

THE ORCHID FLORA OF BENISHANGUL-GUMUZ (WESTERN ETHIOPIA): AN ECOLOGICAL AND PHENOLOGICAL STUDY

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ABSTRACT. For the first time, the orchid flora of Benishangul-Gumuz (western Ethiopia, Wellega and Gojam floristic regions) has been studied over a continuous period of more than two years. A total of 63 species has been recorded, of which twelve were new to Ethiopia, including one species new to science (*Disa facula* P.J.Cribb, C.Herrm. & Sebsebe). This article presents the information on orchids gathered during the study. It includes information on habitats, altitude ranges and flowering time, abundance and distribution. Characteristics of the orchid diversity of the region and threats due to land use changes are also described.

Key words: Orchidaceae, new records, Benishangul-Gumuz National Regional State (BGNRS), western Ethiopia, habitats, threats

INTRODUCTION

Due to its remoteness and poor accessibility, the result of bad road conditions and decades of military conflict, western Ethiopia is, in botanical terms, still poorly understood. At the same time, the area is of great scientific interest: the western escarpment of Ethiopia represents an identifiable vegetation unit, which was classified by White (1983) as “*Undifferentiated woodlands (Ethiopian type)*” (unit no. 29b on his vegetation map of Africa). Friis and Sebsebe Demissew (2001) characterized the same area as “*Combretum-Terminalia* deciduous woodland and savannah vegetation”; however, later on they considered the concept of White (1983) as more appropriate (Sebsebe Demissew et al. 2005).

These woodlands stretch along the Sudanese border from Kefa in the south to Eritrea in the north, forming a belt along the escarpment of the Western Plateau at an altitude range from (500) . . . 900 to 1900 m a.s.l. Although the region is poorly explored, existing results indicate an interesting and partly unique flora with a high proportion of endemic species. Several new spe-

cies of vascular plants have been collected and described in recent years, and numerous species new to Ethiopia have been found (Cribb et al. 2002, Nordal & Sebsebe Demissew 2002, Sebsebe Demissew et al. 2003, Sebsebe Demissew & Nordal 2004, Sebsebe Demissew et al. 2005).

The knowledge of the flora of this region was considerably enhanced when one of the authors (Herrmann) was able to explore the vicinity of Assosa continuously over a period of more than two years. Further records and collections of plants were made from other areas, which were occasionally visited during field trips. Since these areas are confined to different altitude ranges, some other orchid species which do not occur around Assosa were recorded. However, the visits to these areas were rather short and only during specific seasons. Even more species might be found if these areas were investigated over the whole year.

The article presents the information on orchids gathered during the two years’ study. It includes information on habitats, altitude ranges and flowering time, abundance and distribution of a total of 63 species. Furthermore, characteristics of the orchid diversity of the region are also described.

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MAP 1. The geographic location of Benishangul-Gumuz within Ethiopia.

LOCATION AND NATURAL CHARACTERISTICS OF THE STUDY AREA

Location

Benishangul-Gumuz National Regional State (BGNRS) is one of the new Federal States established by the Ethiopian Constitution in 1994. With regard to the floristic regions, as established by the “Flora of Ethiopia and Eritrea” (which refer to the former administrative regions), the southern part of BGNRS belongs to Wellega, and the area north of the Blue Nile to Gojam.

BGNRS is situated in western Ethiopia (Map 1), extending along the Sudanese border between 08°47' and 12°04'N. The western and eastern limits are the longitudes 34°06' and 37°02'E, respectively. The neighboring region to the north and northeast is the Amhara Region, to the south and southeast the Oromiya Region. The total area of BGNRS amounts to about 50,380 km². The region is divided by the Blue Nile. The northern part—Metekel Zone and Pawe Special Woreda—comprises an area of 26,560 km², the southern part—Assosa Zone, Kamashi Zone, and Mao-Komo Special Woreda—23,820 km².

The region is divided into 20 major administrative units called Woredas, including two Special Woredas (Pawe and Mao-Komo) (Map 2).

Topography and Altitude Range

The elevation ranges from 580 m to 2731 m a.s.l. with the highest peak being the Belaya plateau in Dangur Woreda, while the lowest area is where the Blue Nile crosses the Ethiopian/Sudanese border. The major part of the region—

about 75%—is lowlands (kolla, below 1500 m a.s.l.). Twenty-four percent are midlands (woyna dega, 1500–2500 m), and only 1% are highlands (dega, above 2500 m).

Hydrography

Benishangul-Gumuz is crossed by the Blue Nile, which enters the region from the east, turning then to the north-west and leaving it between Sherkole and Guba Woreda towards the Sudan. Major tributaries to the Blue Nile are the Dabus, Didessa, and Beles rivers.

The western and northwestern parts of Benishangul-Gumuz (Kurmuk, Sherkole, Guba, and parts of Dangur Woreda) are characterized by low availability of surface water, especially during the dry season when the smaller water courses become dry.

In the Assosa–Bambesi area, the situation is quite different, with many small creeks and rivers forming an extensive network of permanent water courses.

Lakes do not exist in the region. During the rainy season some depressions fill with precipitation water, forming temporary or even permanent pools.

