Termites and Ants in Burkina Faso (West Africa)

- Taxonomic and functional diversity along land-use gradients

- Ecosystem services of termites in the traditional Zaï system

PART II

APPENDICES

Dissertation zur Erlangung des

naturwissenschaftlichen Doktorgrades

der Julius-Maximilians-Universität Würzburg

vorgelegt von

Dorkas Tabitha Kaiser

Würzburg 2014

Eingereicht am:

Mitglieder der Promotionskommission:

Vorsitzender: Prof. Dr. Thomas Dandekar

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Gutachter: Prof. Dr. Souleymane Konaté

Tag des Promotionskolloquiums:

Doktorurkunde ausgehändigt am:

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APPENDIX – CHAPTER 2

AGRONOMIC AND BIOLOGICAL PRACTICES

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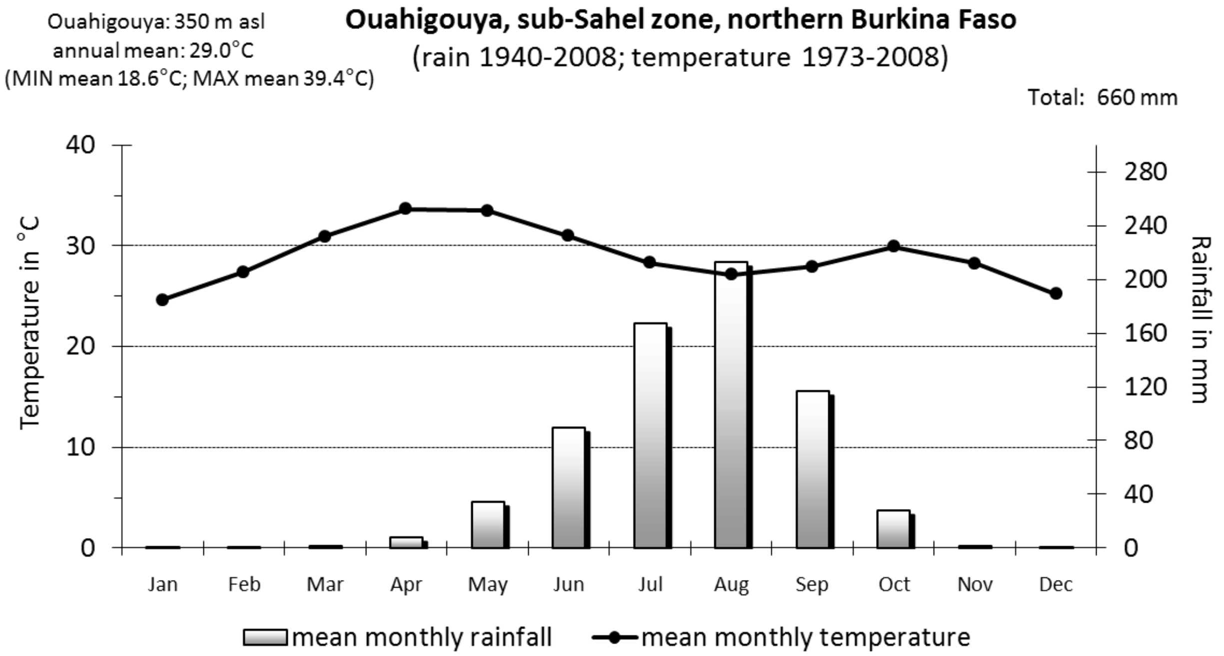
Fig. A2-1: Agronomic and biological practices as e.g. crop rotation, fallowing, weeding, combination of e.g. millet and green beans (nitrogen-fixing) (H), appropriate crop selection, adapted plant spacing (A, G), thinning, mulching with hay or branches (D), stubble grazing (J), household refuse and manure application (K, here: Zaï). Mechanical are practices as e.g. stone lines (C), deep-plough (B), half-moon (E, F), stone- or earth bunds (C, D), living hedges and Zaï (I).

MEAN MONTHLY TEMPERATURE AND RAINFALL IN THE SUB-SAHEL REGION, BURKINA FASO



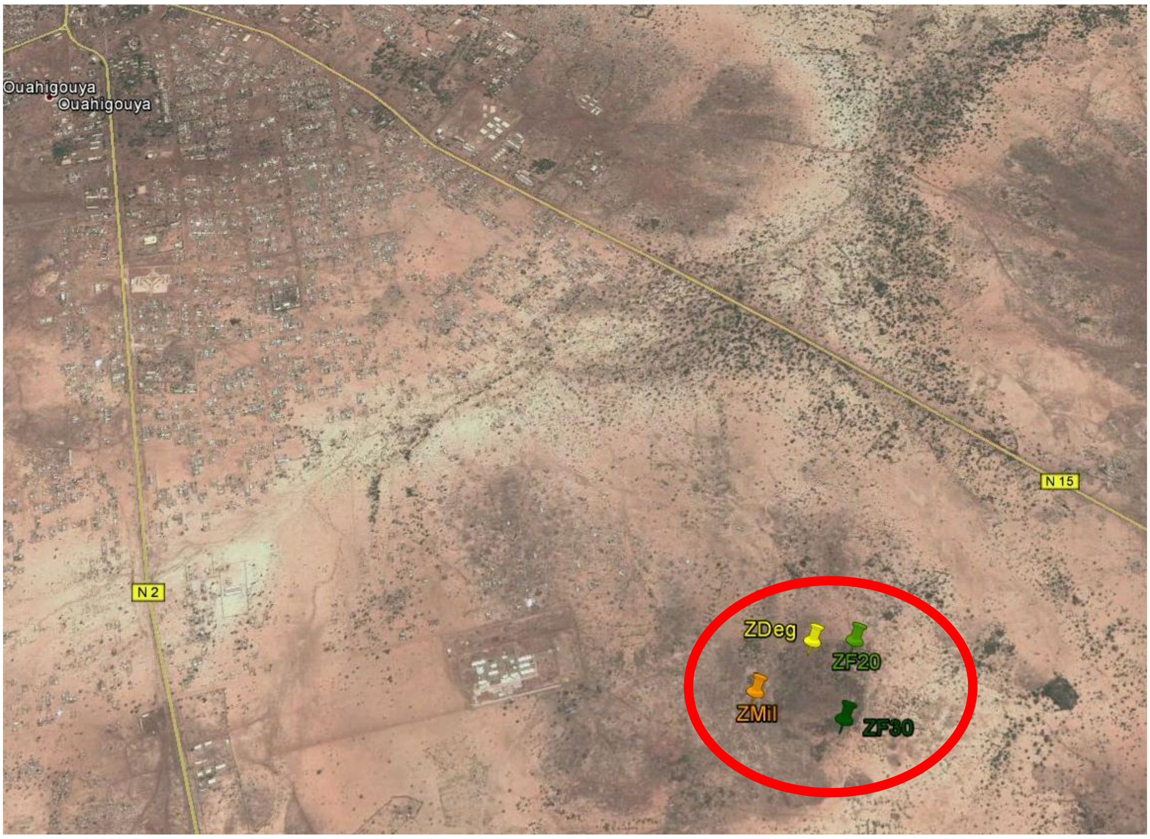
Data sources: Centre for Development Research (ZEF), Bonn, Germany; Direction régionale de l'Agriculture de l´Hydraulique et des Ressources halieutiques, Ouagadougou, Burkina Faso.

1998-2008 (LUI-1)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
mean temp (°C)	24.6	27.4	30.9	33.6	33.5	30.9	28.3	27.2	27.9	29.9	28.2	25.2
mean rainfall (mm)	0	0	2	8	34	89	168	213	117	28	1	0

Fig. A2-2: Mean monthly temperature (°C) and rainfall (mm) in Ouahigouya, Yatenga province (sub-Sahel region, northern Burkina Faso). The temperature means were calculated from data measured between 1973 and 2008 – the precipitation means with data from 1940 to 2008. The data basis used is shown in the table below the figure. The average monthly temperature calculated for this longer period ranged between 18.6°C and 39.4°C, the annual mean was 28.9°C. The mean total annual rainfall summed up to 660 mm.

SOIL-TYPES IDENTIFIED BY THE 'BUREAU NATIONAL DES SOLS' (BURNASOL) IN THE ZAÏ-AREA

A)



B)

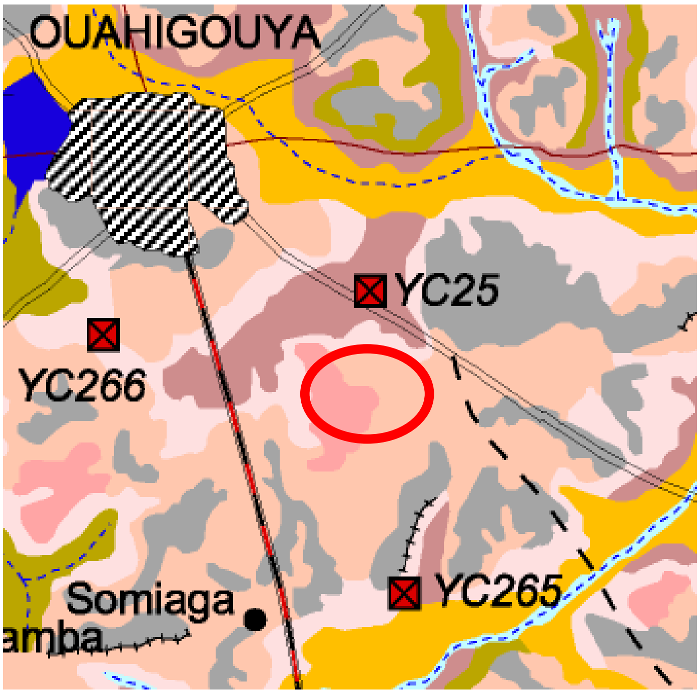


Fig. A2-3: A) Satellite image, screenshot of Google earth, showing Ouahigouya (Yatenga province, Burkina Faso), the Zaï area (red circle) and the study sites (ZDeg: degraded site, ZMil: millet field, ZF20: 20-yrs old Zaï forest, ZF30: 30-yrs old forest).
B) Map-section showing Ouahigouya and the different soil-types identified by the 'Bureau National des Sols' (BURNASOL 2007) in the Zaï area (red circle). Please refer to **Fig. A2-4** for the legend with the sub-groups of the soil-types according to the French classification used by BURNASOL (CPCS 1967).

LEGENDE

GEOMORPHOLOGIE		MATERIAU ORIGINEL LITHOLOGIE	PROCESSUS DE PEDOGENESE	UNITE	SUPERFICIE HA	SUPERFICIE %	SOLS DOMINANTS > 50%		SOLS ASSOCIES 49 - 20 %		SOLS INCLUSIONS < 20 %	
RELIEF RESIDUEL	Buttes et affleurements rocheux	Roches de nature variée: granites, migmatites, granodiorites,schistes.	Embryonnaire et peu caractérisé	1	20429.43	1.66	LR	100	-	-	-	-
	Buttes cuirassées	Cuirasse ferrugineuse issue de roches acides: granites, migmatites, gneiss.	Cuirassement, démantèlement physique et colonisation des fissures par les racines des végétaux	2	96156.60	7.81	LC	89	-	-	FLIS FLIPP	5.5 5.5
	Plateaux cuirassés			3	58202.10	4.73	-	-	FLIS FLIPP FLIMP	41 25 23	LC	11
SURFACE FONCTIONNELLE	Glacis pente supérieure	Materiau de type kaonilitique issu de roches acides variées.	Ferruginisation, lessivage, concrétionnement, induration.	4	387021.53	31.44	FLI	84	-	-	FLC FLTC LC FLM FPLM	8 3 3 2 2
		Matriau montmorillonitique issu de roches basiques variées (schistes, roches vertes)	Brunification, rubéfication, ferruginisation	5	23017.81	1.87	BEF	68	-	-	BEPE BEM PEER PEEL FLI	10 3 13 1 5
		Sols éoliens issus de roches basiques variées (apport ancien)	Dépôt éolien, sédimentaition	6	1190.26	0.10	BSAM	85	-	-	BSAV	15
	Glacis pente moyenne	Matériau de type kaonilitique issu de roche acides variées	Ferruginisation, lessivage, concrétionnement, induration.	7	226812.36	18.42	-	-	FLIPP FLIMP FLIP	29 27 32	FLIS FLC BEF	6 4 2
		Matériau de type kaonilitique issu de roches acides variées	Ferruginisation, lessivage, concrétionnement, hydromorphie, localement peu caractérisé.	8	106986.46	8.69	-	-	FLC FLTC	34 35	FLH FLM PEER PEACM	14 14 2 1
		Sable éolien issu de roches basiques variées (apport ancien)	Dépôt éolien, sédimentaition, hydromorphie localisée	9	16661.29	1.35	-	-	BSAM BSAV BSAG	38 24 29	FLM	9
		Matériau issu de roches basiques variées	Brunification, rubéfication, ferruginisation , induration localisée	10	12945.80	1.05	BEF	83	-	-	BEHV PEER FLI	11 3 3
		Matériau de type kaonilitique issu de roches acides variées	Ferruginisation, lessivage, concrétionnement, hydromorphie localisée.	11	190661.10	15.50	-	-	FLTC FLH	30 34	FLI FLM HPGS PEAAH PEAAM	19 8 4 3 2

The respective sub-groups of the French soil-type classification of 1967 (CPCS 1967)

LC	Lithosols sur cuirasse
FLI	Sols ferrugineux tropicaux lessivés indurés
FLIS	Sols ferrugineux tropicaux lessivés indurés superficiels
FLIPP	Sols ferrugineux tropicaux lessivés indurés peu profonds
FLIMP	Sols ferrugineux tropicaux lessivés indurés moyennement profonds
FLIP	Sols ferrugineux tropicaux lessivés indurés profonds
FPLM	Sols ferrugineux tropicaux peu lessivés modaux
FLC	Sols ferrugineux tropicaux lessivés à concrétions
FLTC	Sols ferrugineux tropicaux lessivés à taches et concrétions
FLH	Sols ferrugineux tropicaux lessivés hydromorphes
FLM	Sols ferrugineux tropicaux lessivés modaux
PEER	Sols peu évolués d'érosion régosiliques
PEAAM	Sols peu évolués d'apport alluvial modaux

Fig. A2-4: Legend of the map resulting from an extensive pedological survey conducted in the Province Yatenga (BURNASOL 2007) indicating the different soil-types identified according to the French classification (CPCS 1967). The red squares are highlighting the four soil-types identified in the area of the Zaï-system in Ouahigouya (Yatenga province, northern Burkina Faso). A satellite image and the map-section of the Zaï area are shown in Fig. A2-3A and Fig. A2-3B.

