

The vegetation of recently fallowed *Masakwa* fields in the Chad basin

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Summary: On the clay plains surrounding Lake Chad (West Africa: northern Sudanian and southern Sahelian zone), certain varieties of pearl millet (*Sorghum bicolor*), commonly referred to as *Masakwa*, are cultivated during the dry season. Recently fallowed *Masakwa* fields support a particular progression of pioneer vegetation. In the first year of fallow, the pioneer vegetation typically belongs to the class Echinochloetea colonae Wittig 2005 and can be classified as Hygrophiletum auriculatae sensu lato. Approximately half of the stands consist of the Hygrophiletum auriculatae Ataholo 2002 sensu stricto, whereas the other half is primarily composed of a *Celosia argentea-Hibiscus trionum* community. After two years of fallow, the vegetation is typically formed by the Sorghetum arundinacei Ataholo 2002, which, in a few cases, can also occur in the first fallow year.

Keywords: Echinochloetea colonae, *firgi*, Hygrophiletum auriculatae, Nigeria, Sahelian zone, Sorghetum arundinacei, *Sorghum bicolor*, Sudanian zone

LA VÉGÉTATION DES JEUNES JACHÈRES D'ANCIENS CHAMPS DE *MASAKWA* DANS LE BASSIN DU TCHAD

Résumé: Sur les sols argileux de la plaine autour du Lac Tchad (Afrique de l'Ouest: zones Soudanienne au Nord et Sahélienne au Sud), des variétés particulières de petit mil (*Sorghum bicolor*) toutes regroupées sous le terme *Masakwa*, sont cultivées pendant la saison sèche. Les jeunes jachères issues d'anciens champs de *Masakwa* forment un type particulier de végétation pionnière. Cette végétation au cours de la première année et dans la majorité des cas, fait sans doute partie de la classe d'Echinochloetea colonae Wittig 2005, et classée comme Hygrophiletum auriculatae sensu lato. Près de la moitié des peuplements constitue le Hygrophiletum auriculatae Ataholo 2002 sensu lato, tandis que l'autre moitié est formée en majorité par le *Celosia argentea-Hibiscus trionum*. Dans les champs de deux ans, on retrouve normalement le Sorghetum arundinacei Ataholo 2002, qui dans certains cas apparaît déjà au cours de la première année de jachère.

Mots clés: Echinochloetea colonae, *firgi*, Hygrophiletum auriculatae, Nigeria, Sorghetum arundinacei, *Sorghum bicolor*, zone Sahélienne, zone Soudanienne

DIE VEGETATION JUNGER BRACHEN DER *MASAKWA*-FELDER IN DER TSCHAD-EBENE

Zusammenfassung: Auf den Tonebenen des Tschadbeckens (West Afrika: südliche Sahel- und nördliche Sudanzone) werden bestimmte Sorten der Perl-Hirse (*Sorghum bicolor*) unter dem Sammelnamen *Masakwa* kultiviert. Junge Brachen von *Masakwa*-Feldern tragen im ersten Jahr in der Regel eine zur Klasse Echinochloetea colonae Wittig 2005 gehörende Pioniervegetation, die im weiteren Sinne dem Hygrophiletum auriculatae Ataholo 2002 zugeordnet werden kann. Etwa die Hälfte der Bestände repräsentiert das Hygrophiletum auriculatae s.str., die andere Hälfte wird meist von einer *Celosia argentea-Hibiscus trionum*-Gesellschaft gebildet. Auf zwei Jahre lang brach liegenden Feldern findet man meist das Sorghetum, arundinacei Ataholo 2002, das in seltenen Fällen auch gleich im ersten Brachejahr auftreten kann.

Schlagworte: Echinochloetea colonae, *firgi*, Hygrophiletum auriculatae, Nigeria, Sahelzone, Sorghetum arundinacei, *Sorghum bicolor*, Sudanzone

ture. Therefore, we present a study of the fallow vegetation of the dry season fields at Lake Chad.

1 INTRODUCTION

Within the clay planes surrounding Lake Chad (West Africa: northern Sudanian and southern Sahelian zone), certain varieties of pearl millet (*Sorghum bicolor*; see DAHLBERG 2001), commonly called *Masakwa*, are cultivated during the dry season (OLABANJI 1999, NEUMANN 2001). Because cropping in the dry season within the Sudanian and Sahelian zone represents a particularity, the fallow vegetation of these fields is of great interest for vegetation science. Furthermore, in the context of increasing populations (KRINGS 2002), the shrinking of Lake Chad (THIEMEYER 2002) and climate change, it is doubtful whether the very laborious traditional dry season cultivation will be maintained in the fu-