Climate

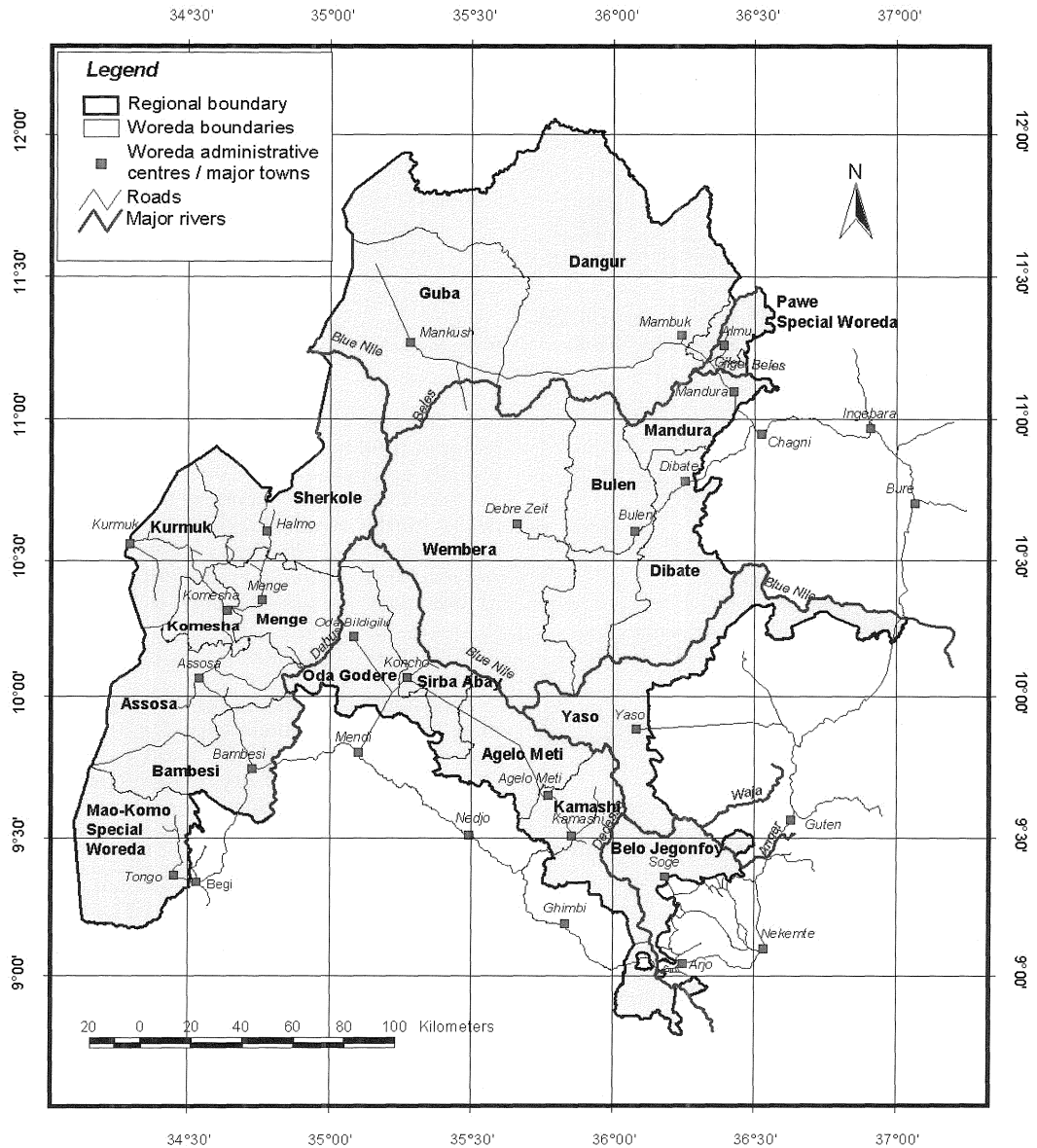
The climate of the region is characterized by a unimodal rainfall pattern (i.e., a single rainfall maximum per year). Unimodal rainfall regimes are characteristic for the whole of western Ethiopia.

The duration of the rainy season decreases from south to north. According to the classification of rainfall regimes given by NMSA (1996a), Benishangul-Gumuz lies in the zone b2, which is characterized by a wet season from April/May to October/November. Beside the latitude, the altitude has a considerable influence on the amount of precipitation, which increases with increasing altitude (FIGURES 1, 2). Thus, Assosa, at an altitude of 1550 m, has an average annual precipitation of 1275 mm, whereas Kurmuk, at an altitude of 700 m, only receives 860 mm rainfall (NMSA 1996b).

The temperature reaches a daily maximum of 20–25°C in the rainy season and rises to 35–40°C in the dry season. The hottest period is from February to April. The minimum temperatures range from 12°C to 20°C, depending on season and altitude.

Vegetation Cover

The western escarpment of Ethiopia represents a recognizable vegetation unit, which was



MAP 2. Overview map of Benishangul-Gumuz.

classified by White (1983) as “*Undifferentiated woodlands (Ethiopian type)*” (unit no. 29b on his vegetation map of Africa). Friis and Sebsebe Demissew (2001) described the vegetation of this transition area between the Ethiopian highlands and the Sudanese lowlands as “*Combretum-Terminalia* deciduous woodland and Savannah zone;” however, later on they considered the concept of White (1983) as more appropriate (Sebsebe Demissew et al. 2005). BGNRS lies almost entirely within this vegetation zone.

Combretum-Terminalia woodlands are the main vegetation type of BGNRS. They occur between 500 and 1900 m a.s.l. and with a rainfall of 800 to 1400 mm per year. Dominant species are *Terminalia brownii*, *Combretum molle*, *Celtis africana*, *Croton macrostachyus*, *Milletia ferruginea*, *Ekebergia capensis*, *Syzygium guineense*, and *Ficus* spp. (UNECA 1998).

The vegetation cover of the region is not homogenous, however. Lowland bamboo (*Oxytenanthera abyssinica*) is another dominant natural

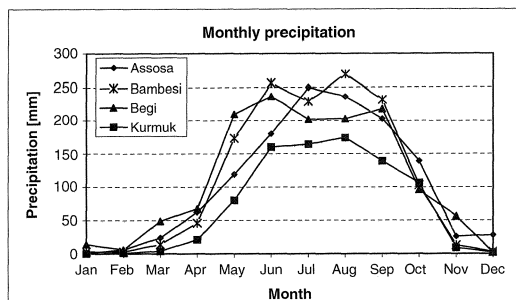


FIGURE 1. Monthly rainfall pattern of selected sites in Benishangul-Gumuz (Data from NMSA 1996b).

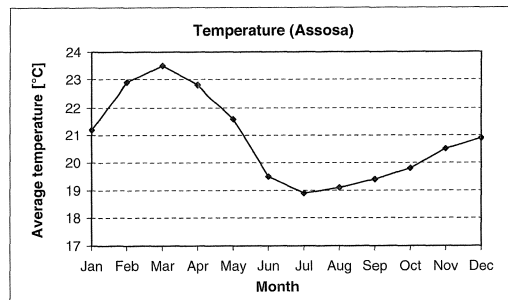


FIGURE 3. Average temperature of Assosa. (Data from NMSA 1996b.)

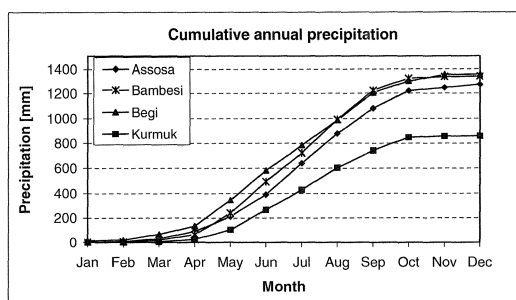


FIGURE 2. Cumulative annual precipitation of selected sites in Benishangul-Gumuz (Data from NMSA 1996b).

component of the woodland vegetation between (700) . . . 1000 to 1800 m a.s.l. It requires a minimum annual rainfall of more than 700 mm and grows on poor soils. Its occurrence is restricted to the western part of Ethiopia, but it emerges also in the savannah woodlands of Sudan. The *Oxytenanthera abyssinica* thickets often form a mixed pattern with *Combretum-Terminalia* woodlands. The total area of bamboo thickets in Benishangul-Gumuz is actually estimated at 440,000 ha (UNECA 1998). The largest bamboo thicket is the Anbessa Chaka ("Lion Forest") between Assosa and Bambesi.