<u>DIFFERENT STAGES OF THE OPTIMIZED AGRICULTURAL ZAÏ-TECHNIQUE</u>

A

B

C

D

E

F

G

H

I

Zaï literature (some examples):

(Bayen 2010; David 2003; Drechsel et al. 2005; Fatondji 2002; Fatondji et al. 2001; Kaboré & Reij 2004; Laguemvare 2003; Maatman et al. 1998; Marchal 1983; Reij et al. 2005; Roose 1988; Roose 1989a, b, 1994, 2000; Roose & Barthes 2001; Roose et al. 1993, 1999; Roose et al. 1994; Rouland et al. 2003; Sawadogo et al. 2008; Shiferaw et al. 2009; Sidibé 2005; Siegle 2009; Slingerland & Sork 2000; Somé et al. 2004; Sterk & Haigis 1998; Trouillier 2003; Vohland & Barry 2009; Zougmore et al. 2003)

Fig. A2-5: Photos of the different stages of the agricultural Zaï technique. A) Close-up of a degraded, barren soil representing the initial habitat stage; B) first Zaï holes chopped in the degraded soil (during the dry season); C) degraded soil prepared with the Zaï technique – here with dead branches placed over the holes to catch organic material (e.g. leaves) transported with the wind during the dry season – as in the Zaï hole shown in D); E) women preparing the house-field for the next rainy season (by means of a 'dappa', the traditional hand-hoe; F) field with young millet plants and a stone line to hold back the water during rainfalls; G) close-up of a Zaï hole with millet, green beans and compost recently applied; I) millet field (green); H) Yacouba Sawadogo passing by a millet field, ready to harvest Zaï; I) close-up of a millet-stump after the harvest and sheetings constructed by termites over the dry leaves left lying on the soil-surface.

Habitat photos of the first land-use intensification gradient (LUI-1), comprising four Zaï stages in Ouahigouya (Yatenga province, sub-Sahel region, Burkina Faso);

A

B

C

Fig. A2-6: A) and B) Degraded, barren area of reddish, infertile soil (ZDeg) with about 70% gravel in the soil samples; representing the initial stage of all sites belonging to the 1st disturbance gradient (LUI-1). Crusted and impermeable soil surface – almost devoid of any vegetation. C) Close-up of the soil surface.

D

E

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Fig. A2-7: Fields of millet (*Pennisetum glaucum*) (ZMil) combined with nitrogen-fixing green beans and cultivated with the Zaï-technique; in 2009 about 10–11 years old. During the last decade, the small-scale farmer Y. Sawadogo started to cultivate his fields longer than he did before: at the time of sampling, the fields were in the 5^{th}, 7^{th} and 8^{th} cultivation year. In D), E), F) and G) shown in different growth-stages; F) after the harvest at the end of the rainy season.

I

J

K

L

M

Fig. A2-8: 20-years old Zaï forest (ZF20), also referred to as 'young Zaï forest' (forestry Zaï). The area was first cultivated for 4 years, and laid fallow ever since. During the dry season, grazing was allowed to the farmers own cattle. I), J), K) and L) different areas of the young forest with rich herbaceous and woody vegetation, however still with degraded spots; M) habitat during the dry season.

N

O

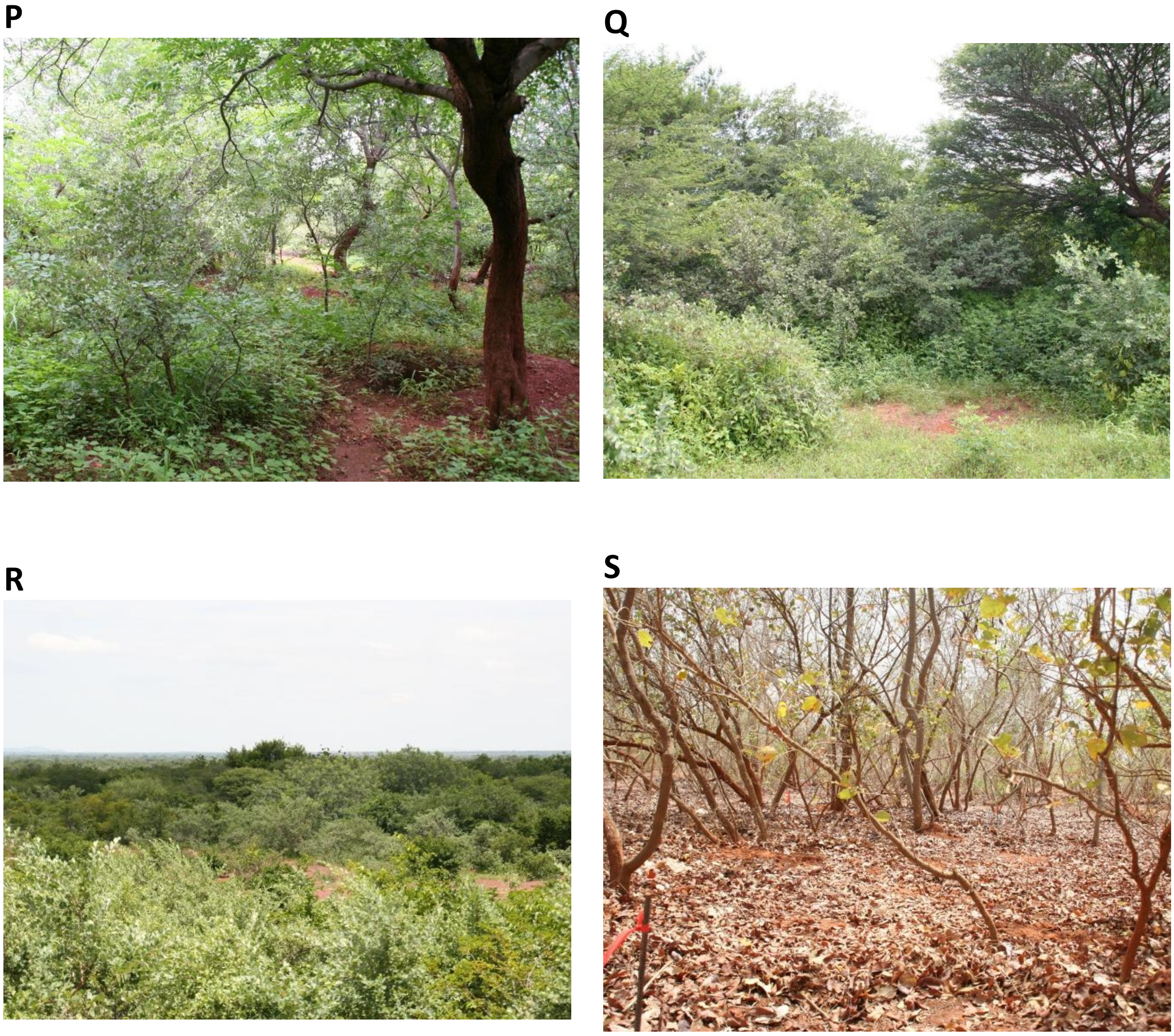


Fig. A2-9: 30-years old Zaï forest (ZF30), also referred to as 'old Zaï forest' (forestry Zaï). The area was first cultivated for 4 years, and laid fallow ever since (26 years). During the last 10 years, grazing and wood collection was not allowed, before as in ZF20 (only during the dry season). P) and Q) old forest with a diverse herbaceous and woody vegetation, stone lines present to hold back the rainfall; R) overview over the Zaï forest from a small hill; S) habitat at the end of the rainy season / start of the dry season.

RELATIVE LOCATION OF THE FOUR SUCCESSION STAGES STUDIED IN THE ZAÏ SYSTEM (LUI-1)

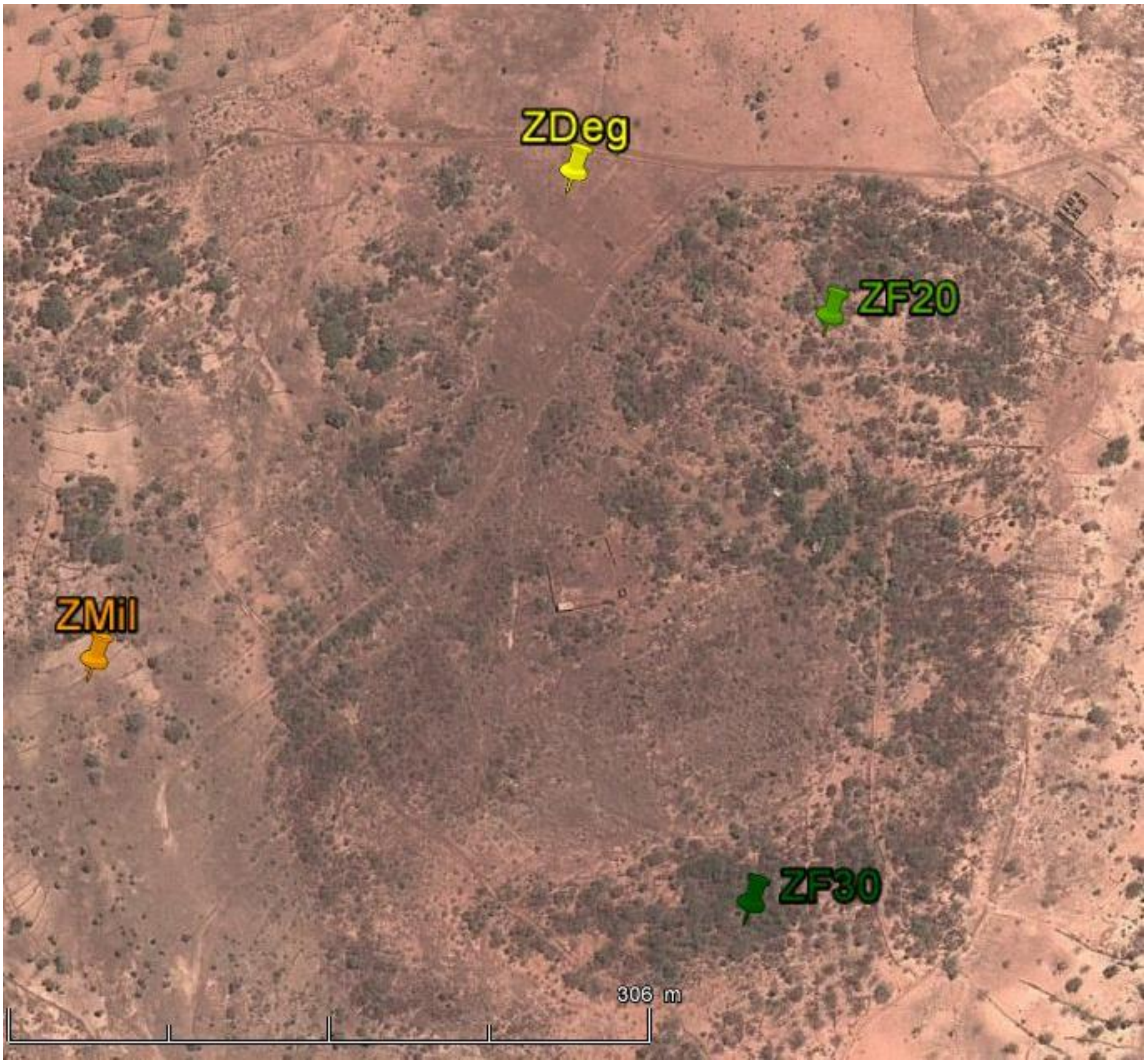
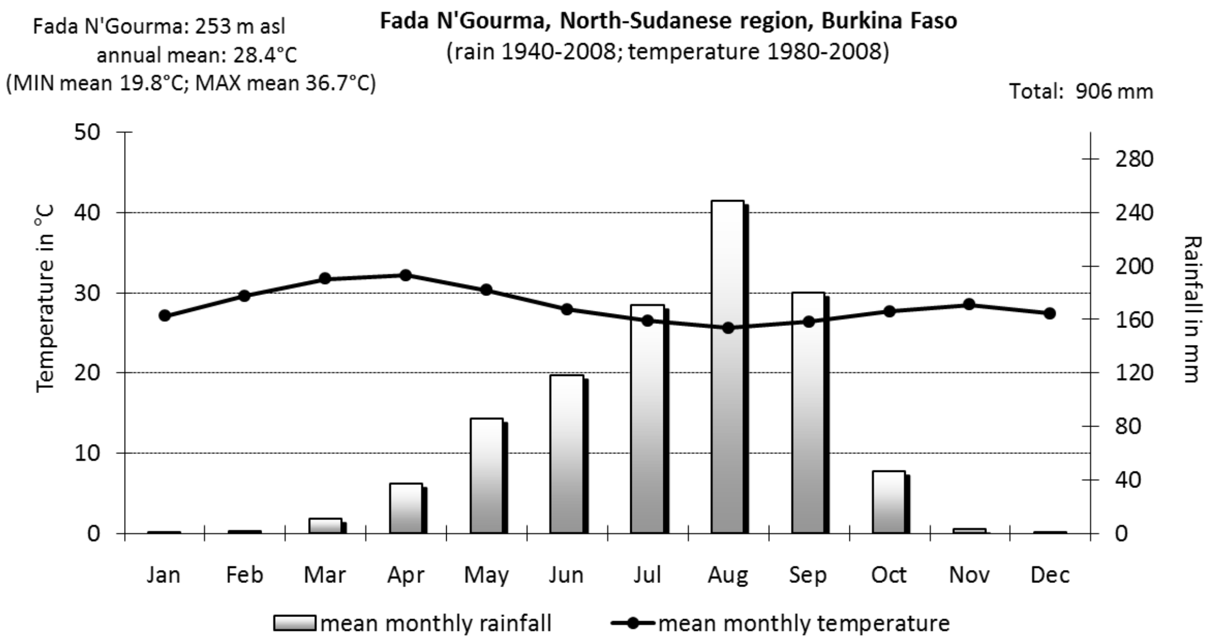


Fig. A2-10: Satellite image (screenshot made in Google earth) showing the type and the relative position of the four succession stages studied in the Zaï-system in Ouahigouya (Yatenga province, sub-Sahel region, northern Burkina Faso). The colors of the sites are yellow: ZDeg, degraded site; orange: ZMil, millet field cultivated with the Zaï-method; light green: ZF20, 20-yrs old Zaï-forest; dark green: ZF30, 30-yrs old Zaï-forest.