2 AREA OF INVESTIGATION

All relevés were taken in the year 1995 in the area near Marte and Ngala (Nigeria) according to the method of BRAUN-BLANQUET (1964). The area of our investigation was located in the Sudanian zone near the border of the Sahelian zone (WHITE 1983). In this area, as well as in other areas in the vicinity of Lake Chad, a particular traditional method of dry season cultivation is used, which is based on the high water retention capacity of the soils that have developed on the lagoonal plains of Chad (called *firgi* in the Kanuri language). The soils and landscape in the vicinity of the Nigerian shore of Lake Chad were intensively surveyed by researchers from the Goethe-University of Frankfurt (Germany) within the framework of the Collaborative Research Center 268 (*Sonderforschungsbereich 268*). Additional detailed informati-

on on this area can be obtained from publications resulting from this investigations (e.g., FRANKE-SCHARF 1997, 2000, KIRSCHT 2001, NEUMANN 2001, SKORUPINSKY & FRANKE-SCHARF 1997, THIEMAYER 1997a, b) or from the review of FRANKE-SCHARF et al. (2004). The linguistic background of the term *Masakwa* was addressed by LÖHR (2001).

Because of the low infiltration rate of clay soils, dykes of 0.5 to 0.75 m high have been built around the fields to impound rainwater, prevent run-off and increase infiltration. In August, which is part of the rainy season, sorghum nurseries are prepared while the dry season fields are still flooded. Several weeks later, when the firgi are dry, the spontaneous vegetation (“weed vegetation”) of the fields is removed, and four- to six-weeks-old seedlings are planted (for additional details of the planting procedure, see OLABANJI 1999). At this time, the surface of the *firgi* has become dry and hard and becomes largely impenetrable for the roots of germinating weeds. Therefore, one or two weeding events are sufficient to achieve a minimal weed cover. The complete potential weed community can only be observed on recently fallowed fields.

3 RESULTS

We identified two plant communities on the fallowed *Masakwa* fields: Hygrophileum auriculatae *sensu lato* (3.1) and Sorghetum arundinacei (3.2).

3.1 Hygrophileum auriculatae *sensu lato*

After one year of fallow, *Masakwa* fields are covered by dense vegetation (covering 65 – 98 %; average 87 %) that is typically dominated by one or several of the species *Celosia argentea*, *Hibiscus trionum*, *Cyperus esculentus* and/or *Hygrophila auriculata*, *Momordica balsamina* and, more rarely, by *Ipomoea aquatica*. Nearly all of the species that occur with medium to high constancy prefer humid or temporarily wet soils. According to LE BOURGEOIS & MERLIER (1993), a high proportion of these species are classified as indicators of vertisols and/or clay or a high soil pH. ATAHOLO (2002) demonstrated that approximately 75 % of the species found in this community are indicators of heavy soils, and 55 % are indicators of alkaline soils. Obviously, the vegetation of fallowed *Masakwa* fields closely mirrors the soil conditions (MORDI et al. 1991) of the *firgi*.

Greater than 50 % of the relévés taken of this vegetation (Table 1, No. 1 – 7) can be identified as belonging to the Hygrophileum auriculatae *s. str.*, which was described by ATAHOLO (2002). This association is one of the two communities that represent the class Caperonietaea palustris Ataholo 2002; however, no valid description of this class presently exists. WITTIG (2005) assigned this community to the alliance Aeschynomenion indicae Wittig 2005 within the class Echinochloetea colona Wittig 2005. In a broader sense, the remaining five relévés also belong to the Hygrophileum auriculatae because of their similar species composition and identical habitat. When the guidelines of BRAUN-BLANQUET (1964) are strictly followed, these relévés must be regarded as representing a rankless community for which ATAHOLO (2002) has proposed the name *Celosia argentea-Hibiscus trionum* community.

3.2 Sorghetum arundinacei Ataholo 2002 nom. corr.

After two years, fallowed fields are covered by the Sorghetum arundinacei Ataholo 2002 nom. corr. (Table 2), which is a grass-dominated vegetation that covers 80 – 95 % (average 88 %) and often reaches a height of 3 m. In most stands, *Sorghum arundinaceum* is dominant, in a few cases *Momordica balsamina* shows the highest cover. Rarely, *Merremia emarginata*, *Echinochloa colona* or *Sorghum bipinnatum* were found to be codominant. Similar to the one-year fallows, *Hibiscus trionum*, *Celosia argentea* and *Caperonia palustris* show high to very high constancy. According to ATAHOLO (2002), indicators of clay and of alkaline soils are strongly represented, which is similar to the vegetation of the recently fallowed fields described above. In a few cases, the Sorghetum arundinacei was observed in one-year fallows. These stands, which are represented by relévé No. 2 in Table 2, were of a much lower height than those of the older fallowed fields.