Large areas of lowland bamboo have been destroyed in the Assosa-Bambesi area starting in 1984/85, when more than one hundred thousand settlers from Wello were brought to this part of the region. The settlers cleared major parts of the natural vegetation cover for crop cultivation and cattle breeding. The destruction continues due to the extraction of wood for construction and fuel purposes.

Riverine forests are found along the permanent or seasonal water courses of the region. Although they do not extend over large areas, they are very important for the biological diversity of the region. Higher air moisture, lower tempera-

ture, and lower exposure to the sun provide the required conditions for many orchid species, especially epiphytes.

Other forest types occurring in the region are dense forests (with *Hagenia abyssinica*, *Juniperus procera*, *Podocarpus falcatus*, *Olea europaea* subsp. *cuspidata*, and *Prunus africanus* as dominant species), *Acacia* woodlands, and *Boswellia* woodlands (UNECA 1998). However, the orchid flora of these forest types could not be studied.

A characteristic feature for the western Ethiopian woodlands is their exposure to fire. The herbal biomass is annually burnt by the local population during the dry season (December-March). This practice does not seem to harm the forest vegetation; the plants show clear adaptations to fire.

Although most of Benishangul-Gumuz is still covered by natural forests, a considerable proportion of the region has been transformed to cropland and pastures, especially in the areas with higher population density (Assosa-Bambesi area, Pawe, Bulen, and Dibate). The pastures are usually characterized by the presence of bushes and single trees. Often shallow soils over rocks, which are not arable, are used for grazing. These bushy meadows are the habitat for a number of orchid species.

Of crucial importance for the region's orchid diversity are different types of wetlands:

a. Permanent wetlands: These wetland types occur where ground water emerges on the slopes or at the foot of the hills. Quite often they are found adjacent to small creeks and rivers, where, during the rainy season, they may be reached by flood water from the river, but the main permanent water supply comes from groundwater outlets. The wetlands are supplied with water all year round, although during the dry season the water level is relatively low. They are found mainly in the Assosa-Bambesi area.

- b. Seasonal wetlands:** These wetlands are the flood plains. They are found in the valleys of some larger rivers. They become flooded annually during the rainy season, but dry up during the dry season. Some important flood plains are found along the Dabus river east of Bambesi, and the Keshmando river, about 20 km south of Bambesi.
- c. Temporary and permanent pools:** These wetlands are formed in depressions of rocks or heavy soils with low drainage capacity. They are filled with rainwater during the rainy season. During the dry season, they dry out completely or become considerably reduced in size. However, quite often some water or at least mud remains until the new rains start to fill the pool again. These wetland areas may extend over surfaces of 0.5–5 hectares. They are found around Assosa and along the road Bambesi–Begi.

In the hot and dry lowland areas (below 1200 m; e.g., Kurmuk, Sherkole, Sirba Abay, and Guba Woreda) no permanent wetlands are found.

MATERIAL AND METHODS

Every orchid species found was collected, identified, and pressed. Identification was done with the keys given in volume 6 of the “Flora of Ethiopia and Eritrea” (Cribb & Thomas 1997). All specimens collected were handed over to the National Herbarium of Ethiopia, Addis Ababa University. Species not included in volume 6 of the “Flora of Ethiopia and Eritrea” (i.e., new species records for Ethiopia) were sent for identification via the Addis Herbarium to one of the authors (Cribb), at the Royal Botanical Gardens, Kew.

Geographical position and altitude range of the collection site were determined with GPS (Garmin 12). However, it has to be mentioned that the altitude measurements are rather approximate. Especially those taken before May 2000, when GPS signals still were scrambled for military reasons, may be of rather low accuracy. In case of doubtful readings, the contour lines of topographic maps 1:50,000 were used for comparison. In addition to the collections, information on species, date, habitat, geographical position, and altitude was recorded for all orchids found in the field.

The main study area was the vicinity of Assosa, up to a distance of about 20 km around the town. During two dry and almost three complete rainy seasons, each different habitat was regularly (usually every weekend) searched for orchids and other monocotyledonous plants.

Other areas were visited during field work. A three-week visit to Kamashi zone (Kamashi, Agelo Meti, and Belo Jigonfoy Woredas) in June 2001 resulted in records and collections of a considerable number of orchid species, including several species which obviously do not occur in the Assosa area. Some of them were new for Ethiopia. However, it must be mentioned that the records and collections from Kamashi zone represent only one seasonal aspect; species with a flowering period later in the rainy season (e.g., all *Habenaria* species) are not represented in the records and collections from this area.

The lowland areas of BGNRS (<1000 m, e.g., Guba, Sirba Abay, Menge, Sherkole, and Kurmuk Woreda) were visited only during the dry season and at the very beginning of the rainy season, i.e., from November to May. Hence, only very few orchids were recorded. The areas are inaccessible during the rainy season. They provide climatically different conditions in comparison to the Assosa–Bambesi (1300–1600 m a.s.l.) and Kamashi areas (1000–1300 m a.s.l.), being hotter and drier. During the dry season hardly any water can be found. Wetlands, which form important orchid habitats in the higher zones, are not found in the lowlands.

The higher areas of the region, above 2000 m (the Belaya plateau in Dangur Woreda and some areas in Wembera Woreda), could not be visited. Therefore, it must be emphasized that the results presented here give a reasonably comprehensive picture for the 1300–1500 m altitude range of the Assosa–Bambesi zone, but not for the whole region. The discovery of more species can be expected if the lowland and highland zones are studied in detail.

RESULTS

Species Records

A total of 63 orchid species from 16 genera were recorded, of which twelve species were new to Ethiopia, including one species new to science (*Disa facula*, P.J.Cribb, C.Herrm. & Sebsebe 2002). The orchids recorded in Benishangul-Gumuz thus account for the majority of the species recently added to the “Flora of Ethiopia and Eritrea.” From the appearance of volume 6 of the “Flora of Ethiopia and Eritrea” in 1997 to the publication of the “Field Guide to Ethiopian Orchids” (Sebsebe Demissew et al. 2004), the number of orchid species known for Ethiopia increased from 154 to 171; eleven of the 17 new species were found in Benishangul-Gumuz. Another new species (*Polystachya* aff. *albescens* subsp. *imbricata*) collected in Benishangul-Gumuz has not been considered by Sebsebe De-

misew et al. (2004) since the specimen was too poor for positive identification.