MEAN MONTHLY TEMPERATURE AND RAINFALL IN THE NORTH-SUDAN ZONE, BURKINA FASO



Data sources: BIOTA West climatology group (2005-2008); Centre for Development Research (ZEF), Bonn, Germany; Direction régionale de l'Agriculture de l´Hydraulique et des Ressources halieutiques, Ouagadougou, Burkina Faso.

1940/1980-2008 (LUI-2)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
mean temp (°C)	26.9	28.9	31.9	32.4	30.4	28.2	26.5	25.8	26.4	27.8	27.8	27.1
mean rainfall (mm)	0	1	3	28	78	123	180	235	194	33	0	0

Fig. A2-11: Mean monthly temperature (°C) and rainfall (mm) in Fada N'Gourma and PK52, Gourma province (North-Sudan region, south-eastern Burkina Faso). The temperature means were calculated from data measured between 1980 and 2008 – the precipitation means with data from 1940 to 2008. The data basis used is shown in the table below the figure. The average monthly temperature ranged between 19.8°C and 36.7°C, the annual mean was 28.4°C. The mean total annual rainfall summed up to 906 mm.

HABITAT PHOTOS OF THE SECOND LAND-USE INTENSIFICATION GRADIENT (LUI-2), COMPRISING FOUR HABITATS LOCATED 54 KM SOUTH OF FADA N'GOURMA (GOURMA PROVINCE, NORTH-SUDAN REGION, SOUTH-EASTERN BURKINA FASO)

A

B

C

Fig. A2-12: Protected near-natural arboreous and shrubby savanna in the Pama reserve (FRes), representing the initial stage of all sites belonging to this disturbance gradient (LUI-2). Dense grass sods, bushes and 8–9 m high trees with open canopy (assemblages of *Combretum* spp., *Anogeisus leiocarpus*, *Vitellaria paradoxa*). A) and B) habitat during the rainy season, the latter taken in 2007 during the vegetation assessment; C) nest-surface of the fungus-growing termite genus *Odontotermes*.

D

E

F

Fig. A2-13: Pasture land (FPas) of the community, exclusively used for grazing cattle since about 20 years (in 2009), comprised few areas with thin but closed canopy of up to 9 m in height, others with grass and some bushes (as in E) and those with bushes and open canopy but more than just a few isolated trees (as in D). F) Pasture land during the dry season.

G

H

I

Fig. A2-14: Fallowed field (FFal), in 2009 about 19 years since the first cultivation year. At the time of sampling, the field was in the 2nd year fallow (2004), and in the 4th and last year fallow (2006). Before fallowing, crop rotation was practiced every 3rd year (crop-sequence see Chapter 2.1.2). All trees which were growing within the area had been felled, only smaller bushes of fallow-typical species *Pyliostigma thonningii* and *Acacia gourmaensis* were left by the farmer. Most areas had dense grass cover.

J

K

L

Fig. A2-15: Cotton fields (FCot), about 300–400 m apart; at the time of sampling both in the 2nd year of cotton cultivation. In 2009, both fields were about 13 years old. Most disturbed habitat of LUI-2 although crop-rotation was practiced every 3rd year (crop-sequence see Chapter 2.1.2). Seven different insecticides and fungicides were applied (9.31 kg ha^{-1} yr^{-1}) during the years of cotton cultivation. One 4.5 m high *V. paradox*a tree was left at the margin of the first cotton field (see L). J) Field before harvest; K) and L) after the harvest end of the rainy season.

RELATIVE LOCATION OF THE FOUR LAND-USE TYPES STUDIED NEAR FADA N'GOURMA (LUI-2)

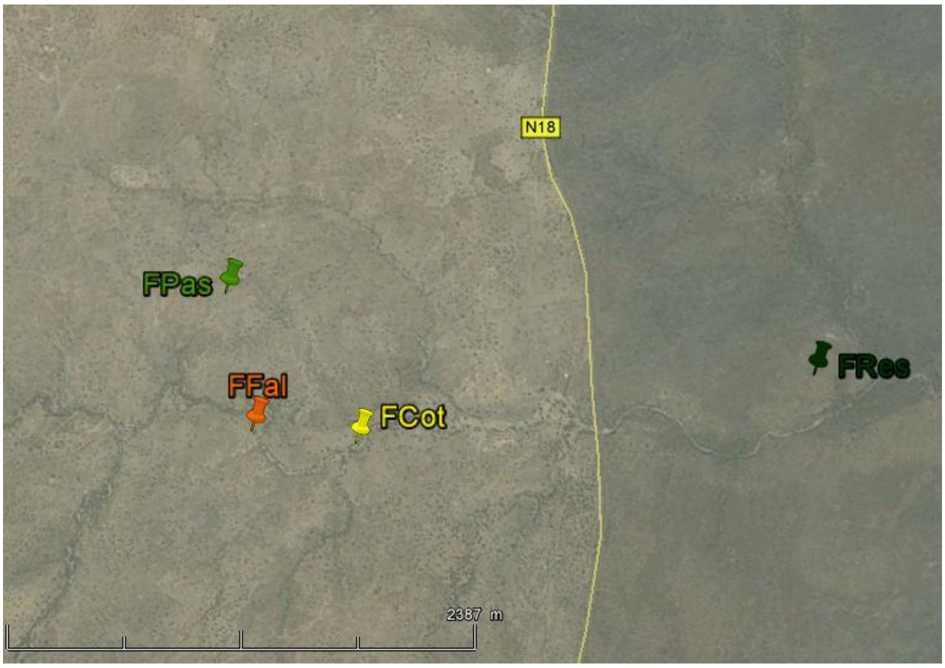


Fig. A2-16: Satellite image (screenshot made in Google earth) showing the relative location of the four habitats studied 54 km south of Fada N'Gourma (Gourma province, North-Sudan region, south-eastern Burkina Faso). The colors of the sites are yellow: FCot, cotton field; orange: FFal, field left fallow for 4 years (in total); light green: FPas, pasture land; dark green: FRes, near-natural savanna in the Pama reserve. Unfortunately, the resolution of the region turned bad only 20 km above – into the direction of Fada N'Gourma.

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APPENDIX – CHAPTER 3

SAMPLING TERMITES ACCORDING TO THE RAP-PROTOCOL

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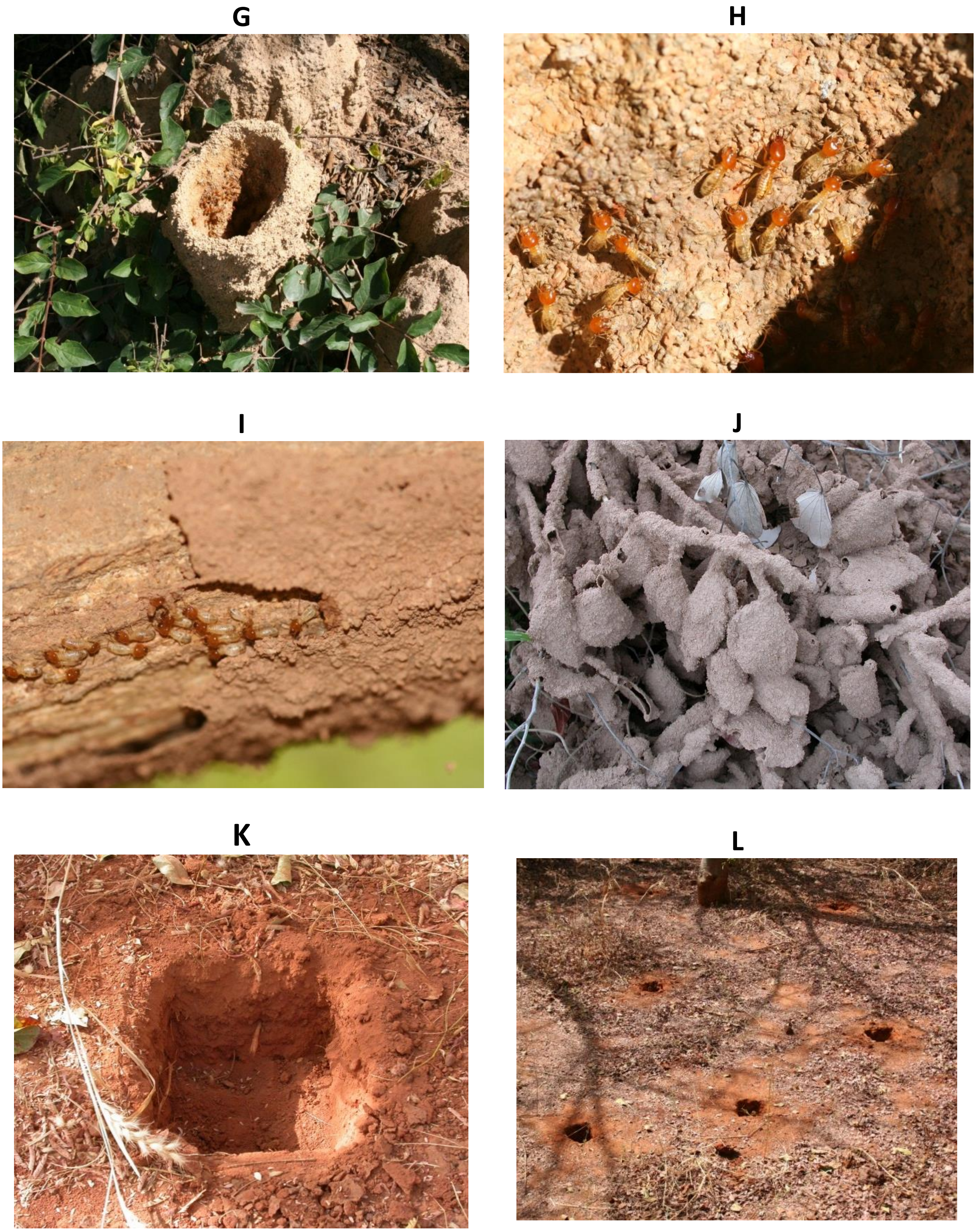

Fig. A3-1: Sampling termites within transect-sections following the standardized and rapid assessment protocol (RAP). A) – J) Some examples for microhabitats; K) one soil-scrape, L) soil-scrapes randomly distributed over a transect-section – here: only five of eight soil scrapes visible.

ADDITIONAL SAMPLING METHODS FOR TERMITES: BAITING


A


B


C

D



E


F

G

H

Fig. A3-2: Baiting: additional sampling methods for termites. A) Toilet paper roll placed on the soil-surface and fixed by means of an iron bar and B) another roll, offered below the surface – both covered with sheetings of *Odontotermes* sp. C) Soft wood block in the degraded barren land (LUI-1), offered mainly below the soil surface – the small part visible above the is covered with soil-sheetings of *Odontotermes* sp.; D) Soft wood block placed on the soil-surface in the degraded site, completely eaten by termites; E) wooden block offered below the surface (as in C), however no sheetings visible from above; F) and G) show the block-part that was attacked by termites – only visible after excavating it; the latter with fungus-growers of the genus *Microtermes* or *Ancistrotermes*. H) Monolith dug up to a depth of 30 cm before separating it into the horizons 0–10 cm, 11–20 cm and 21–30 cm. The method was dropped after the first year.

