

Notes and records

New observations of the terrestrial holoparasite *Chlamydoxylum aphyllum* Mildbr. and its consumption by bonobos at Kokolopori, Democratic Republic of Congo

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Introduction

Little is known about the life history of many Balanophoraceae, a mostly tropical family of holoparasitic angiosperms. This is particularly true for *Chlamydoxylum aphyllum*, that has been described on the basis of only four specimens collected from three locations in West/Central Africa (Molau, 1995). What little information exists on its ecology can be found in Halle (1978) and Hansen (1986). Kuijt (1969) speculated, on the basis of reproductive morphology, that frugivorous animals may act as seed dispersers but no observations of such an interaction are yet available. Here we present new data on the period of flowering of *C. aphyllum* and provide a short report on the occasional consumption of this plant by bonobos (*Pan paniscus*) at Kokolopori Bonobo Reserve, Democratic Republic of Congo (DRC). This is only the fourth and eastern-most locality for which the presence of *Chlamydoxylum* has been established in Africa and the first report of this plant as a food item for a great ape species.

Materials and methods

Study site and subjects

Nsondo Camp (0°12'N, 22°51'E) was established in Kokolopori Bonobo Reserve, DRC in October 2006 as part of a

pilot study of bonobo feeding ecology. Habituation of the Hali-Hali bonobo community, our study group, has been ongoing since 2002 (Lokasola, 2008) thus making behavioural observations feasible. The site is a low-elevation humid rainforest, with three main habitat types: primary forest on dry ground, seasonally inundated swamp forest and disturbed secondary forest near the villages. Average annual rainfall for 2004–2005 at Wamba village, which is 30–35 km from our study site was about 2900 mm (Mulavwa *et al.*, 2008).

Behavioural observations

A.G. established data-collection protocols on feeding ecology and observed bonobos at Nsondo Camp during October–December 2006 and June–July 2007. The rest of the team collected additional data on bonobo diet independently from January through June 2007 following the methods established and practiced with the first author. Bonobos were followed by two or three observers. Feeding was usually observed at a distance of at least 15–20 m due to the incomplete habituation of the apes. When foraging took place on the ground, dense undergrowth limited visibility and, in some instances, the consumption of ground foods (e.g. herbs) was inferred by the discarded fresh vegetative remains. The consumption of or the observation of fresh remains from unusual food items such as the one described in this report was noted *ad libitum* (Altmann, 1974). Data on feeding are presented as the proportion of days during which a food item was consumed at least once from the total number of observational days. This 'feeding score' is a simple but robust measure of seasonal changes in primate diets (Robbins, Nkurunungi & Mcneilage, 2006) and we use it here to maximize the dataset by including days during which behavioural records were incomplete.

Plant identification

Bonobo plant foods were noted by their vernacular Longondo names in the field. These were then identified to genus and where possible species after verification against two sources: a Longondo-Latin name list of bonobo foods available for the nearby study site of Wamba (Idani *et al.*,

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1994); and against specimens at the Royal Botanic Gardens, Kew. To identify the holoparasite photographs from the field were compared with written descriptions (Evrard & Breyne, 1975; Halle, 1978) and illustrations (Halle, 1978) from the literature. Herbarium specimens of other Balanophoraceae were also inspected. Misidentification in the field was unlikely given the particular appearance of the plant. All members of the team except A.G. live in the Kokolopori area and were able to reliably identify the holoparasitic plant from distance and also from feeding remains.