The new species from Benishangul-Gumuz belong to the genera *Habenaria* (2), *Disa* (3), *Polystachya* (1), and *Eulophia* (6).

The total number of orchid records (collections and sight records) was 440. The data gathered provide information about flowering time, habitat requirements, distribution, and abundance. This information is summarized in the species list in the appendix.

An examination of the collections from the National Herbarium in Addis Ababa showed that there are very few previously noted orchid records from the western parts of Wellega and Gogjam floristic regions. The herbarium material did not include orchid species from the territory of BGNRS prior to the present study. However, two species not yet found in BGNRS have been collected in neighboring areas of Oromiya (formerly western Wellega): *Polystachya rivae* Schweinf. (Mooney 6878, collected near Dembi Dolo, alt. 1920 m, 05 March 1957), and *Polystachya bennettiana* Rchb.f. (Mooney 6915, collected near Bube, alt. 1980 m, 08 March 1957). The collection sites are situated about 90 and 50 km south of BGNRS, respectively.

Orchid Habitats

Three ecological groups can be distinguished:

1. Wetland species (i.e., orchids which are strictly confined to wetlands)
2. Species of open bush- and woodland (*Combratum-Terminalia* wood- and bushlands), grazed grasslands or semi-open places of *Oxytenanthera abyssinica* thickets
3. Epiphytic species.

The wetlands of Benishangul-Gumuz consist of:

1. Spring water outlets on hill slopes, especially on the bottom of river valleys (e.g., wetlands along the Selga river, wetland near Ura, wetlands in the Hoha valley); the soil is wet all year.
2. Flood plains of larger rivers (Dabus, Kesh-mando); these wetlands fall dry during the dry season.
3. Pools; these are depressions of usually 0.5–5 hectares without drainage, which fill with precipitation during the rainy season, recede during the dry season, but usually remain wet to some extent all the year round.

Among the species of open bush and woodlands, there are species which usually occur in places with high light exposure (most species) and others that prefer stronger shade (*Eulophia guineensis*, *Habenaria egregia*, *Habenaria cla-*

vata, the *Nervilia* spp.). Furthermore, there are some species which can occur on dry sites as well as on wetlands (e.g., *Eulophia cucullata*).

Among the epiphytic species, there are those which occur exclusively in shady places in riverine forests, characterized by higher air moisture and lower temperature, and those which also occur on single trees in open meadows with strong exposure to sun and wind (e.g., *Calyptrichilum christyanum*, *Polystachya steudneri*). TABLE 1 gives a summary of the ecological groups of the orchids found in Benishangul-Gumuz.

Threats

The main threat to the orchid diversity of BGNRS is the drainage of wetlands. One third of the species found are restricted to wetland areas and would disappear if the wetlands were destroyed. Wetland areas are very limited in extension and also in distribution. They are relatively common in Assosa and Bambesi Woredas and do also exist to a limited extent in Kamashi, Agelo Meti, and Belo Jigonfoy Woredas. They do not exist in the vast areas of lowlands below 1000 m. Unfortunately, the area with the main occurrence of wetlands—Bambesi and Assosa Woredas—is also the area with the highest extension and intensity of crop production. This is a result of the settlement program of 1984/85, when more than one hundred thousand farmers from the famine-stricken area in Wello were brought to Benishangul-Gumuz. The Wello farmers knew how to control the water supply of wetlands in order to cultivate all the year round. In particular, the spring water outlet areas along rivers and creeks are supplied with drainage and irrigation channels, plowed, and seeded with crop plants. These drainage and irrigation systems are a clear advantage for the farmers, who can produce during 12 months and thus improve their livelihood; they are also an important benefit for the local population, since they provide fresh fruits and vegetables (such as carrots, lettuce, tomatoes, bananas) for the local markets from November to April. However, since a major part of the wetlands has already been transformed to cropland, an important orchid habitat is becoming more and more reduced and could even be lost in the near future. During the time of the study, a continuous decline of wetlands around Assosa was observed. Some wetlands with very high orchid diversity were destroyed, among them the Selga wetlands 2 km NE of Assosa (15 species on only two hectares, the only place where *Disa hircicornis* has so far been found in Ethiopia!). For this reason, a conservation program for wetlands in Benishangul-Gumuz is urgently needed. This conservation

TABLE 1. Number of orchids found according to habitat types.

Genus	Wetland species	Species of open bush- and woodland, grazed grassland, and <i>Oxytenanthera abyssinica</i> thickets		Epiphytic species	
		Open places	Shady places	Riverine forests and other rather shady and moist places	Epiphytes on trees in open areas with higher exposure
<i>Aerangis</i> Rchb.f.				1	
<i>Angraecopsis</i> Kraenzl.				1	
<i>Brachycorythis</i> Lindl.	1	2			
<i>Bulbophyllum</i> Thouars				2	
<i>Calypstrochilum</i> Kraenzl.					1
<i>Cyrtorchis</i> Schltr.				1	
<i>Diaphananthe</i> Schltr.				1	
<i>Disa</i> Bergius	3	1			
<i>Eulophia</i> Lindl.	7	6	3		
<i>Habenaria</i> Willd.	9	8	3		
<i>Microcoelia</i> Lindl.				1	
<i>Nervilia</i> Gaudich.			3		
<i>Platycoryne</i> Rchb.f.		1			
<i>Polystachya</i> Hook.				3	1
<i>Pteroglossaspis</i> Rchb.f.		1			
<i>Satyrium</i> Sw.	1	2			
Total	21	21	9	10	2

program should respect the needs of the farmers for income sources and of the population for fresh fruits and vegetables, but it should also provide protection for a certain proportion of the most diverse and valuable wetlands.

The *Combretum-Terminalia* woodlands as well as the *Oxytenanthera abyssinica* thickets are also largely reduced due to the needs for cropland and firewood, especially in the area of the settlement program around Assosa and Bam-



FIGURE 4. Wetland with *Habenaria zambesina* in the Hoha river valley, 13 km N of Assosa. Photograph: C. Herrmann 1999.



FIGURE 5. Transformation of wetlands into croplands: The loss of habitat is a major threat to the orchid diversity of BGNRS. Photograph: C. Herrmann 2001.

besi. However, these habitats still cover extensive areas. Woodlands on shallow and rocky soils are hardly attractive for crop production. A certain proportion of this woodland is transformed to pastures, which are usually covered with scattered trees and bushes. Many of the woodland orchids still find adequate living conditions in these grasslands. Woodlands and bamboo thickets as well as pastures are annually exposed to controlled fires. Between December and March, the local population burns the excess biomass of these habitats. However, this traditional practice reportedly has been employed for centuries. Although it should have an effect on the vegetation composition, the actual “natural” vegetation seems to have adapted.