SAMPLING ANTS ACCORDING TO THE RAP-PROTOCOL

A

B

C

D

E

F

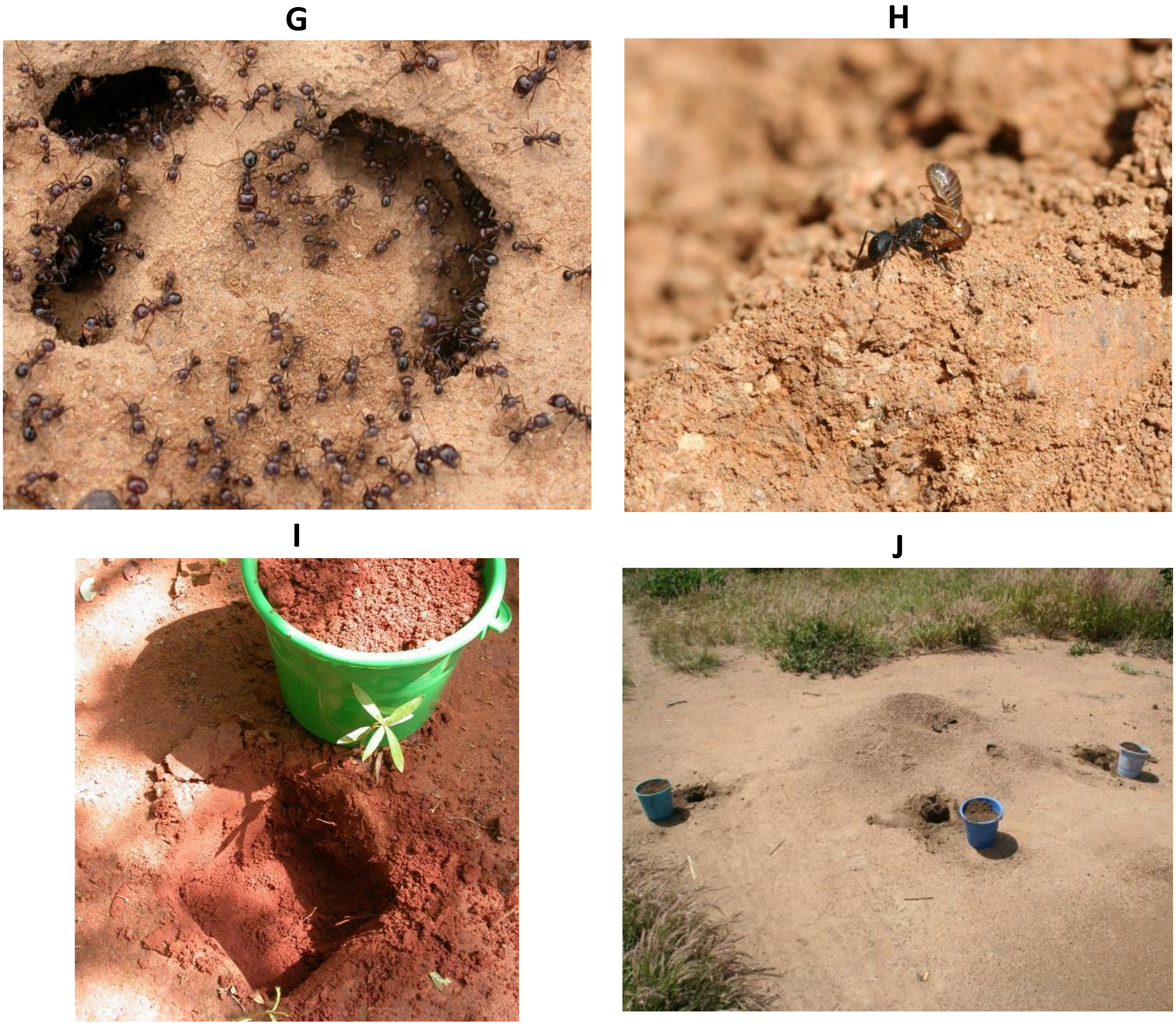

Fig. A3-3: Sampling ants following the standardized and rapid assessment protocol (RAP). One sampling-station for ants comprised two parts: a pitfall trap (see A and B) and 1 m apart a Winkler quadrate (1 m^2). The original Winkler method (see C, D and E), described for forest habitats where litter covers the soil surface, was applied in all land-use types for one year. Since comparable litter layers were virtually missing in the land-use types studied in Burkina Faso, a modified version was applied henceforth: in an area of 1 m^2 (so-called 'Winkler site or 'Winkler quadrate'), the vegetation was at first searched for ants and thereupon totally removed and all ants were collected for the duration of 5 minutes. According to our new combined protocol, ants were additionally collected whenever encountered within the termite transect sections. Microhabitats and soil scrapes thereby increase the standard methods used to collect ants. Examples of microhabitats: F) and G) nest-entrance of the granivorous ant species *Messor galla*; H) *Camponotus*-worker carrying a *Macrotermes*-worker after opening the termite mound. I), J) Soil-scrapes (12 x 12 cm, 15 cm deep).

ADDITIONAL SAMPLING METHODS FOR ANTS: BAITING

A

B

C

D

E

F

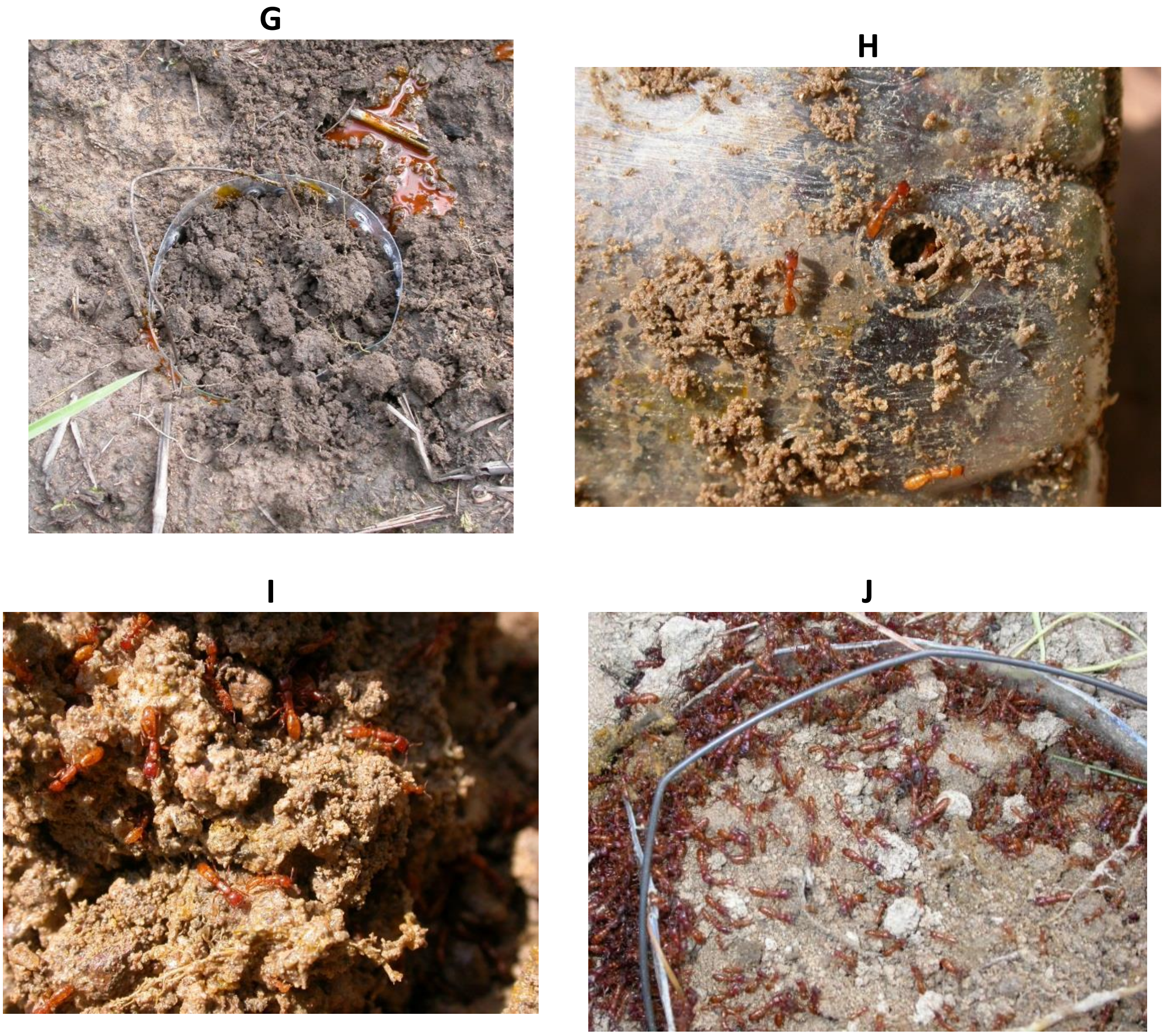

Fig. A3-4: Additional sampling methods for ants: baiting. Four bait types following two protocols were used to attract ants actively. 1) *Cookies, tuna and sugar water*. Crumbs of cookies, tuna and sugar water, each replicated 10 times, were placed on plastic bags or plastic plates and alternately distributed across the habitat. The distance between the 30 baits was about 5–10 m, depending on the size of the study site. Two hours, mostly additionally four hours after placement, all baits were checked for ants. 2) *Sieve buckets*. To attract subterranean army ants (sub-family Dorylinae), palm oil was mixed with soil and filled in the lower halves of 1 ½ liter plastic water bottles (Laafi). A soldering iron was used to perforate all sides (see E). These 'sieve buckets' (Berghoff et al. 2003) were then burrowed below the soil surface so that its upper border was on a level with the soil surface. They were checked regularly for the duration of 14 days. A handle made from wire were used to lift the sieve buckets out of the soil.

SPECIES RICHNESS ESTIMATORS (INCIDENCE-BASED)

All formulae are from Colwell and Coddington (1994), where more details are given for the different estimators. They were computed in the software program EstimateS.

Definition of variables used in the following formulas:

S_{est}	Estimated species richness, where *est* is replaced in the formula by the name of the estimator
S_{obs}	Total number of species observed in all samples pooled
$S_{inf\,r}$	Number of infrequent species (each found in 10 or fewer samples)
S_{freq}	Number of frequent species (each found in more than 10 samples)
m	Total number of samples
$m_{inf\,r}$	Number of samples that have at least one infrequent species
Q_j	Number of species that occur in exactly *j* samples (Q_1 is the frequency of uniques, Q_2 the frequency of duplicates)
γ^2_{ice}	Estimated coefficient of variation of the Q_i for infrequent species
p_k	Proportion of samples that contain species *k*
$N_{inf\,r}$	Total number of incidences (occurrences) of infrequent species
C_{ice}	Sample incidence coverage estimator

Jackknife 1: First-order jackknife estimator of species richness (short: Jack1) (Burnham & Overton 1978, 1979; Heltshe & Forrester 1983).

$$S_{jack1} = S_{obs} + Q_1\left(\frac{m-1}{m}\right)$$

Bootstrap: Bootstrap estimator of species richness (short: Boot) (Smith & van Belle 1984).

$$S_{boot} = S_{obs} + \sum_{k=1}^{S_{obs}} (1-p_k)^m$$

Michaelis-Menten Mean: Michaelis-Menten Mean estimator of species richness (short: MMM) (Raaijmakers 1987).

The asymptotic behavior of the accumulation curve modeled as hyperbola, where S_{max} and B are fitted constants:

$$S(n) = \frac{S_{max}\, n}{B + n}$$

This is the Michaelis-Menten equation used in enzyme kinetics and thus there is an extensive literature discussing the estimation of its parameters, which unfortunately presents considerable statistical difficulties. The approach favored by (Raaijmakers 1987) is to calculate S_{max} and B using their maximum likelihood estimators. This approach is applied in EstimateS Version 7.5 (Colwell 2005).

ICE: Incidence-based Coverage Estimator of species richness (short: ICE) (Lee & Chao 1994).

First note that:

$$S_{obs} = S_{inf\,r} + S_{freq}$$

The sample coverage estimate based on incidence data is:

$$C_{ice} = 1 - \frac{Q_1}{N_{inf\,r}}$$

Where:

$$N_{inf\,r} = \sum_{j=1}^{10} jQ_j$$

Thus, the sample coverage estimate is the proportion of all individuals in infrequent species that are not uniques.

Then the ICE estimator of species richness is:

$$S_{ice} = S_{freq} + \frac{S_{inf\,r}}{C_{ice}} + \frac{Q_1}{C_{ice}}\gamma_{ice}^2$$

Where the estimate the coefficient of variation estimates the coefficient of variation of the Q_j's, is:

$$\gamma_{ice}^2 = \max\left[\frac{S_{inf\,r}}{C_{ice}} \frac{m_{inf\,r}}{(m_{inf\,r-1})} \frac{\sum_{j=1}^{10} j(j-1)Q_j}{(N_{inf\,r})^2} - 1, 0\right].$$

The formula for ICE is undefined when all Infrequent species are Uniques ($Q_1 = N_{inf\,r}$, yielding $C = 0$). In this case, EstimateS computes the bias-corrected form of Chao2 instead (on Anne Chao's advice).

MEASURES TO JUDGE THE PERFORMANCE OF SPECIES RICHNESS ESTIMATORS

The following formulas were taken from Palmer (1990)

Mean deviation (MD) is a measure of bias.

MD is calculated as follows:

$$\mathrm{MD} = \sum_{j=1}^{P} (E_j - O_j)/P,$$

where E_j is the estimated SR of Zaï stage j,

and O is the true SR of Zaï stage j,

and P is the number of RAP-transects.

MD will be positive if the estimator overestimates and negative if it underestimates. The magnitude of MD measures the poorness of fit.

The mean square deviation (MSD) measures the estimator's closeness to the true species richness SR. MSD is calculated as follows:

$$\mathrm{MSD} = \sum_{j=1}^{P} (E_j - O_j)^2/P.$$

Estimators with small MSDs are more precise than those with large MSDS. An estimate with a high MSD may nevertheless have a MD close to zero. Such an estimator is accurate but not precise.

Both MD and MSD measure the absolute deviation of estimated SR from actual SR.

The mean square proportional deviation (MSPD) measures the relative deviation; MSPD is calculated as follows:

$$\mathrm{MSPD} = \sum_{j=1}^{P} [(E_j - O_j)/O_j]^2/P.$$

Pearson's correlation coefficient (r^2) between estimators and true values measures the adequacy of estimators for comparison purposes.

If the Pearson's correlation coefficient r^2 is close to one, the estimator can be used to compare true species richness SR of different areas. The comparison would be valid even with a biased estimator. Conversely, an unbiased estimator would be inappropriate for comparing two sites if it was weakly correlated with true SOBs.

A high correlation does not imply that a one-unit difference in the estimator means a one-unit difference in true species richness SR: it implies that areas with high estimators will generally have more species than areas with low estimators.

ALPHA-DIVERSITY INDICES

Two standard indices of species diversity used to express the α-diversity of termite and ant communities (see General Methods). They were computed by EstimateS and combine information on the species' richness and relative abundance in different ways (calculations followed the description in Magurran (2004).

Shannon diversity: Shannon-Wiener (also known as Weaver) diversity index.

$$H = -\sum_{i=1}^{s} p_i \ln p_i \text{ or, preferably, } e^H$$

Where p_i = the proportion of the i^{th} species (between 0 and 1) and S = the number of species.