Because only a few relévés are available, the position of this association within the phytosociological system is arguable. Therefore, it is desirable to obtain additional relévés of this community as well as of the pioneer vegetation of other temporarily inundated argillaceous soils in the Sudanian and Sahelian zone.

4 DISCUSSION

The ecological conditions of recently fallowed and temporarily inundated fields are very similar to that of disturbed areas at the shores of lakes or in depressions with argillaceous soils and of the dry fallen soils of temporary waters (called *mares* in French). In all cases, wet bare soil exists and remains humid during the first weeks of the dry season. Therefore, germination conditions are excellent and competition is, at first, very low. Therophytes dominate the resulting vegetation, but seedlings of perennial species common in later successional stages, and of the adjacent communities, might be present. The therophytes comprise three groups:

- Ubiquitous species found at the majority of disturbed sites,
- Species that mainly occur in cultivated fields (i.e., agricultural weeds *s.str.*),
- Species with a unique ecological adaptation to these temporarily inundated (or temporarily wet) and periodically disturbed habitats. These species form the core of the class Echinochloetea colona Wittig 2005.

The Hygrophileum auriculatae represents a key example of this type of vegetation: the class Echinochloetea colona is represented by its name-giving species (*Echinochloa colona*) and by a character species of one of its associations (*Hygrophila auriculata*). Agricultural weeds *s.str.* are present (e.g., *Celosia argentea*, *Corchorus olitorius* and *Commelina nigritana*), and *Sida alba* represents the group of ubiquists. *Cyperus esculentus*, *Oryza barthii* and *Echinochloa stagnina* are mainly considered reed species.

As the succession continues, species that are taller than the aforementioned plants become dominant such that the dimensions of the vegetation are completely altered. The

Table / Tableau 1: Hygrophileton auriculatae and Celosia argentea-Hibiscus trionum community

No.	1	2	3	4	5	6	7	8	9	10	11	12
No. in Table 57 of Ataholo 2002	4	5	12	3	6	16	7	2	8	10	11	14
vegetation cover (%)	95	90	90	80	98	95	80	75	90	65	80	95
height of the vegetation (m)	0.6	0.6	0.5	0.5	0.6	0.4	0.8	0.4	0.5	0.3	0.4	0.4
relévé area (m2 x 10)	40	60	60	40	50	90	12	50	60	40	90	90
C Hygrophileton auriculatae												
<i>Hygrophila auriculata</i>	5	2	1	2	3	2	+	.	.	.	.	.
C and D* of the Aeschynomene indicae												
<i>Cyperus palustris</i>	1	+	1	1	1	.	.	.	1	1	1	2
<i>Cyperus esculentus</i>	.	.	2	2	2	3	.	2	4	2	+	3
<i>Ipomoea aquatica</i>	.	1	2	3	.	1	1	1	1	.	.	1
<i>Oryza barthii</i>	1	1	.	.	3	.	.	.	.	.	.	.
<i>Aeschynomene indica</i>	.	.	.	2	.	.	.	.	.	+	+	.
<i>Echinochloa stagnina</i>	.	.	.	.	.	1	.	.	.	.	.	.
<i>Centrostachys aquatica</i>	.	.	.	.	.	.	1	.	.	.	.	.
C of the Echinochloetea colonae												
<i>Echinochloa colona</i>	.	.	.	.	1	1	3	.	3	.	.	.
Indicators of clay and/or vertisols**												
<i>Celosia argentea</i>	1	4	3	1	1	2	+	2	1	1	2	2
<i>Ocimum canum</i>	.	+	.	.	+	.	+	+	+	+	+	.
<i>Merremia emarginata</i>	.	.	.	.	.	.	+	1	1	.	.	1
<i>Corchorus olitorius</i>	.	.	.	.	.	.	1	.	+	.	.	2
<i>Phyllanthus maderaspatensis</i>	.	.	.	.	.	.	.	1	1	1	.	.
<i>Corchorus fascicularis</i>	.	+	.	.	.	.	.	.	+	.	.	.
companions												
<i>Hibiscus trionum</i>	2	2	4	.	1	2	.	2	1	3	2	3
<i>Momordica balsamina</i>	.	.	.	.	.	4	1	3	.	2	.	3
<i>Sida alba</i>	.	.	.	.	+	+	.	+	.	.	+	.
<i>Commelina nigriflora</i>	.	3	.	.	.	.	.	2	2	.	.	.
<i>Aeschynomene americana</i>	1	.	.	.	+	.	.	.	.	.	.	.
<i>Abutilon pannosum</i>	.	.	.	.	.	1	.	.	.	.	.	2
<i>Aeschynomene sensitiva</i>	.	.	.	.	.	1	.	.	.	.	.	2
<i>Euphorbia forsskalii</i>	.	.	.	.	.	.	+	+	.	.	.	.
<i>Calotropis procera</i>	.	.	.	.	.	.	+	.	.	+	.	.
<i>Lagera oloptera</i>	.	.	.	2	.	.	.	.	.	.	.	.
<i>Acroceras amplexans</i>	.	.	.	.	.	.	3	.	.	.	.	.
<i>Acacia seyal</i> (juv.)	.	.	.	.	.	.	2	.	.	.	.	.
<i>Hibiscus panduriformis</i>	.	.	.	.	.	.	1	.	.	.	.	.
<i>Chloris barbata</i>	.	.	.	.	.	.	1	.	.	.	.	.
<i>Sida alba</i>	.	.	.	.	.	.	1	.	.	.	.	.
<i>Merremia hederacea</i>	.	.	.	.	.	.	.	.	3	.	.	.
<i>Phyllanthus amarus</i>	.	.	.	.	.	.	.	.	1	.	.	.
<i>Chlorophytum pusillum</i>	.	.	.	.	.	.	.	.	1	.	.	.
<i>Pennisetum violaceum</i>	.	.	.	.	.	.	.	.	.	.	.	1