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**APPENDIX: LIST OF ORCHID SPECIES
RECORDED IN BENISHANGUL-GUMUZ,
INCLUDING INFORMATION ON HABITATS,
ALTITUDE RANGE AND FLOWERING TIME**

Note: The collections are kept in the National Herbarium, Addis Ababa University, Ethiopia. Some duplicates are kept at the Royal Botanic Gardens, Kew, UK.

Brachycorythis Lindl.

1. **Brachycorythis pubescens** Harv.

Found around Assosa and at Keshmando marsh, usually occurring as single plants or groups of few plants; **Habitat:** grassland with scattered bushes and open woodlands, semi-open places in *Oxytenanthera abyssinica* thickets, road sides, occasionally also in temporarily wet areas (areas that are wet at the end of the rainy season, but not all year); **Altitude:** 1370–1575 m; **Flowering time:** July–August; **Collection:** C. Herrmann 3

2. **Brachycorythis buchananii** (Schltr.) Rolfe

Recorded around Assosa (Selga river, some small creeks S of Assosa), and near the road Bambesi–Begi 20 km S of Bambesi; **Habitat:** wetlands, damp areas; **Altitude:** 1370–1550 m; **Flowering time:** July–September; **Collection:** C. Herrmann 13

3. **Brachycorythis ovata** Lindl. subsp. **schweinfurthii** (Rchb.f.)

Found at one location only, in Anbessa Chaka half way between Assosa and Bambesi; the species starts flowering at the beginning of the rainy season in May, i.e., earlier than the other two species of the genus; **Habitat:** an open transition area between a wetland and *Combretum-Terminalia/Oxytenanthera abyssinica* woodland; **Altitude:** 1500 m; **Flowering time:** May–beginning of July; **Collection:** Sebsebe D., C. Herrmann & Tesfaye A. 6021

Habenaria Willd.

Section **Chlorinae** Kraenzl.

4. **Habenaria distantiflora** A. Rich.

Found only once about 1 km S of the village Ura, about 12 km NE of Assosa; **Habitat:** wet meadow; **Altitude:** 1430 m; **Flowering time:** July; **Collection:** C. Herrmann 142

5. **Habenaria bracteosa** A. Rich.

Found on several sites around Assosa, locally abundant; **Habitat:** swampy meadows along rivers and creeks; **Altitude:** 1450–1550 m; **Flowering time:** July–August; **Collection:** C. Herrmann 17

6. **Habenaria filicornis** A. Rich.

Common around Assosa and at the Keshmando marsh; **Habitat:** open grasslands with scattered bushes and swampy meadows along rivers and creeks; **Altitude:** 1370–1570 m; **Flowering time:** July–September; **Collection:** C. Herrmann 9

Section **Commelynifoliae** Kraenzl.

7. **Habenaria platyanthera** Rchb.f.

Found around Assosa, recorded at only three locations; **Habitat:** swampy meadows along rivers and creeks; **Altitude:** 1490–1550 m; **Flowering time:** July–September; **Collection:** C. Herrmann 38

8. **Habenaria peristyloides** A. Rich.

Found around Assosa, locally abundant; **Habitat:** swampy meadows along rivers and creeks; **Altitude:** 1430–1500 m; **Flowering time:** July–September; **Collection:** C. Herrmann 18

9. **Habenaria zambesina** Rchb.f.

A very common orchid, found on almost every wetland around Assosa, often in high density; also recorded at the Keshmando marsh and near Kamashi; **Habitat:** swampy meadows along rivers; spring water outlet areas on hill slopes; **Altitude:** 1280–1560 m; **Flowering time:** July–August (beginning of September); **Collection:** C. Herrmann 12 & 31

Section **Multipartitae** Kraenzl.

10. **Habenaria aethiopica** S. Thomas & P.J. Cribb

Found at only one location, about 1 km S of Ura (12 km NE of Assosa); **Habitat:** wet meadow; **Altitude:** 1430 m; **Flowering time:** July–beginning of August; **Collection:** C. Herrmann 29 & 151

11. **Habenaria egregia** Summerh.

A new record for Ethiopia; found on Inzi mountain near Assosa and in Anbessa Chaka between Assosa and Bambesi; **Habitat:** shady places on a meadow with scattered bushes and *Acanthus*; *Oxytenanthera abyssinica* thicket; **Altitude:** 1450–1550 m; **Flowering time:** June–July; **Collection:** C. Herrmann 124, 125 & 239

Section **Pentaceras** (Thouars) Schltr.

12. **Habenaria malacophylla** Rchb.f.

Found only in Anbessa Chaka between As-

sosa and Bambesi; **Habitat:** *Oxytenanthera abyssinica* thicket; **Altitude:** 1510 m; **Flowering time:** September; **Collection:** C. Herrmann 161 & 162

Section **Replicatae** Kraenzl.

13. **Habenaria chirensis** Rchb.f.

Found along the Dabus and Keshmando rivers, and near Komasha, but not recorded on wetlands around Assosa; **Habitat:** wet meadows along rivers, damp grasslands of spring water outlet areas; **Altitude:** 1300–1400 m; **Flowering time:** July–September; **Collection:** C. Herrmann 6 & 163

14. **Habenaria schimperiana** A.Rich.

A very common species around Assosa; **Habitat:** meadows with scattered bushes and rock outcrops, swamp meadows; **Altitude:** 1430–1600 m; **Flowering time:** July–beginning of September; **Collection:** C. Herrmann 19 & 20

15. **Habenaria humilior** Rchb.f.

A very common species around Assosa; **Habitat:** open grassland, bushed meadows and meadows with rock outcrops; also on swampy meadows; **Altitude:** 1430–1600 m; **Flowering time:** July–beginning of September; **Collection:** C. Herrmann 21, 22 & 23

16. **Habenaria ichneumonia** (Sw.) Lindl.

A common species around Assosa; also near Kamashi; **Habitat:** swampy meadows, damp grasslands; **Altitude:** 1280–1560 m; **Flowering time:** June–September; **Collection:** C. Herrmann 14

Section **Ceratopetalae** Kraenzl.

17. **Habenaria cornuta** Lindl.

A rare species, recorded on only two sites (Selga valley 2 km NE of Assosa, and near Akuda, 15 km NE of Assosa); **Habitat:** swampy meadows; **Altitude:** 1430–1500 m; **Flowering time:** August–September; **Collection:** C. Herrmann 39

18. **Habenaria clavata** (Lindl.) Rchb.f.