Simpson diversity: Diversity index to describe the probability that a second individual drawn from a population should be of the same species as the first.

$$D = 1 - \sum_{i=1}^{s} p_i^2 \text{ or, preferably, } D' = \left(\sum_{i=1}^{s} p_i^2 \right)^{-1}.$$

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APPENDIX – CHAPTER 4

SOIL TEXTURAL TRIANGLE

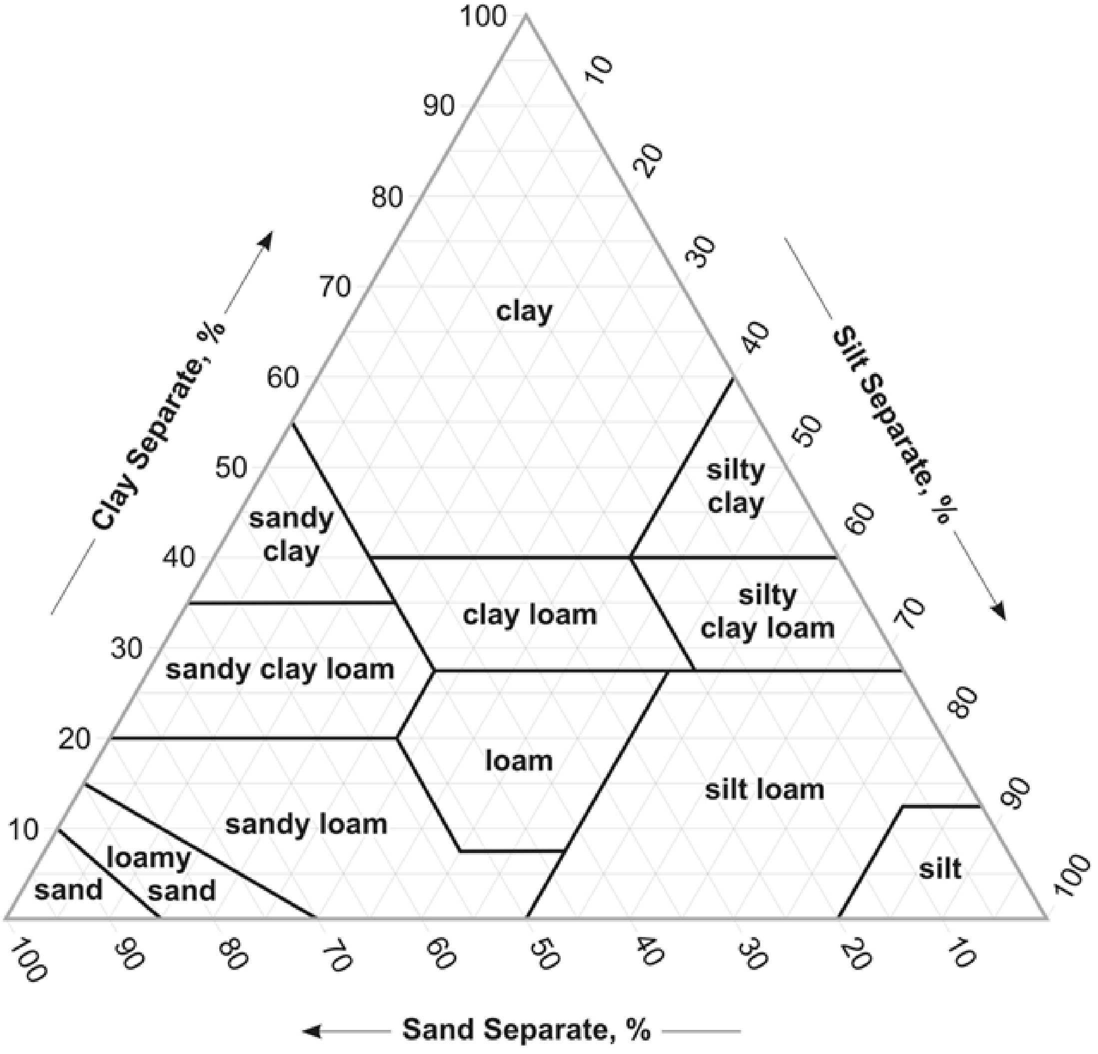

Fig. A4-1: Soil textural triangle used to obtain the soil type with the totals of the main grain size fractions sand, silt and clay (in %) mechanically determined for a soil sample.

CLIMATIC STATION INSTALLED IN THE DEGRADED LAND, THE INITIAL ZAÏ STAGE

Fig. A4-2: In 2005, a small tipping-bucket rain gauge (1) and a temperature sensor (2) were installed in the degraded site of the Zaï system (sub-Sahel region, Burkina Faso). In 2007, a climatic station (3a) with solar panel (3b) was installed by the climatology group of BIOTA West Africa.

Table A4-1: Species name, family and order corresponding to the abbreviations used in Table A4-3 and Table A4-5 for woody plant species assessed in each land-use type of the sub-Sahel and the North-Sudan zone in Burkina Faso. The vegetation was assessed once during the rainy season in an area of 900 m^2 (2006 North-Sudan; 2007 sub-Sahel).

Short	Species name	Family	Order
A.dd.	*Acacia dudgeonii*	Fabaceae - Mimosoideae	Fabales
A.go.	*Acacia gourmaensis*	Fabaceae - Mimosoideae	Fabales
A.h.	*Acacia hockii*	Fabaceae - Mimosoideae	Fabales
A.m.	*Acacia macrostachya*	Fabaceae - Mimosoideae	Fabales
A.n.	*Acacia nilotica*	Fabaceae - Mimosoideae	Fabales
A.p.	*Acacia polyacantha*	Fabaceae - Mimosoideae	Fabales
A.sn.	*Acacia senegal*	Fabaceae - Mimosoideae	Fabales
A.sy.	*Acacia seyal*	Fabaceae - Mimosoideae	Fabales
A.sb.	*Acacia sieberiana*	Fabaceae - Mimosoideae	Fabales
A.d.	*Adansonia digitata*	Bombacaceae	Malvales
A.l.	*Anogeissus leiocarpus*	Combretaceae	Myrtales
A.i.	*Azadirachta indica*	Meliaceae	Sapindales
B.m.	*Baissea multiflora*[1)]	Apocynaceae	Gentianales
B.ae.	*Balanites aegyptiaca*	Zygophyllaceae	unassigned
B.r.	*Bauhinia rufescens*	Fabaceae - Caesalpinioideae	Fabales
B.an.	*Boscia angustifolia*	Capparidaceae	Brassicales
B.s.	*Bridelia scleroneura*	Euphorbiaceae	Malpighiales
C.s.	*Cassia sieberiana*	Fabaceae - Caesalpinioideae	Fabales
C.a.	*Combretum aculeatum*	Combretaceae	Myrtales
C.c.	*Combretum collinum*	Combretaceae	Myrtales
C.gl.	*Combretum glutinosum*	Combretaceae	Myrtales
C.m.	*Combretum micranthum*	Combretaceae	Myrtales
C.n.	*Combretum nigricans*	Combretaceae	Myrtales
C.f.	*Crossopteryx febrifuga*	Rubiaceae	Gentianales
D.c.	*Dichrostachys cinerea*	Fabaceae - Mimosoideae	Fabales
Di.m.	*Diospyros mespiliformis*	Ebenaceae	Ericales
F.ap.	*Feretia apodanthera*	Rubiaceae	Gentianales
G.e.	*Gardenia erubescens*	Rubiaceae	Gentianales
G.t.	*Gardenia ternifolia*	Rubiaceae	Gentianales
G.b.	*Grewia bicolor*	Tiliaceae	Malvales
G.m.	*Grewia mollis*	Tiliaceae	Malvales
G.s.	*Guiera senegalensis*	Combretaceae	Myrtales
J.c.	*Jatropha curcas*	Euphorbiaceae	Malpighiales
J.g.	*Jatropha gossypiifolia*	Euphorbiaceae	Malpighiales

Short	Species name	Family	Order
L.a.	*Lannea acida*	Anacardiaceae	Sapindales
L.m.	*Lannea microcarpa*	Anacardiaceae	Sapindales
M.s.	*Maytenus senegalensis*	Celastraceae	unassigned
P.r.	*Piliostigma reticulatum*	Fabaceae - Caesalpinioideae	Fabales
P.t.	*Piliostigma thonningii*	Fabaceae - Caesalpinioideae	Fabales
P.l.	*Pterocarpus lucens*	Fabaceae - Papilionoideae	Fabales
S.b.	*Sclerocarya birrea*	Anacardiaceae	Sapindales
S.i.	*Sclerocarya indica*	Anacardiaceae	Sapindales
S.k.	*Stereospermum kunthianum*	Bignoniaceae	Lamiales
T.i.	*Tamarindus indica*	Fabaceae - Caesalpinioideae	Fabales
T.a.	*Terminalia avicennioides*	Combretaceae	Myrtales
V.p.	*Vitellaria paradoxa*	Sapotaceae	Ericales
Z.ma.	*Ziziphus mauritiana*	Rhamnaceae	Rosales
Z.mu.	*Ziziphus mucronata*	Rhamnaceae	Rosales

[1)] Life form: Liana = species that germinates on the ground and maintains soil contact while using another plant for support. All other species are Phanerophytes = woody or herbaceous perennial species (≥ 51 cm height), whose shoots do not die back (in other words: trees and large shrubs).

RESULTS FOR THE STUDY SITES IN THE SUB-SAHEL REGION (LUI-1)

MEAN GRAVEL AND MEAN SOIL WATER CONTENT ALONG PROFILES DUG IN THE ZAÏ STAGES

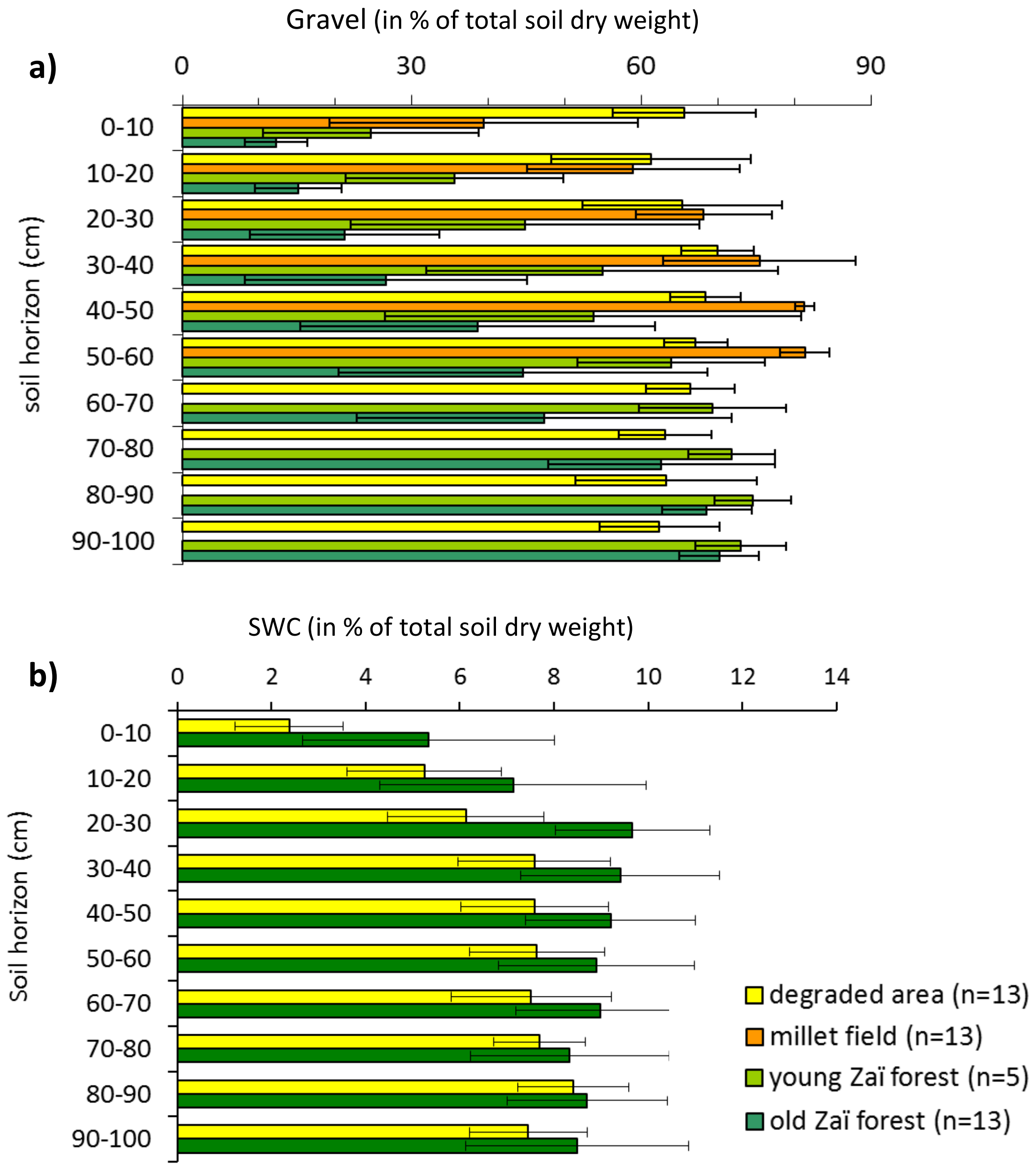

Fig. A4-3: For each Zaï stage and each horizon along the soil profile, **a)** the mean gravel content (grain-size ≥ 2 mm) is shown; **b)** the mean soil water content (%) is shown for the degraded site and the old forest. The means were calculated from the replicate profiles dug in each habitat (*n* = 5 in the young forest, *n* = 13 in the other three sites) and are given as percentage of the total soil dry weight. The standard deviations are indicated by the horizontal bars.

ADDITIONAL TOPSOIL PARAMETERS ANALYZED FOR SAMPLES OF THE FOUR ZAÏ STAGES

Table A4-2: Plant available nutrients, cations and cation exchange capacity of the upper soil horizon (0–10 cm) in the succession stages of the Zaï system in Ouahigouya (sub-Sahel zone, Burkina Faso). For each parameter, first the median ± standard deviation, then minimum / maximum values are given.

