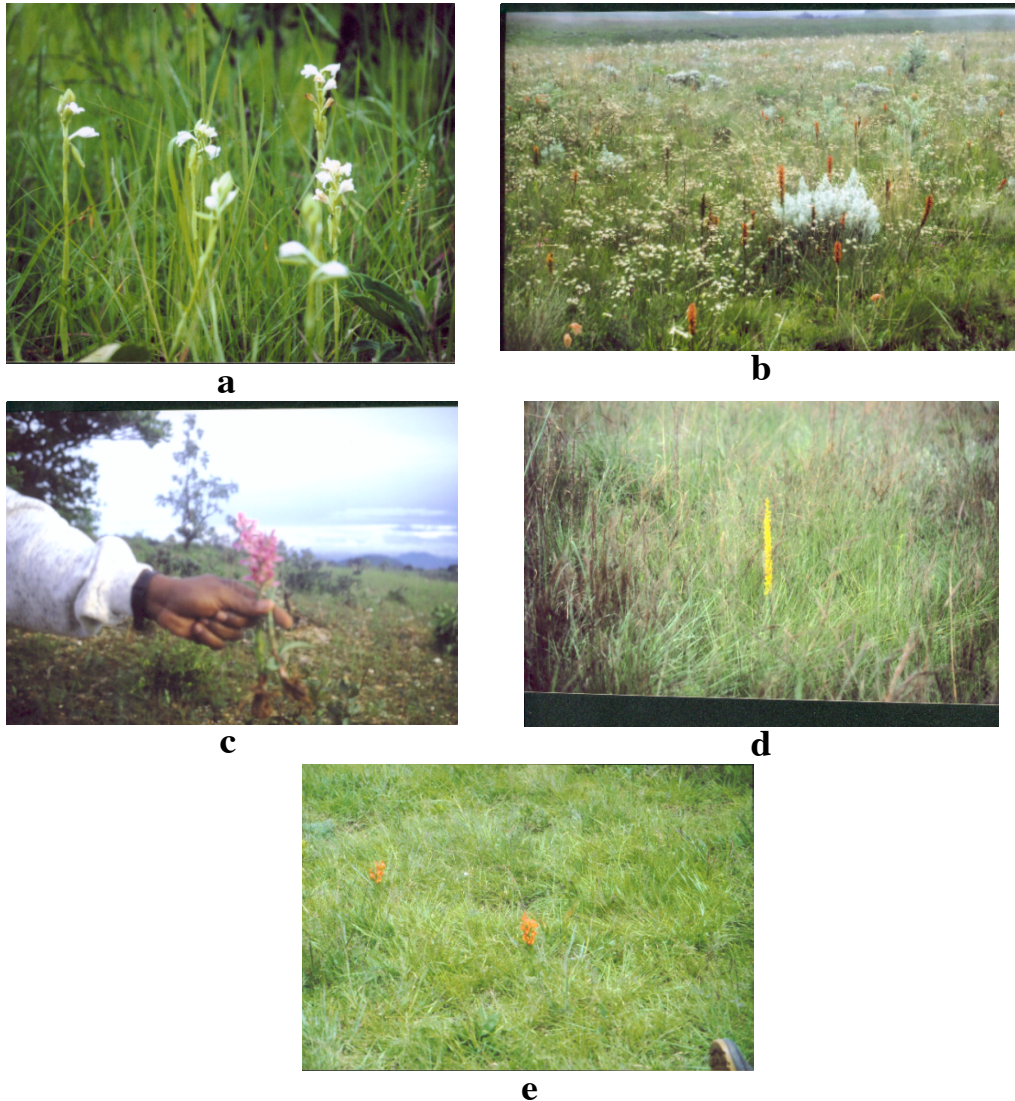


Figure 2: Species of orchids from various sites (a: *Habenaria adolphii* Schltr, b: *Satyrium* spp. c: *Disa usambarensis* d: *Disa* spp. e: *Disa walerrii*)

Species abundance and density

All edible orchid species recorded during this survey were from the genera *Satyrium*, *Disa* and *Habenaria*. This is consistent with various reports on edible orchids in the Southern Highlands (Davenport and Ndangalasi, 2003) and supported by other findings in the Southern Tanzania (Cribb and Leedal 1982, Lovett et al 1995, Temu and Chihongo 1998).