A rare species, found at three places in the vicinity of Assosa; **Habitat:** *Oxytenanthera abyssinica* thickets; **Altitude:** 1200–1520 m; **Flowering time:** August–September; **Collection:** C. Herrmann 40

19. **Habenaria holubii** Rolfe

A rare species, found in only one area 3 km SW of Assosa; **Habitat:** meadows with scattered trees and bushes; **Altitude:** 1510–1575 m;

Flowering time: July–beginning of August; **Collection:** C. Herrmann 145

20. **Habenaria cirrhata** (Lindl.) Rchb.f.

A rare species, found 3 km SW of Assosa and in Ambessa Chaka between Assosa and Bambesi; **Habitat:** meadows with scattered trees and bushes; *Oxytenanthera abyssinica* thicket; **Altitude:** 1510–1575 m; **Flowering time:** July; **Collection:** C. Herrmann 145 & 243

Section **Macrurae** Kraenzl.

21. **Habenaria perbella** Rchb.f.

Rare, found on only one site 2 km S of Assosa; **Habitat:** meadows with scattered trees and bushes; **Altitude:** 1530 m; **Flowering time:** July; **Collection:** C. Herrmann 244

Section **Diphyllae** Kraenzl.

22. **Habenaria vaginata** A.Rich.

Found around Inzi Mountain near Assosa and in Ambessa Chaka between Assosa and Bambesi; **Habitat:** on shallow soils in meadows with scattered trees and bushes; *Oxytenanthera abyssinica* thicket; **Altitude:** 1510–1600 m; **Flowering time:** June–July; **Collection:** C. Herrmann 120 & 240

Section **Trachypetalae** Summerh.

23. **Habenaria longirostris** Summerh.

A new record for Ethiopia; found at three places in the Assosa area; **Habitat:** meadows with scattered trees and bushes; grass covered opening in bamboo thicket; **Altitude:** 1500–1520 m; **Flowering time:** August; **Collection:** C. Herrmann 28 & 52

Platycoryne Rchb.f.

24. **Platycoryne crocea** (Rchb.f.) Rolfe subsp. **montiselgon** (Schltr.) Summerh.

Found around Assosa and along the road between Bambesi–Begi, where it may form dense stands; also recorded along the road between Nedjo and Ghimbi; **Habitat:** meadows with scattered trees and bushes, often on shallow soils; **Altitude:** 1510–1600 m; **Flowering time:** end of June–July (beginning of August); **Collection:** C. Herrmann 5

Disa Bergius

25. **Disa aconitoides** Sond. subsp. **goetzeana** (Kraenzl.) Linder

Rare, found at only three very distant places;

Anbessa Chaka, Keshmando marsh and between Arjo and Soge; **Habitat:** bamboo forest, swampy grassland and temporarily inundated meadows; **Altitude:** 1310–1500 m; **Flowering time:** May; **Collection:** C. Herrmann 103, Sebsebe D., C. Herrmann & Tesfaye A. 6017

26. *Disa cryptantha* Summerh.

New record for Ethiopia; common around Assosa, but not recorded elsewhere; **Habitat:** swampy meadows along rivers and damp grasslands; **Altitude:** 1450–1550 m; **Flowering time:** July–beginning of September; **Collection:** C. Herrmann 24, 181 & 182

27. *Disa facula* P.J.Cribb, C. Herrm. & Sebsebe

The species was found in 1999 and 2000 on five locations in the vicinity of Assosa; it was described as a new species by Cribb, Herrmann & Sebsebe Demissew in 2002. The type was collected by Burger (603) in Gojam, 74 km NW of Debre Marcos, on 11 Aug. 1961; **Habitat:** bushland, edges of cultivated land, road sides, transition area between wet meadow and *Combretum-Terminalia* woodland; **Altitude:** 1430–1490 m; **Flowering time:** July–August; **Collection:** C. Herrmann 26, 27, 183 & 184

28. *Disa hircicornis* Rchb.f.

New record for Ethiopia; obviously very rare, the species was found with only a few specimens on one site in the Selga valley 3 km NE of Assosa; **Habitat:** wetland along river; **Altitude:** 1490 m; **Flowering time:** August–September; flowering started mid September in 1999 and 2000, but mid August in 2001; **Collection:** C. Herrmann 57

Satyrium Sw.

29. *Satyrium aethiopicum* Summerh.

Common around Assosa; locally very abundant; **Habitat:** *Combretum-Terminalia* woodland and bushland, bushed meadows, and *Oxytenanthera abyssinica* thickets; **Altitude:** 1450–1600 m; **Flowering time:** July–August; **Collection:** C. Herrmann 16

30. *Satyrium crassaule* Rendle

A rare plant; found on only two sites near Assosa; **Habitat:** wet meadows along rivers and creeks; **Altitude:** 1490–1550 m; **Flowering time:** end of July–September; **Collection:** C. Herrmann 58

31. *Satyrium sacculatum* (Rendle) Rolfe

Common around Assosa; **Habitat:** bushy meadows, wet meadows, road sides, *Combretum-Terminalia* woodlands, and *Oxytenanthera abyssinica* thickets; **Altitude:** 1425–1575 m; **Flowering time:** end of June–beginning of August; **Collection:** C. Herrmann 4

Combretum-Terminalia woodlands, and *Oxytenanthera abyssinica* thickets; **Altitude:** 1425–1575 m; **Flowering time:** end of June–beginning of August; **Collection:** C. Herrmann 4

Nervilia Gaudich.

32. *Nervilia bicarinata* (Blume) Schltr.

Found in the Assosa area, around Kamashi and Soge; **Habitat:** in semi-shady places in *Combretum-Terminalia* woodlands, *Oxytenanthera abyssinica* thickets, and riverine forests; **Altitude:** 1240–1575 m; **Flowering time:** flowers not found, leaves found from June to September; **Collection:** C. Herrmann 152

33. *Nervilia kotschyi* (Rchb.f.) Schltr. var. *kotschyi*

Common; found in the Assosa area, around Kamashi, and Soge; locally abundant; **Habitat:** in semi-shady places in *Combretum-Terminalia* woodlands and bushlands, *Oxytenanthera abyssinica* thickets and riverine forests; **Altitude:** 1240–1575 m; **Flowering time:** April–beginning of June; **Collection:** C. Herrmann 90, 133 & 226

34. *Nervilia simplex* (Thouars) Schltr. [syn. *N. crociformis* (Zoll. & More) Seidenf.]