Results and discussion

Chlamydoxylum aphyllum at Kokolopori

Esulunguli (Fig. 1) is thought by the local Bongando people to be a poisonous mushroom that can cause people severe pain on skin contact alone. We identified *Esulunguli* to be the male inflorescence of *Chlamydoxylum aphyllum*, a dioecious holoparasitic angiosperm of the Balanophoraceae. *Chlamydoxylum* has been reported from only three localities during the 1970s and the early 1980s, from Cameroon, Gabon, and from south-western DRC (Evrard & Breyne, 1975; Halle, 1978). This new observation of *C. aphyllum* at Kokolopori extends its known distribution to the east (Fig. 2). *Chlamydoxylum aphyllum* inflorescences were seen above ground in late September, at the begin-

ning of the field trip. Bonobos fed occasionally on this plant as late as June of the following year. Hansen (1986) reported the flowering period of this species as December to June but our observations indicate that future investigators interested in studying the reproductive biology of *C. aphyllum* at Kokolopori would also be able to locate its inflorescences from as early as September. Alternatively, this discrepancy in the flowering period leaves the possibility that the specimens we observed belong to a closely related to *C. aphyllum* and as-yet undescribed species. Future specimen collection should provide detailed morphological and molecular data in order to resolve this question definitively.

Consumption of *C. aphyllum* by bonobos

On the 16 days in November and December 2006, for which we obtained at least 5 h of bonobo observational data (mean duration of daily observations: 560 min; SD = 123), A.G. directly saw bonobos eat *C. aphyllum* on two occasions, and on another occasion discarded remains were used to infer consumption. The two observed feeding episodes involved at least two female bonobos. The apes fed on one male plant that was fully in bloom and on another inflorescence which was still covered by a volva and was dug out from underground. In the first case, a female carried the male inflorescence and dropped remains in her tracks for about 950 m. The second direct observation

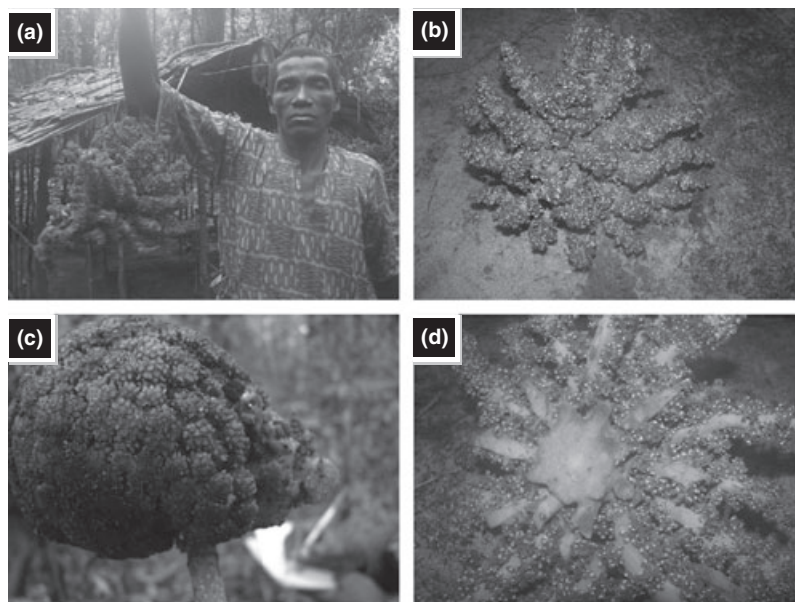


Fig 1 *Chlamydoxylum aphyllum* at Nsondo Camp, Kokolopori Bonobo Reserve, DRC. (a) Jacques Likenge holding a mature male inflorescence of *Chlamydoxylum aphyllum*; (b) Male inflorescence, as seen from above (in camp; not at the original location of collection); (c) Immature male inflorescence (held up on a stick); (d) Male inflorescence in section, as seen from below. November 2006. Photos: Alexander V. Georgiev