Additionally with + in relévé No.1: *Leucas martinicensis*; **in No.2:** *Cucumis melo* var. *agrestis*; **in No.7:** *Citrullus colocynthis*, *Sesbania leptocarpa*, *Indigofera senegalensis*, *Leptadenia hastata*, *Cassia tora*, *Achyranthes sicula*, *Panicum mueense*; **in No.9:** *Eragrostis atrovirens*, *Ipomoea coptica*, *Portulaca oleracea*, *Commelina africana* var. *africana*; **in No.12:** *Ludwigia octovalvis*.

* all species of reed communities and other amphibious habitats

** mentioned by LE BOURGEOIS & MERLIER (1995)

Table / Tableau 2: Sorghetum arundinacei

relévé no.	1	2	3	4	5
Table no. in Ataholo (2002)	58	58	58	57	57
vegetation cover (%)	90	80	85	90	95
height of the vegetation (m)	3	3.5	3	0.4	1.5
relévé area (a)	9	9	9	9	5
Character species					
<i>Sorghum arundinaceum</i>	5	4	3	2	3
Other species					
<i>Hibiscus trionum</i>	1	2	2	1	2
<i>Momordica balsamina</i>	2	2	2	4	1
<i>Celosia argentea</i>	+	+	2	2	.
<i>Echinochloa stagnina</i>	+	1	1	1	.
<i>Abutilon pannosum</i>	+	1	2	+	.
<i>Phyllanthus maderaspatensis</i>	+	+	+	+	.
<i>Cyperus esculentus</i>	2	2	2	2	.
<i>Caperonia palustris</i>	1	2	2	.	1
<i>Sida alba</i>	+	1	+	.	.
<i>Merremia emarginata</i>	.	+	+	3	.
<i>Gynandropsis gynandra</i>	+	+	.	.	.
<i>Euphorbia forsskalii</i>	+	+	.	.	.
<i>Hibiscus scotellii</i>	+	+	.	.	.
<i>Echinochloa colona</i>	.	+	.	.	3
<i>Corchorus olitorius</i>	.	.	+	.	2
<i>Leucas martinicensis</i>	.	.	1	.	.
<i>Ipomoea aquatica</i>	.	.	.	1	.
<i>Aeschynomene sensitiva</i>	.	.	.	1	.
<i>Sorghum bipennatum</i>	.	.	.	.	3
<i>Hibiscus panduriformis</i>	.	.	.	.	2
<i>Bidens pilosa</i>	.	.	.	.	1

Additionally with + in relévé No.1: *Pennisetum violaceum*, *Rhynchosia minima*; **in No.3:** *Cassia obtusifolia*, *Aeschynomene indica*, *Bidens pilosa*; **in No.4:** *Phyllanthus amarus*.

species composition, however, does not substantially vary: eight of the eleven species with a constancy class of III - V in Hygrophileta auriculatae also occur in Sorghetum arundinacei at a constancy class III or greater; and also eight of the eleven species that occur with intermediate to very high constancy in the Sorghetum arundinacei are present in Hygrophileta auriculatae at class III or greater.

As shown above, the Hygrophileta auriculatae clearly belongs to the Echinochloetea colonae. Further investigations are needed to clarify whether the Sorghetum arundinacei also can be assigned to this vegetation class or whether it forms the core of a separate class, i.e., the Caperonietea palustris proposed by ATAHOLO 2002.

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