Found around Kamashi and in Anbessa Chaka between Assosa and Bambesi; **Habitat:** in semi-shady places in *Combretum-Terminalia* woodlands, *Oxytenanthera abyssinica* thickets and riverine forests; **Altitude:** 1260–1510 m; **Flowering time:** supposedly May–beginning of June; fruiting plant collected on 17 June 2001; **Collection:** C. Herrmann 227

Polystachya Hook.

35. *Polystachya tessellata* Lindl.

Found around Kamashi and in the Didessa valley; **Habitat:** Riverine forests; **Altitude:** 1200–1290 m; **Flowering time:** May–June; **Collection:** Sebsebe D., C. Herrmann & Tesfaye A. 5909, C. Herrmann 231

36. *Polystachya steudneri* Rchb.f.

The most common *Polystachya* species in the study area; common around Assosa; also found in Anbessa Chaka, at the Keshmando marsh and near Soge; flowers are developed in February, when the plants are without leaves; leaves are developed during the rain season, starting in May; **Habitat:** epiphytic on deciduous trees; riverine forests, *Combretum-Terminalia* woodlands, single trees on grazed bushland; occasionally lithophytic; **Altitude:** 1330–1600 m; **Flow-**

ering time: February; **Collection:** C. Herrmann 179 & 180, Sebsebe D., C. Herrmann & Tesfaye A. 5946 & 5958

37. *Polystachya eurychila* Summerh.

Rare, found only in the Hoha valley 15 km NE of Assosa and in the Didessa valley; flowers are developed in February, when the plants are without leaves; leaves are developed during the rainy season, starting in May; **Habitat:** epiphytic on deciduous trees in riverine forests; **Altitude:** 1330–1430 m; **Flowering time:** February; **Collection:** C. Herrmann 178

38. *Polystachya* aff. *albescens* Ridl. subsp. *imbricata* (Rolfe) Summerh.

A tiny plant found near to Kamashi town; however, the specimen is poor for undoubted determination. Characters: leaves up to 10.5×2 cm, 5 veins; flowers white, except of lip side lobes, which are purplish; dorsal sepal ovate, acute 5×4 mm, lateral sepals acute, 8×5 mm, petals spatulate, 4×1.5 mm; lip side lobes purplish; callus on base of lip, lip inside all over pubescent; **Habitat:** epiphytic on deciduous trees in a riverine forest in an area covered with a mixed pattern of bamboo and *Combretum-Terminalia*; **Altitude:** 1220 m; **Flowering time:** June; **Collection:** C. Herrmann 238

Bulbophyllum Lindl.

39. *Bulbophyllum lupulinum* Lindl.

Common in the area around Kamashi; **Habitat:** epiphytic on deciduous trees in riverine forests; **Altitude:** 1130–1240 m; **Flowering time:** unknown; plants collected in June with previous year's fruit stands; **Collection:** C. Herrmann 230

40. *Bulbophyllum scaberulum* (Rolfe) Bolus

Found around Kamashi and in the Didessa valley; **Habitat:** epiphytic on deciduous trees in riverine forests; **Altitude:** 1220–1360 m; **Flowering time:** unknown; plants collected in June with previous year's fruit stands; **Collection:** Sebsebe D., C. Herrmann & Tesfaye A. 5910, C. Herrmann 229

Pteroglossaspis Rchb.f.

41. *Pteroglossaspis eustachya* Rchb.f.

Found on several sites around Assosa; **Habitat:** wooded grassland, damp grassland, openings in bamboo thicket; **Altitude:** 1500–1575 m; **Flowering time:** July–September; **Collection:** C. Herrmann 55 & 56

Eulophia Lindl.

42. *Eulophia guineensis* Lindl.

Common and widespread at the beginning of the rainy season; found around Assosa, Bambesi, Kamashi, Agalo Meti, in the Didessa valley, near Mankush and Dibate; **Habitat:** shady places in *Combretum-Terminalia* woodlands, bushland, bamboo thickets, under rocks, etc.; **Altitude:** 785–1590 m; **Flowering time:** May–June; **Collection:** C. Herrmann 116 & 117, Sebsebe D., C. Herrmann & Tesfaye A. 5926

43. *Eulophia stachyodes* Rchb.f.

Common around Kamashi; also found in Belo Jegonfoy Woreda, Anbessa Chaka, and Keshmando; not found around Assosa; **Habitat:** semi-shady places in *Combretum-Terminalia* woodlands, meadow with scattered bushes, bamboo thickets; **Altitude:** 1240–1500 m; **Flowering time:** May–June; **Collection:** C. Herrmann 214 & 235

44. *Eulophia adenoglossa* (Lindl.) Rchb.f.

New record for Ethiopia; found on only one site near Kamashi; **Habitat:** semi-open bamboo thicket; **Altitude:** 1270 m; **Flowering time:** June; **Collection:** C. Herrmann 228

45. *Eulophia horsfallii* (Bateman) Summerh.

Recorded along Selga river 2 km NE of Assosa and between Arjo and Soge; **Habitat:** wet grassland along rivers and around pools; **Altitude:** 1310–1500 m; **Flowering time:** April–October; **Collection:** C. Herrmann 53

46. *Eulophia angolensis* (Rchb.f.) Summerh.

A wetland species, recorded on wetlands around Assosa, at the Keshmando marsh and between Arjo and Soge; **Habitat:** wet grassland along rivers and around pools; **Altitude:** 1310–1565 m; **Flowering time:** May–September; **Collection:** C. Herrmann 95, Sebsebe D., C. Herrmann & Tesfaye A. 6019

47. *Eulophia caricifolia* (Rchb.f.) Summerh.

New record for Ethiopia; recorded on wetlands around Assosa and in Anbessa Chaka; **Habitat:** swampy grasslands, wet meadows along rivers; **Altitude:** 1500–1555 m; **Flowering time:** April–September; **Collection:** C. Herrmann 33, 34 & 51, Sebsebe D., C. Herrmann & Tesfaye A. 5999

48. *Eulophia flavopurpurea* (Rchb.f.) Rolfe

New record for Ethiopia; a rare species, found at only three locations near to Assosa, between Bambesi and Assosa, and north of Kamashi town; **Habitat:** meadows with scattered bushes

and open *Combretum-Terminalia* woodlands; **Altitude:** 1040–1530 m; **Flowering time:** May–July; **Collection:** Sebsebe D., C. Herrmann & Tesfaye A. 5914; C. Herrmann 215 & 245

49. *Eulophia cucullata* (Sw.) Steud.