	Characteristics of the habitats' topsoil (0–10 cm)			
Study sites of the sub-Sahel zone	Degraded area ZDeg	Millet field ZMil	Young forest ZF20	Old forest ZF30
N	15	8	15	10
P_CAL *	1.0 ± 0.9 0.17 / 3.2	0.58 ± 2.1 0.34 / 4.94	0.42 ± 1.03 0.17 / 3.0	0.36 ± 1.3 0.25 / 3.7
K_CAL *	7.0 ± 21.0 5.0 / 66.8	16.6 ± 60.6 11.0 / 152.9	8.2 ± 29.4 5.5 / 98.9	15.5 ± 55.4 6.5 / 166.5
Na^+ ($mmol_c\ kg^{-1}$)	0.12 ± 0.22 0 / 0.92	0.34 ± 0.13 0.22 / 0.60	0.22 ± 0.29 0.01 / 0.87	0.30 ± 0.18 0.05 / 0.54
K^+ ($mmol_c\ kg^{-1}$)	2.07 ± 0.92 1.23 / 4.42	2.84 ± 0.72 1.47 / 3.93	2.05 ± 5.75 0 / 23.90	3.23 ± 1.63 1.44 / 7.03
Mg^{2+} ($mmol_c\ kg^{-1}$)	3.71 ± 3.70 1.15 / 16.51	10.45 ± 1.74 8.26 / 12.90	6.38 ± 8.64 3.20 / 38.10	8.52 ± 2.10 3.61 / 10.84
Ca^{2+} ($mmol_c\ kg^{-1}$)	14.65 ± 9.11 7.10 / 43.61	31.22 ± 3.93 28.07 / 40.53	18.36 ± 25.98 7.94 / 109.0	17.77 ± 7.32 6.23 / 31.18
$CEC_{pH\ 8.1}$ ($mmol_c\ kg^{-1}$)	51.5 ± 26.9 6.9 / 89.7	92.6 ± 12.5 74.4 / 111.3	46.1 ± 30.2 7.9 / 109.8	53.3 ± 16.2 21.4 / 82.0
BS (%)	35.6 ± 16.1 22.4 / 72.2	50.3 ± 8.5 40.5 / 69.4	48.7 ± 10.4 33.1 / 63.6	56.1 ± 8.7 48.2 / 74.2

* Plant-available phosphorous / potassium (P_CAL / K_CAL): *N* = 16 for ZF20, *N* = 11 for ZF30.

Abbreviated parameters left are: *N* = sample number; Cations = sodium Na^+, potassium K^+, magnesium Mg^{2+}, calcium Ca^{2+}; $CEC_{pH\ 8.1}$ = potential cation exchange capacity at pH 8.1; BS = base saturation.

Table A4-3: Woody plant species assessed in an area of 900 m^2 in each of the four succession stages of the Zaï system in Ouahigouya (sub-Sahel zone, Burkina Faso). The degraded, barren area had no trees at all. The species (names abbreviated) are ranked in descending order according to a) their abundance (Ind; number of individuals) and b) the total 'woody plant basal area' (wPBA) of all individuals belonging to the species (in cm^2). Ranks are shown 1) for the combined area of all assessment plots (3600 m^2) (Rank all), and 2) for each habitat separately (Rank). RA_{cum}: cumulated relative abundance (in %).

Succession stages of the Zaï system in Ouahigouya (3.600 m^2)					**barren soil (ZDeg)**	**Millet field (ZMil) (900 m^2)**				**Young Zaï forest (ZF20) (900 m^2)**				**Old Zaï forest (ZF30) (900 m^2)**			
Rank all	Tree species	Ind	RA_{cum} (%)	wPBA (cm^2)	no trees at all	Rank	Ind	RA_{cum} (%)	wPBA (cm^2)	Rank	Ind	RA_{cum} (%)	wPBA (cm^2)	Rank	Ind	RA_{cum} (%)	wPBA (cm^2)
1	G.s.	227	29.5	3557		12	1	2.1	2	**1**	105	34.9	1686	**1**	121	28.7	1869
2	C.m.	157	49.9	1983		**7**	1	4.3	92	**2**	52	52.2	952	**2**	104	53.3	939
3	P.r.	88	61.3	1679		**3**	7	19.1	71	**5**	13	56.5	174	**3**	68	69.4	1434
4	S.b.	62	69.4	2337		**4**	6	31.9	118	**4**	40	69.8	1071	**6**	16	73.2	1148
5	B.ae.	57	76.8	3340						**3**	47	85.4	2143	**7**	10	75.6	1197
6	P.l.	37	81.6	262						**6**	11	89.0	60	**4**	26	81.8	202
7	C.s.	32	85.7	1119		**5**	6	44.7	90	**7**	7	91.4	217	**5**	19	86.3	812
8	A.sb.	15	87.7	1371		**2**	8	61.7	32					**10**	7	87.9	1339
9	A.d.	14	89.5	285		**1**	11	85.1	181	**10**	3	92.4	104				
10	L.m.	11	90.9	1581		**8**	1	87.2	39	13	2	93.0	34	**9**	8	89.8	1508
11	Z.ma.	11	92.3	84						14	2	93.7	8	**8**	9	91.9	76
12	A.n.	10	93.6	780		**6**	3	93.6	11					11	7	93.6	769
13	J.g.	7	94.5	166										12	7	95.3	166
14	A.i.	6	95.3	398						**8**	4	95.0	50	15	2	95.7	348
15	A.p.	5	96.0	303										13	5	96.9	303
16	C.a.	5	96.6	25						**9**	4	96.3	20	22	1	97.2	5
17	**G.b.**	**4**	**97.1**	**8**						**19**	**1**	**96.7**	**3**	**14**	**3**	**97.9**	**5**

*For the corresponding species names, as well as the family and order they belong to, please refer to Table A4-1 (Appendix 4).

Zaï system sites Ouahigouya (3.600 m²)					**barren soil (ZDeg)**	**Millet field (ZMil) (900 m²)**				**Young Zaï forest (ZF20) (900 m²)**				**Old Zaï forest (ZF30) (900 m²)**			
Rank all	Tree species	Ind	RA_{cum} (%)	wPBA (cm^2)	no trees at all	Rank	Ind	RA_{cum} (%)	wPBA (cm^2)	Rank	Ind	RA_{cum} (%)	wPBA (cm^2)	Rank	Ind	RA_{cum} (%)	wPBA (cm^2)
18	A.sy.	3	97.5	298						17	1	97.0	11	16	2	98.3	287
19	V.p.	2	97.8	623						11	2	97.7	623				
20	M.s.	2	98.1	163						12	2	98.3	163				
21	D.c.	2	98.3	25		**9**	1	95.7	23					24	1	98.6	2
22	B.an.	2	98.6	10						21	1	98.7	2	20	1	98.8	8
23	Di.m.	1	98.7	92						15	1	99.0	92				
24	A.sn.	1	98.8	50										17	1	99.1	50
25	G.t.	1	99.0	42										18	1	99.3	42
26	S.i.	1	99.1	13						16	1	99.3	13				
27	B.m.	1	99.2	11										19	1	99.5	11
28	B.r.	1	99.4	10		**10**	1	97.9	10								
29	Z.mu.	1	99.5	8						18	1	99.7	8				
30	A.m.	1	99.6	6										21	1	99.8	6
31	T.i.	1	99.7	6		11	1	100	6								
32	J.c.	1	99.9	4										23	1	100	4
33	S.k.	1	100	3						20	1	100	3				
4 x 900 m²	**33 species; 770 trees ∑ wPBA: 20,642 cm²**				**no trees**	**12 species; 47 trees ∑ wPBA: 675 cm²**				**21 species; 301 trees ∑ wPBA: 7,437 cm²**				**24 species; 422 trees ∑ wPBA: 12,530 cm²**			

*For the corresponding species names, as well as the family and order they belong to, please refer to Table A4-1 (Appendix 4).

RESULTS FOR THE STUDY SITES IN THE NORTH-SUDAN REGION (LUI-2)

ADDITIONAL PARAMETERS ANALYZED FOR TOPSOIL SAMPLES OF THE NORTH-SUDANESE SITES

Table A4-4: For the topsoil (0–10 cm) of each land-use type studied near Fada N'Gourma (North-Sudan zone, Burkina Faso), the potential cation exchange capacity ($CEC_{pH\ 8.1}$), the concentration of the cations sodium (Na^+), potassium (K^+), magnesium (Mg^{2+}) and calcium (Ca^{2+}), and the base saturation (BS) are shown. The parameters were analyzed for one composite sample per habitat (*N* = 1).

Study sites of the North-Sudan zone in Burkina Faso (LUI-2)	Chemical parameters of the habitats' topsoil (0–10 cm)			
	Pama reserve FRes	Pasture area FPas	Fallow (4th year) FFal	Cotton field FCot
N	1	1	1	1
Na^+ ($mmol_c\ kg^{-1}$)	0.3	0.5	0.6	1.4
K^+ ($mmol_c\ kg^{-1}$)	1.0	0.9	3.8	2.0
Mg^{2+} ($mmol_c\ kg^{-1}$)	10.8	7.2	50.5	46.4
Ca^{2+} ($mmol_c\ kg^{-1}$)	32.7	21.8	218.0	149.6
$CEC_{pH\ 8.1}$* ($mmol_c\ kg^{-1}$)*	54.9	50.5	322.9	259.4
BS (%)	81.7	60.4	84.5	76.9

EPIGEAL TERMITE MOUNDS

ASSESSMENT OF EPIGEAL TERMITE MOUNDS IN THE DIFFERENT STUDY SITES (METHODOLOGY)

In each Zaï stage studied in Ouahigouya (sub-Sahel region, northern Burkina Faso), epigeal termite mounds had been assessed once during the rainy season in August 2008 within the whole hectare-plot. Each site was sub-divided into plots of 25 m^2 (5 x 5 m), yielding a total of about 400 contiguous subplots per land-use type. The location of each termite mound was mapped and its height measured. The mounds were sampled destructively to allow for determining its status 'dead' or 'alive', and to collect specimens of the constructing and inquiline species (Eggleton & Bignell 1997). Specimens were placed in vials with 90% ethanol for later identification.

In the North-Sudanese sites, solely live termite mounds had been assessed together with the vegetation which had been assessed during the rainy season 2007 within a square cut plot of 900 m^2 area. The constructing termites were identified to the genus level. To enable comparisons with results of the Zaï system, mound numbers were converted into mounds per hectare.

Table A4-5: Woody plant species assessed in an area of 900 m^2 in each of the four habitats studied near Fada N'Gourma (North-Sudan zone, Burkina Faso). The species (names abbreviated*) are ranked in descending order according to a) their abundance (Ind; number of individuals) and b) the total 'woody plant basal area' (wPBA) of all individuals belonging to the species (in cm^2). Ranks are shown 1) for the combined area of all assessment plots (3600 m^2) (Rank all), and 2) for each habitat separately (Rank). RA_{cum}: cumulated relative abundance (in %). *For the corresponding species names, please refer to Table A4-1 (Appendix 4).

Study sites in the North-Sudan region (3.600 m^2)					**Pama reserve (FRes) (900 m^2)**				**Pasture area (FPas) (900 m^2)**				**Fallow land (FFal) (900 m^2)**				**Cotton field (FCot) (900 m^2)**		
Rank all	Tree species	Ind	RA_{cum} (%)	wPBA (cm^2)	Rank	Ind	RA_{cum} (%)	wPBA (cm^2)	Rank	Ind	RA_{cum} (%)	wPBA (cm^2)	Rank	Ind	RA_{cum} (%)	wPBA (cm^2)	Rank	Ind	wPBA (cm^2)
1	T.a.	21	14.0	5546	2	20	25.3	5437					7	1	5.6	109			
2	C.f.	21	28.0	1792	1	21	51.9	1792											
3	A.l.	14	37.3	6987					1	14	26.9	6987							
4	C.gl.	14	46.7	1061	3	13	68.4	958	8	1	28.8	103							
5	A.go.	12	54.7	1268	11	1	69.6	39	2	9	46.2	1155	5	2	16.7	74			
6	A.h.	10	61.3	331	8	1	70.9	161	3	9	63.5	170							
7	P.t.	9	67.3	462	9	1	72.2	97					1	8	61.1	365			
8	M.s.	8	72.7	1979	4	8	82.3	1979											
9	F.ap.	8	78.0	473					4	8	78.8	473							
10	C.c.	7	82.7	264	5	7	91.1	264											
11	C.n.	7	87.3	113					5	7	92.3	113							
12	B.ae.	4	90.0	781					6	2	96.2	592	4	2	72.2	189			
13	G.e.	4	92.7	289	6	4	96.2	289											
14	V.p.	3	94.7	1361									2	2	83.3	971	1	1	390
15	C.m.	2	96.0	429									3	2	94.4	429			
16	A.dd.	1	96.7	448					7	1	98.1	448							
17	L.a.	1	97.3	296	7	1	97.5	296											
18	Di.m.	1	98.0	161									6	1	100	161			
19	B.s.	1	98.7	72	10	1	98.7	72											
20	D.c.	1	99.3	32					9	1	100	32							
21	G.m.	1	100	8	12	1	100	8											
4 x 900 m^2		**21 species; 150 trees ∑ wPBA: 24,153 cm^2**			**12 species; 79 trees ∑ wPBA: 11,392 cm^2**				**9 species; 52 trees ∑ wPBA: 10,073 cm^2**				**7 species; 18 trees ∑ wPBA: 2,298 cm^2**				**1 species; 1 tree ∑ wPBA: 390 cm^2**		

DIFFERENCES BETWEEN THE TWO REGIONS WITH REGARD TO THE NESTING BEHAVIOR (RESULTS)

When comparing the termite fauna between the North-Sudan and the sub-Sahel region, some differences were particularly striking with regard to the nesting behavior:

- In the two regions, different nesting behavior could be observed for the fungus-growing termite genus *Odontotermes*. The 'classical' nest structure of *Odontotermes* according to (Darlington 1997) is an epigeal mound that is penetrated by a few open air passages – vertical shafts of circular to oval cross-section (Fig. A4-12). However, the genus *Odontotermes* contains many species, which build a variety of nests. The nest architecture can be affected by local factors such as soil depth, texture and drainage, however it tends to be constant at any one locality (Darlington 1997).
    - In the sub-Sahelian sites, no traces of *Odontotermes* nests could be seen above the surface – they were fully subterranean. When digging soil profiles up to a depth of one meter, fungus combs of *Odontotermes* had been found in a depth of 50–90 cm below the soil surface.
    - In the North-Sudanese sites, *Odontotermes* mounds had a low but distinctly raised surface (10–30 cm above the surrounding soil) that was devoid of any vegetation, and a few open air passages in 10–20 cm tall raised rims (Ø 5–10 cm) resembling small chimneys ('classical' nest structure) (Fig. A4-12). In an area of one hectare, 11 *Odontotermes* mounds had been found in the land which had been exclusively used as pasture area for the last 20 years. In an area of one hectare of the near-natural savanna in the reserve of Pama, 33 *Odontotermes* mounds had been assessed.
- The tallest and most conspicuous epigeal mounds in both regions were constructed by fungus-growing termites of the genus *Macrotermes*. Differences could be observed in the mound-architecture (external and the internal shape).
    - In the North-Sudanese sites, mounds of *Macrotermes bellicosus* (Smeathman) were tall and had an eye-catching, unique external shape. The mound surface was highly structured and 'folded' with many ridges. (Grassé & Noirot 1961) classified them as 'nids en cathédrale' (Fig. A4-6, Fig. A4-7, Fig. A4-8, Fig. A4-9).
    - In the sub-Sahelian sites, *Macrotermes* mounds (mostly *M. subhyalinus*) were lower, compacter and dome-shaped, and they were lacking the protruding structures. (Grassé & Noirot 1961) classified them as 'nids en dome' (Fig. A4-10, Fig. A4-11).
- High numbers of mounds constructed by the grass-feeding termite genus *Trinervitermes* were characterizing the savanna habitats of the North-Sudan zone. *Trinervitermes* mounds had been especially numerous in the near-natural reserve of Pama.