Mean species diversity was highest at Tandala (1.283 ± 0.035) followed by Molo hills (1.255 ± 0.062). These two sites are located in the montane grassland. The Matamba study areas found in miombo woodlands recorded the lowest species diversity index of less than 0.4 comprising only of *H. Adolphii* Schltr., (Figure 3). The variation in species diversity was found to

be statistically significant ($P < 0.05$) using t-test.

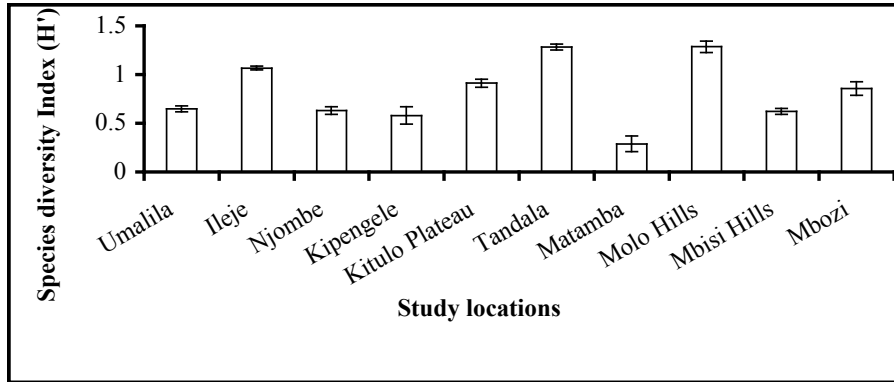


Figure 3: Variation in edible orchids species diversity at studied locations in the Southern Highlands of Tanzania

Kitulo plateau with its typical montane grassland and volcanic clay soil had the highest orchid species richness with over 200 plants/30m² quadrants followed by Matamba and Tandala in that order. The

lowest species richness was found in Madaba and Wino both located in the miombo woodlands. Mbozi, Umalila and Ileje had moderate richness of about 30 plants/30m² quadrants (Figure 4).

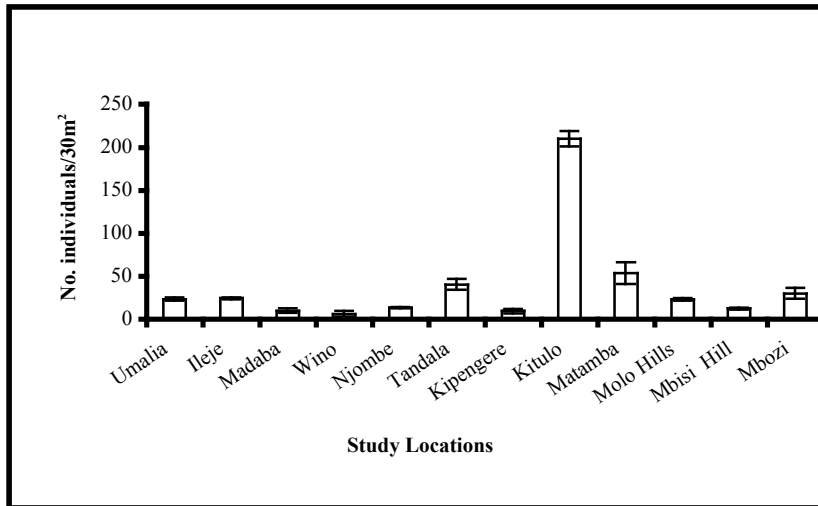


Figure 4: Variation in edible orchid species richness at the study sites in the Southern Highlands of Tanzania