The most common and widespread *Eulophia* species in the study area; many records in Assosa, Bambesi, Kamashi, and Belo Jefonfoy Woredas; **Habitat:** meadows with scattered bushes, open *Combretum-Terminalia* woodlands and damp grassland; **Altitude:** 980–1560 m; **Flowering time:** May–July; **Collection:** C. Herrmann 2 & 119

50. *Eulophia cristata* (Sw.) Steud.

Found around Assosa and further north (Menge and Komesha Woreda); plant flowers before and just at the beginning of the rainy season; leaves develop after flowering; **Habitat:** meadows with scattered bushes, open *Combretum-Terminalia* woodland; **Altitude:** 1200–1560 m; **Flowering time:** March–May; **Collection:** C. Herrmann 89

51. *Eulophia livingstoniana* (Rchb.f.) Summerh.

A rather rare species, found around Assosa at only one site; also Keshmando marsh, and between Arjo and Soge; **Habitat:** wet meadows, seasonally inundated areas, locally in high numbers; **Altitude:** 1310–1555 m; **Flowering time:** May–July; **Collection:** C. Herrmann 92 & 93, Sebsebe D., C. Herrmann & Tesfaye A. 6010

52. *Eulophia schweinfurthii* Kraenzl.

A rather common species around Assosa and between Assosa and Bambesi; leaves appear in May (at the beginning of the rainy season), flowers in September–December (end of the rainy season, beginning of the dry season); **Habitat:** open meadows with scattered bushes, *Combretum-Terminalia* woodland and open areas in *Oxytenanthera abyssinica* thickets; **Altitude:** 1490–1600 m; **Flowering time:** September–December; **Collection:** C. Herrmann 54 & 224

53. *Eulophia pyrophila* (Rchb.f.) Summerh.

Rare, found only once at the Keshmando marsh; **Habitat:** seasonally inundated meadow; **Altitude:** 1385 m; **Flowering time:** May; **Collection:** Sebsebe D., C. Herrmann & Tesfaye A. 6016

54. *Eulophia milnei* Rchb.f.

New record for Ethiopia; found at the Keshmando marsh, near Kamashi, and between Arjo and Soge; not found around Assosa; **Habitat:** swamp grassland, seasonally wet meadows; **Al-**

titude: 1280–1385 m; **Flowering time:** May–June; **Collection:** Sebsebe D., C. Herrmann & Tesfaye A. 6011, C. Herrmann 221 & 222

55. *Eulophia odontoglossa* Rchb.f.

Rare; found only once 2 km SW of Assosa; **Habitat:** bushy meadow; **Altitude:** 1550 m; **Flowering time:** June; **Collection:** C. Herrmann 223

56. *Eulophia zeyheri* Hook.f.

New record for Ethiopia; rare, found at only two locations (3 km SW of Assosa and Keshmando marsh); **Habitat:** bushy meadow, *Combretum-Terminalia* woodland; **Altitude:** 1370–1560 m; **Flowering time:** May–June; **Collection:** C. Herrmann 101, Sebsebe D., C. Herrmann & Tesfaye A. 6018

57. *Eulophia kyimbilae* Schltr.

New record for Ethiopia; frequent around Assosa, but not found elsewhere; **Habitat:** swampy meadows along rivers; **Altitude:** 1430–1550 m; **Flowering time:** July–August; **Collection:** C. Herrmann 32, 122 & 123

Calyptrochilum Kraenzl.

58. *Calyptrochilum christyanum* (Rchb.f.) Summerh.

The most common epiphytic orchid in the study area; found around Assosa and Bambesi, Halmo, at the Keshmando marsh and in the Diddessa valley; **Habitat:** epiphytic; *Combretum-Terminalia* woodlands, single trees on grazed meadows, riverine forests; **Altitude:** 785–1600 m; **Flowering time:** April–May; **Collection:** C. Herrmann 207

Microcoelia Lindl.

59. *Microcoelia globulosa* (Hochst.) L.Jonss.

Found only in riverine forests around Kamashi town; **Habitat:** epiphytic in riverine forests; **Altitude:** 1290 m; **Flowering time:** unknown; collected and pressed on 17 June 2001 with old fruit stands; **Collection:** C. Herrmann 216

Diaphananthe Schltr.

60. *Diaphananthe candida* P.J.Cribb

Found near Assosa and around Kamashi; **Habitat:** lithophytic in a very shady place; epiphytic in riverine forest; **Altitude:** 1255–1535 m; **Flowering time:** July; **Collection:** C. Herrmann 247; **Note:** In Cribb et al. (2002) this collection was referred to as *Angraecopsis holo-*

chila Summerh.; however, this identification was erroneous and must be corrected.

Aerangis Rchb.f.

61. **Aerangis brachycarpa** (A.Rich.) Th.Dur & Schinz

Found only at the Hoha waterfall, 13 km NE of Assosa; **Habitat:** epiphytic in riverine forest; **Altitude:** 1430 m; **Flowering time:** July; **Collection:** C. Herrmann 153, 154 & 155

Cyrtorchis Schltr.

62. **Cyrtorchis erythraeae** (Rolfe) Schltr.

The species was found in riverine forests at the Hoha river, at a river between Assosa and Bambesi, near to Kamashi and in the Didessa valley.

The key for identification of the Ethiopian *Cyrtorchis* species has been modified several times during recent years. The distinguishing characters between *C. arcuata* and *C. erythraeae* are the measurements of the bracts and the leaves. According to the identification keys given by Thomas & Cribb (1997) and Cribb et al. (2002), the collection from Benishangul does

not key out: concerning the bract measures, it should be *C. erythraeae*; concerning the leaf measures it should be *C. arcuata*. The latest key (Sebsebe Demissew et al. 2004) uses the length of the leaves as the distinguishing character instead of the width. According to this key, the collection from Benishangul clearly keys out as *C. erythraeae*. However, as Cribb et al. (2002) and Sebsebe Demissew et al. (2004) suggest, the distinctiveness of *C. erythraeae* is questionable; further studies are needed to clarify whether *C. erythraeae* deserves the rank of a species or of an ecotype of *C. arcuata*. **Habitat:** epiphytic in riverine forest; **Altitude:** 1220–1420 m; **Flowering time:** May–June; **Collection:** C. Herrmann 160

Angraecopsis Kraenzl.

63. **Angraecopsis trifurca** (Rchb.f.) Schltr.

A rare species, found only with a few plants at the Hoha waterfall 13 km NE of Assosa; **Habitat:** epiphytic in very shady, moist place at a waterfall; **Altitude:** 1430 m; **Flowering time:** not observed flowering in its habitat; the plant was collected in December 2000 and grown at home in Assosa, where it flowered in July 2001; **Collection:** C. Herrmann 252