NUMBER OF EPIGEAL TERMITE MOUNDS ASSESSED IN THE TWO STUDY REGIONS (RESULTS)

For each of the succession stages of the Zaï system in Ouahigouya, the number of epigeal mounds assessed in one hectare is shown per termite species, functional group and mound status (live or dead) (Fig. A4-4). In those cases where the constructing termite species could not be determined, the genus is indicated instead. Fig. A4-5 is illustrating the number of live epigeal termite mounds assessed per termite genus and functional group in the habitats near Fada N'Gourma within an area of 900 m^2. To facilitate the comparison with the sub-Sahelian sites, numbers were converted into mounds per hectare.

In both figures, the functional group to which the termites belong is indicated by the bar color and additionally, as two-digit code in parentheses which are preceding the species (genus) name, with fungus growers (fg) in orange, grass feeders (gf) in green, soil feeders (sf) in brown, wood feeders (wf) in grey, and unknown (uk) in white (Fig. A4-4, Fig. A4-5). Compared to the sites in the sub-Sahel region, significant more epigeal termite mounds had been found in those of the North-Sudan region. However, in both climate zones epigeal termite mounds were completely missing in areas which were heavily impacted by humans: the degraded land in the sub-Sahel region and the cotton fields in the North-Sudan zone of Burkina Faso (Fig. A4-4, Fig. A4-5).

The subsistence farmer Yacouba Sawadogo (Zaï system, Ouahigouya, sub-Sahel region) knew about the beneficial effect of soil feeding termites (e.g. genus *Cubitermes*) on the soil nutrient status. Over the last decade, he therefore transferred several *Cubitermes* mounds from other places into his millet fields. The high number of *Cubitermes* mounds found in his millet field has therefore to be handled with caution (Fig. A4-4). Furthermore, since soil feeding termites often show a subterranean nesting behaviour, the highest number of epigeal soil feeding termite mounds visible in the millet field, should not be automatically equated with the highest number of soil feeding termite colonies in general. In the diagram in Chapter 5.3.2.2 (Fig. 5-2), illustrating the total termite diversity assessed in the eight study sites, more soil feeding species and genera were found in the two forest sites compared to the millet fields – and most of these species were living subterranean.

No epigeal mound constructed by soil-feeding termites was recorded in any of the North-Sudanese sites (Fig. A4-5). However according to Fig. 5-2 and Table 5-6 in Chapter 5.3.2.2, two soil-feeding species belonging to two different genera were collected following the standard protocol RAP in the near-natural savanna of the Pama reserve and one soil-feeding species in the short-term fallow (for the RAP-protocol please refer to Chapter 3.1).

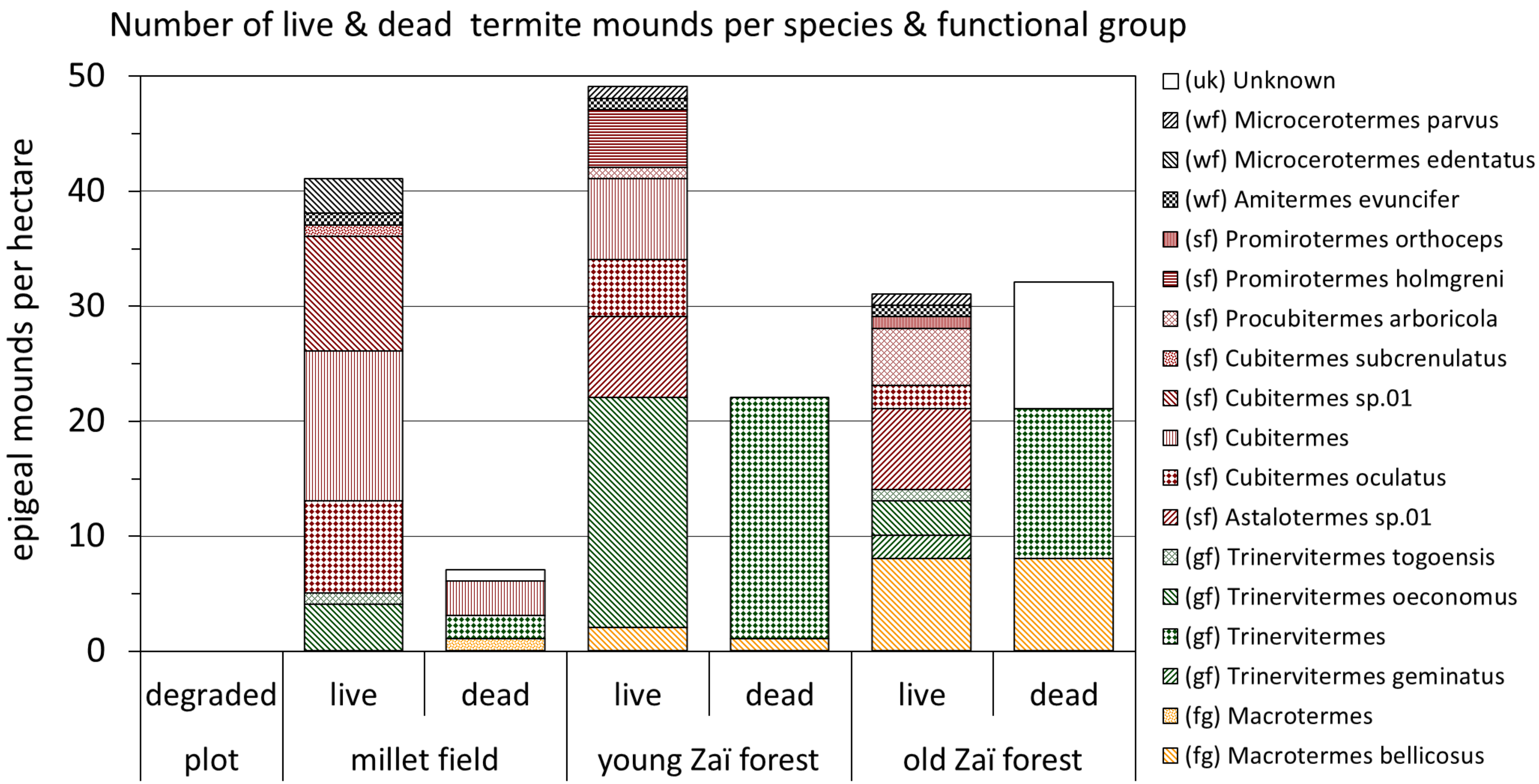

Fig. A4-4: For each Zaï stage, the number of live and dead termite mounds per hectare is shown per species and functional group. In those cases where the constructing termite species could not be determined, the genus is indicated instead. No epigeal termite mound was found in the degraded, barren site. The functional group is indicated by the color and as two-digit code written in parentheses preceding the species name: fungus grower (fg) = orange; grass feeder (gf) = green; soil feeder (sf) = brown; wood feeder (wf) = grey and unknown (uk) = white.

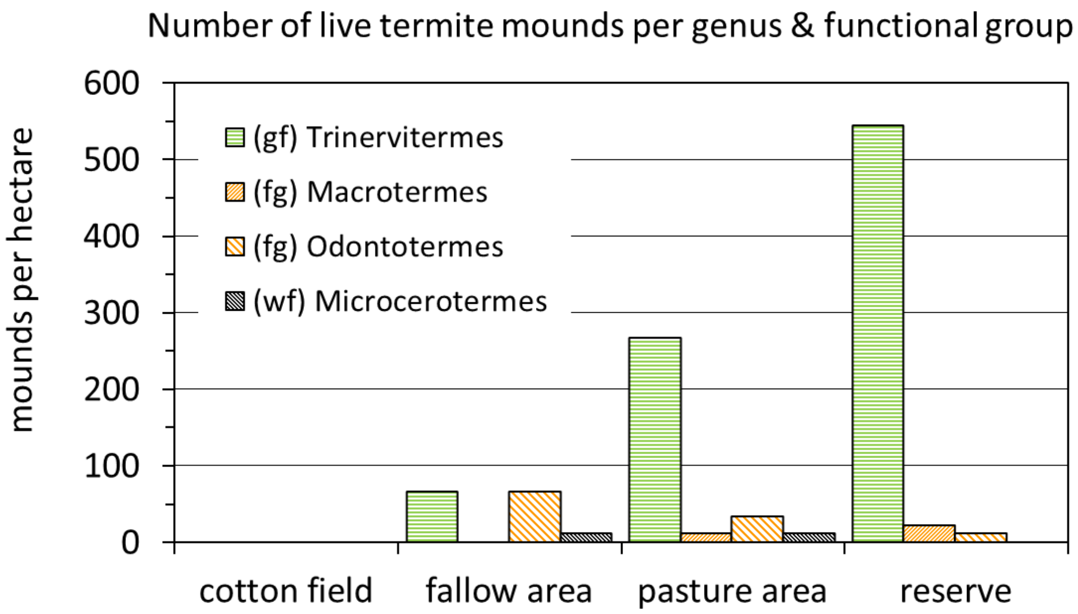

Fig. A4-5: For each habitat studied in the North-Sudan region, the number of live termite mounds per hectare is shown per genus and functional group. No epigeal termite mound was found in the heavily impacted site, the cotton field. The functional group is indicated by the color and as two-digit code written in parentheses preceding the genus name: fungus grower (fg) = orange; grass feeder (gf) = green and wood feeder (wf) = grey.

EPIGEAL MOUNDS OF *MACROTERMES BELLICOSUS* IN THE NORTH-SUDAN REGION

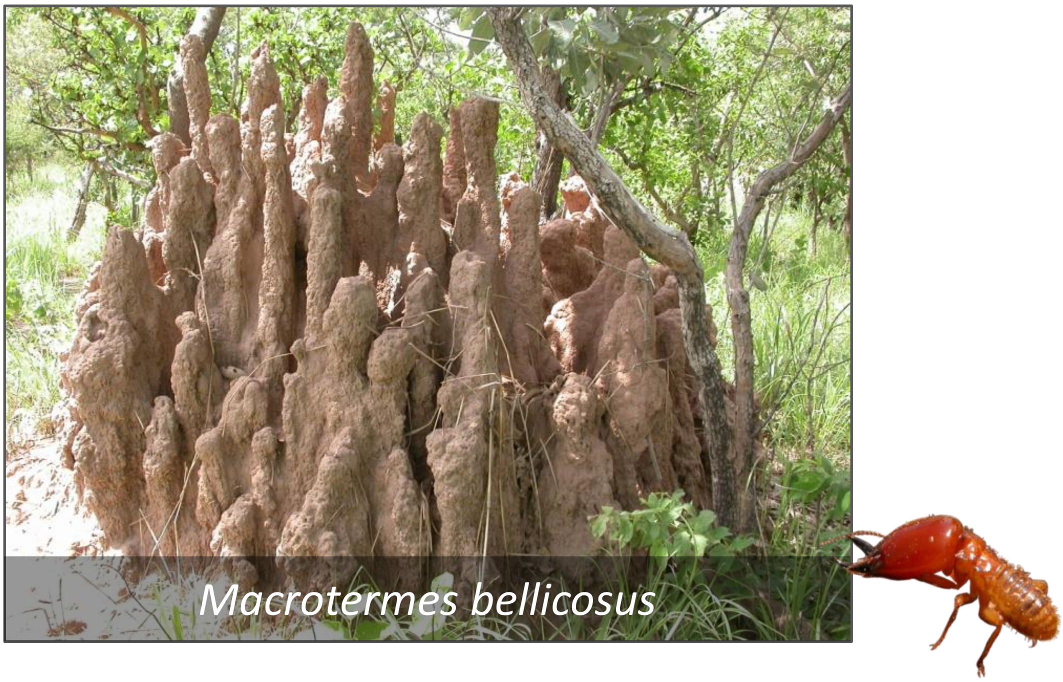

Fig. A4-6: Mound built by *Macrotermes bellicosus* (Smeathman, 1781) in the North-Sudan zone (Burkina Faso) were tall and had an eye-catching, unique external shape. (Grassé & Noirot 1961) classified them as 'nids en cathédrale'.

Fig. A4-7: Opened mound built by *Macrotermes bellicosus* (Smeathman, 1781) in the North-Sudan zone (Burkina Faso). Close-up: Fungus-comb of the symbiotic fungus (*Termitomyces*).

Fig. A4-8: *Macrotermes bellicosus* (Smeathman, 1781) queen.

Fig. A4-9: Royal chamber of *Macrotermes bellicosus* (Smeathman, 1781) in the North-Sudan region (Burkina Faso)

EPIGEAL MOUNDS OF *MACROTERMES SUBHYALINUS* IN NORTHERN BURKINA FASO

Fig. A4-10: Opened mound built by *Macrotermes subhyalinus* (Rambur, 1842) in northern Burkina Faso.