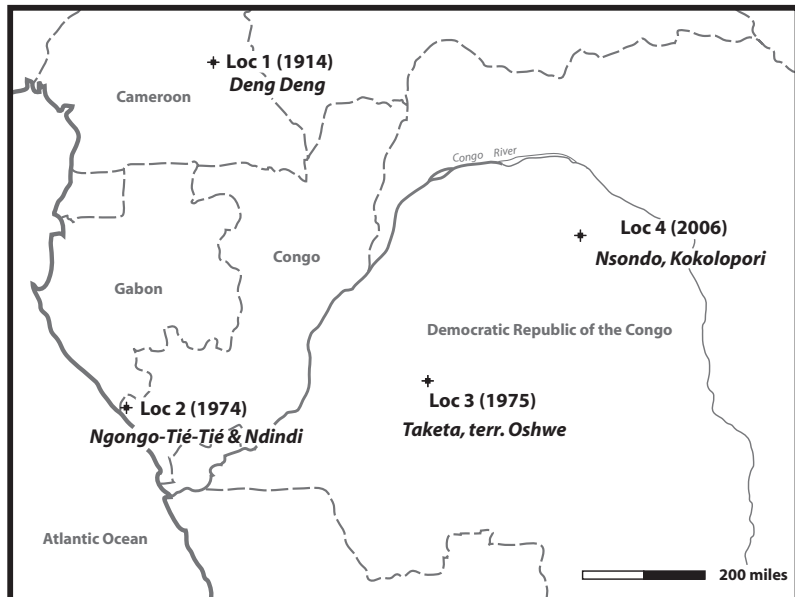


Fig 2 Distribution range of *Chlamydomyrtum aphyllum*. Source: Evrard & Breyné (1975), Halle (1978) and the current study. Year of specimen description is provided in parenthesis. Map design: Neil T. Roach

recorded in detail by A.G. involved the digging up of an unopened inflorescence from the ground layer. Its sex was uncertain because the digging and consumption occurred at dusk, when visibility on the forest floor was poor. The discarded vegetative parts in both cases suggested that bonobos were peeling the cortical layers off the base of the plant, possibly feeding on the base of the inflorescence axis. From January to June 2007 *C. aphyllum* was seen to be or inferred to be consumed by bonobos on 32 separate days bringing the total number of days during which this plant was consumed at least one time to 35 days (Table 1). On most days an average of 1.8 such feeding events were recorded (min = 1, max = 5, median = 2, $n = 32$). Usually only one or two individual apes fed each time thus the contribution of the parasite plant to bonobo diet is minor. Bonobos have not been reported to feed on this plant at

other sites, although they are capable of finding ground foods such as truffles at this and at other study areas (Kokolopori: Georgiev, unpublished data; Lilungu: Bermejo, Illera & Sabater, 1995, Wamba: Kano, 1992). Other subterranean root-parasitic plants, however, are eaten by lemurs in Madagascar. Irwin *et al.* (2007) have reported that *Langsdorffia* sp. (Balanophoraceae) and *Citynus* sp. (Citynaceae) are eaten seasonally by diademed sifakas (*Propithecus diadema*). Simmen, Hladik & Ramasiarisoa (2003) and online photographs by Susan Caless (<http://joachimj.club.fr/mada076.htm>) identify another parasitic plant, *Hydnora esculenta* (Hydnoraceae) whose ripe fruit and seeds are consumed by brown lemurs (*Eulemur fulvus*), ring-tailed lemurs (*Lemur catta*) and sifakas (*Propithecus verreauxi*). Although our report does not confirm Kuijt's (1969) speculation that *Chlamydomyrtum* seeds are

Table 1 Bonobo observation time and *C. aphyllum* consumption at Kokolopori, DRC

Observation period	Number of observation days	Bonobo observation hours	Number of days with eating episodes	Index of contribution to diet composition: (number of days with eating episodes/total number of observation days)
Nov–Dec 2006	16*	164	3	0.2
3 Jan–16 June 2007	91	809.4	32	0.4
18 June–26 July 2007	39	446.2	0	0

*Only data collected on days with more than 5 hrs observation time are included in the analysis.

dispersed by fruit-eating mammals, it does present the first evidence of any mammal feeding on this unusual species, and it shows that future study of the relationship between *C. aphyllum* and bonobos will be worthwhile.

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