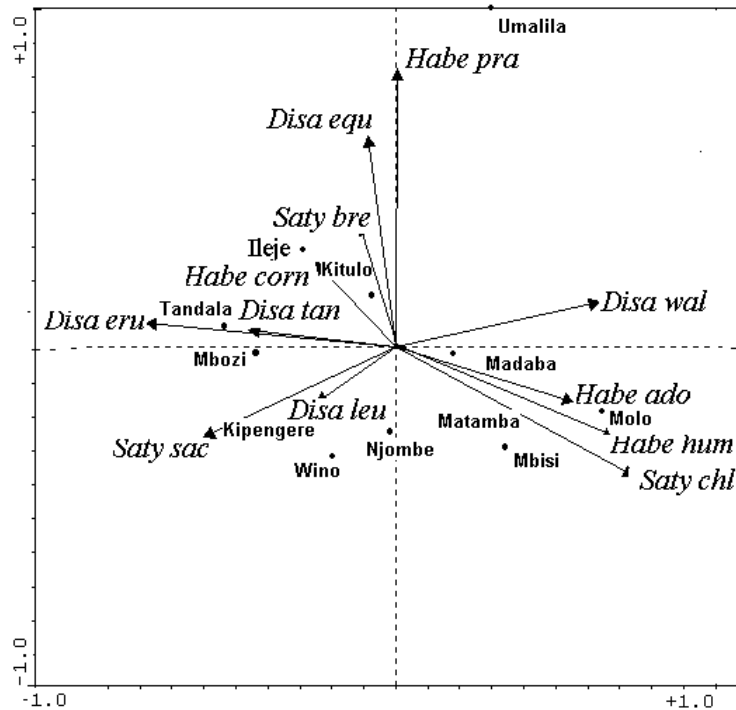


Figure 5: Ordination diagram of sites (bold) and species (Italic) distribution

Disa walleri, *H. Adolphii* Schltr., and *H. Humilior* Reichb.f., were the most abundant species in Madaba and Molo hills but less in Matamba, Umalila and Mbisi hills. Likewise, Ileje, Kitulo had high abundance of *D. erubescens*, *H. cornuta* Lindl., and *S. brevis* Rolfe but less in others. Mbozi and Tandala contained high abundance of *D. erubescens*, *D. tanganyikensis* Summarch., but less abundance of *S. chlorocorys* Rolfe and *S. sacculatum* (Rendle) Rolfe, that were more abundant in the Kipengere study area (Figure 5).

Orchid use

Local communities in Madaba, Molo and Mbisi used the orchids as vegetables and snacks in lieu of animal meat, the rest of the studied areas used orchids as source of cash by selling to Zambian traders and or their middlemen. Many holes depicting last year’s harvest were seen on the Kitulo plateau, Mbisi and Mbozi vicinities

possibly due to their relative densities of orchids and the proximity and accessibility to the Zambian market. Some interviewee contended that tubers harvested in Mbozi and Mbisi hills had better cooking quality and were highly sought after by Zambian traders than those from Kitulo.

Recommendations and Future research

Evidence for over-harvesting was obvious but trade should not be prevented particularly at village level since it is a source of needed cash. Rather, orchid trade need to be controlled by sensitizing the villagers about the importance of orchids as part of natural resources heritage to attract tourism to the area as well as instituting some regulatory mechanism. This should be done hand in hand with in-situ and ex-situ conservation measure efforts by relevant government institutions and NGOs. Following research areas are suggested: Monitoring of growth phase of edible

orchids to ascertain periods of tuber formation and seed set. Studies on sexual propagation are also required to determine conditions for seed viability and germination as well as studies on vegetative multiplication (micropropagation). Phylogenetic studies at conventional systematics and molecular level also should be undertaken so as to have a full characterization of the orchid germplasm found in the Southern Highlands.

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