Fig. A4-11: *Macrotermes subhyalinus* (Rambur, 1842) queen with workers and small solders in northern Burkina Faso.

EPIGEAL MOUNDS OF *ODONTOTERMES* SP. IN THE NORTH-SUDAN REGION

A)

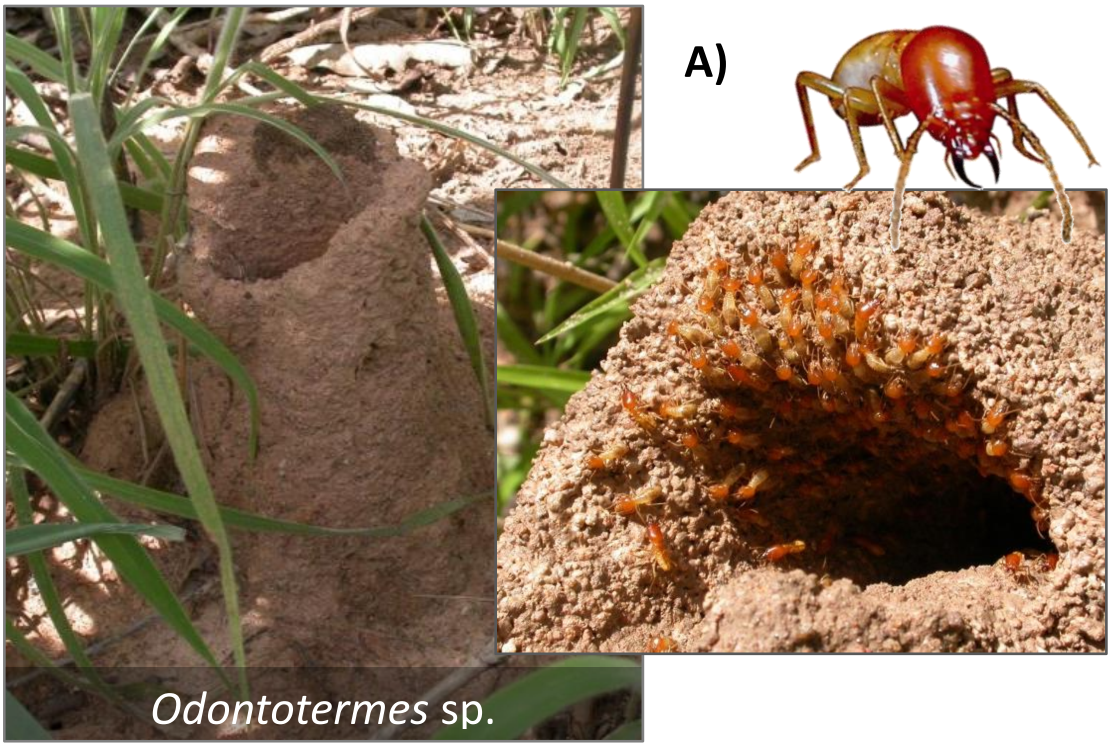

Fig. A4-12: In the North-Sudan region in Burkina Faso, mounds of *Odontotermes* Holmgren, 1912 have a low but distinctly raised surface (10–30 cm above the surrounding soil) and a few open air passages (‘classical’ nest structure). **A)** Open air passages (10–20 cm tall raised rims; Ø 5–10 cm) resembling small chimneys; view from the side and from above with workers and solders. **B)** Low but distinctly raised surface of an *Odontotermes* mound in the Pama reserve.

B)

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APPENDIX – CHAPTER V

AGRICULTURAL INTENSIFICATION INDEX

Table A5-1: For each habitat of the two disturbance gradients studied in Burkina Faso, the intensity of anthropogenic impact was calculated. Habitat-health for the first gradient in the sub-Sahel region increases from left to right, while it is decreasing for the second gradient in the North-Sudan region. The range of the values calculated for each sub-index is being equally weighted between 0-1: the respective maximum values are brought back to 1 by dividing each value by the corresponding highest value. In each cell, first the value is shown and in parentheses for the calculation of the Agricultural Intensification (AI) Index, the sub-index is shown. Habitats are ZDeg: degraded land, ZMil: millet fields, ZF20: young Zaï forest, ZF30: old Zaï forest; and FRes: Pama reserve, FPas: pasture, FFal: fallow, FCot: cotton field.

Climatic region Mean annual rainfall	Sub-Sahel region 500 – 700 mm yr^{-1}				North-Sudan region 900 – 1100 mm yr^{-1}			
Cropping season (% of year)	Jun – mid-Oct (38 %)				May – mid-Nov (54 %)			
Land-use type	ZDeg	ZMil	ZF20	ZF30	FRes	FPas	FFal	FCot
Age of site, length of fallow (in years)	30, 30	11, 0	20, 16	30, 26	20, 20	20, 20	19, 4	13, 0
Mean cultivation-intensity (CI) (in %)	0 (0. 0)	0.38 (1.00)	0.08 (0.21)	0.05 (0.13)	0 (0.00)	0 (0.00)	0.43 (0.80)	0.54 (1.00)
Mean pest control rate (PCR) (in kg chemicals ha^{-1} yr^{-1})	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1.96 (0.55)	3.58 (1.00)
Mean grazing-pressure (GP) (in %)	100 (1.00)	62.5 (0.63)	62.5 (0.63)	62.5 (0.63)	0 (0.00)	100 (1.00)	57.2 (0.57)	45.8 (0.46)
Mean fertilization rate (FR) (in kg compost ha^{-1} yr^{-1})	0 (0.00)	4600 (1.00)	920 (0.20)	613 (0.13)	0 (0.00)	0** (0.00)	5526 (0.79)	7000 (1.00)
Mean tillage frequency (TF)	0 (0.00)	2 (1.00)	0.4 (0.20)	0.27 (0.14)	0 (0.00)	0 (0.00)	1.57 (0.79)	2 (1.00)
AI-Index	1.00*	0.73	0.25	0.17	0.00	0.20	0.70	0.89

* Degraded, barren land (ZDeg): index-value of 1.00 was artificially set.

** No fertilizer was applied, however, grazing cattle in the whole pasture area (FPas)

ORDER OF THE SITES ACCORDING TO THE VALUES OF THE AGRICULTURAL INTENSIFICATION INDEX (AI):

Starting with the least intensified, near natural system and ending with the most intensified habitat:

Sites in the sub-Sahel region: ZDeg > ZMil > ZF20 > ZF30

Sites in the North-Sudanese region: FCot > FFal > FPas > FRes

CALCULATING THE SUB-INDICES OF THE AGRICULTURAL INTENSIFICATION INDEX:

AGE OF SITE (IN YEARS) * (ALL FOR THE YEAR 2008)

The degraded, barren land **ZDeg** and the near-natural savanna in the Pama reserve **FRes** are assumed to be the initial stage of the respective LUI-gradient. Therefore and since their correct age is unknown, it was artificially set to the same age as the oldest of the other three sites

MEAN CULTIVATION-INTENSITY (CI)

Duration of the cropping season in the sub-Sahel region: 6.5 months per year;
Duration of the cropping season in the North-Sudanese region: 4.5 months per year;

Fallow land **FFal**:
Age of site 19 years = 228 months, including 4 years fallowing;
15 years x 6.5 months = 97.5 months during which site had been cultivated since establishment;
CI: 97.5 months / 228 months → CI = 0.43 (sub-index value: 0.43 /0.54 = 0.80)

Cotton field **FCot**:
Age of site 13 years/ 156 months; 13 years x 6.5 months = 49.5 cropping-months in total;;
CI: 84.5 months / 156 months → CI = 0.54 (sub-index value: 1.00)

Millet field **ZMil**:
Age of site 11 years = 132 months; 11 years x 4.5 months = 84.5 cropping-months in total;
CI: 49.5 months / 132 months → CI = 0.38 (sub-index value: 1.00)

Young Zaï forest **ZF20**:
Age of site 20 years = 240 months, including 16 years fallow;
4 years x 4.5 months = 18 cropping-months in total;
CI: 18 months / 240 months → CI = 0.08 (sub-index value: 0.08 / 0.38 = 0.21)

Old Zaï forest **ZF30**:
Age of site 30 years = 360 months, including 26 years fallow;
4 years x 4.5 months = 18 cropping-months in total;
CI: 18 months / 360 months → CI = 0.05 (sub-index value: 0.05 / 0.38 = 0.13)

MEAN PEST CONTROL RATE (PCR)

In the North-Sudanese region, seven different chemicals (insecticides, fungicides) with a total weight of 9.31 kg per hectare and year were applied for cotton cultivation

Cotton field **FCot**:
Age of site 13 years including 5 years of cotton cultivation; 5 years x 9.31 kg ha^{-1} yr^{-1}
= 46.55 kg per hectare were applied in total since establishment of the site;
PCR: 46.55 kg ha^{-1} / 13 years → PCR =3.58 kg ha^{-1} yr^{-1} (sub-index value: 1.00)

Fallow land **FFal**:
Age of site 19 years including 4 years of cotton cultivation;
4 years x 9.31 kg ha^{-1} yr^{-1} = 37.24 kg per hectare applied in total;
PCR: 37.24 kg ha^{-1} / 19 years → PCR =1.96 kg ha^{-1} yr^{-1} (sub-index value: 1.98 / 3.58 = 0.55)

MEAN GRAZING-PRESSURE (GP)

Mean percentage of the year when grazing was allowed is used instead.

Pasture area **FPas**: age of site 20 years or 240 months; grazing allowed all-the-year;
GP: (240 months / 240 months) x 100% → GP = 100% (sub-index value: 1.00)

Fallow land **FFal**: age of site 19 years = 228 months, 4 years or 48 months fallow: grazing year-round; 15 years x 5.5 months grazing = 82.5 months + 48 months = 130.5 months grazing pressure
GP: (130.5 months / 228 months) x 100% → GP = 57.2%

Cotton field **FCot**: age of site 13 years = 156 months; 13 years x 5.5 months grazing = 71.5 months
GP: (71.5 months / 156 months) x 100% → GP = 45.8%

Degraded land **ZDeg**: grazing allowed all-the-year;
GP: (360 months / 360 months) x 100% → GP = 100% (sub-index value: 1.00)

Millet field **ZMil**: age of site 11 years = 132 months; 11 years x 7.5 months = 82.5 grazing pressure;
GP: (82.5 months / 132 months) x 100% → GP = 62.5%

Young Zaï forest **ZF20**: age of site 20 years = 240 months, including 16 years fallow;
During the peak rainy season (4 months of the year) cattle is brought to grass nearby to graze;
4 years cropping x 7.5 months = 30 months; 16 years fallow x 8 months grazing = 128 months;
GP: (158 months/ 240 months) x 100% → GP = 65.8%

Old Zaï forest **ZF30**: age of site 30 years = 360 months, including 26 years fallow;
For the last 10 years, the forest was protected all-the-year; 16 years fallow with 8 months grazing
4 years cropping x 7.5 months = 30 months; 16 years fallow x 8 months grazing = 128 months;
GP: (158 months/ 360 months) x 100% → GP = 43.9%

MEAN TILLAGE FREQUENCY (TF)

In both regions, the fields are tilled 2 times per year

Fallow land **FFal**: age of site 19 years, including 4 years fallow and no tilling;
15 years x 2 = 30 times the fallow was tilled in total
TF: 30 times / 19 years → TF = 1.57 times mean tilling frequency per year

Cotton field **FCot**: age of site 13 years x 2 times = 26 times the field was tilled in total
TF: 26 times / 13 years → TF = 2 times (sub-index value: 1.00)

Millet field **ZMil**: age of site 11 years x 2 times = 22 times the field was tilled in total ;
TF: 22 times / 11 years → TF = 2 times (sub-index value: 1.00)

Young Zaï forest **ZF20**: age of site 20 years, including 16 years fallow; cropping period: 4 years
TF: 8 times / 20 years → TF = 0.4 times

Old Zaï forest **ZF30**: age of site 30 years, including 26 years fallow; cropping period: 4 years
TF: 8 times / 30 years → TF = 0.27 times

MEAN FERTILIZATION RATE (FR)

In the North-Sudan zone: about 700 g compost applied per squaremeter; the mean fertilization rate per hectare therefore is: 10,000 m^2 x 700 g → about 7,000 kg compost ha^{-1} yr^{-1}

In the sub-Sahel zone (Zaï system): 375-475 g compost applied per Zaï-pit; 1 ha ≈ 9,700 pits; the mean fertilization rate per hectare therefore is: 375-475 g compost x 9,700 pits
→ 3,638 – 4,608 kg ha^{-1} yr^{-1} → 4,600 kg compost ha^{-1} yr^{-1}

Fallow land **FFal**:
Age of site 19 years, including 4 years fallow; 15 years x 7000 kg ha^{-1} yr^{-1} = 105,000 kg ha^{-1} in total;
FR: 105,000 kg ha^{-1}/ 19 yrs → FR = 5,526 kg ha^{-1} yr^{-1}

Cotton field **FCot**: age of site 13 years;
FR: 13 years cropping x 7000 kg ha^{-1} yr^{-1} → FR = 7,000 kg ha^{-1} yr^{-1} (sub-index value: 1.00)

Millet field **ZMil**:
Age of site 11 years; **FR:** 11 years cropping x 4,600 kg compost ha^{-1} yr^{-1}
→ FR = 4,600 kg ha^{-1} yr^{-1} (sub-index value: 1.00)

Young Zaï forest **ZF20**:
Age of site 20 years, 16 years fallow; cropping period: 4 years =18,400 kg ha^{-1}
FR: (18,400 kg ha^{-1}) / 20 years → FR = 920 kg ha^{-1} yr^{-1}

Old Zaï forest **ZF30**:
Age of site 30 years, 26 years fallow; cropping period: 4 years =18,400 kg ha^{-1}
FR: (18,400 kg ha^{-1}) /30 years → FR = 613 kg ha^{-1} yr^{-1}

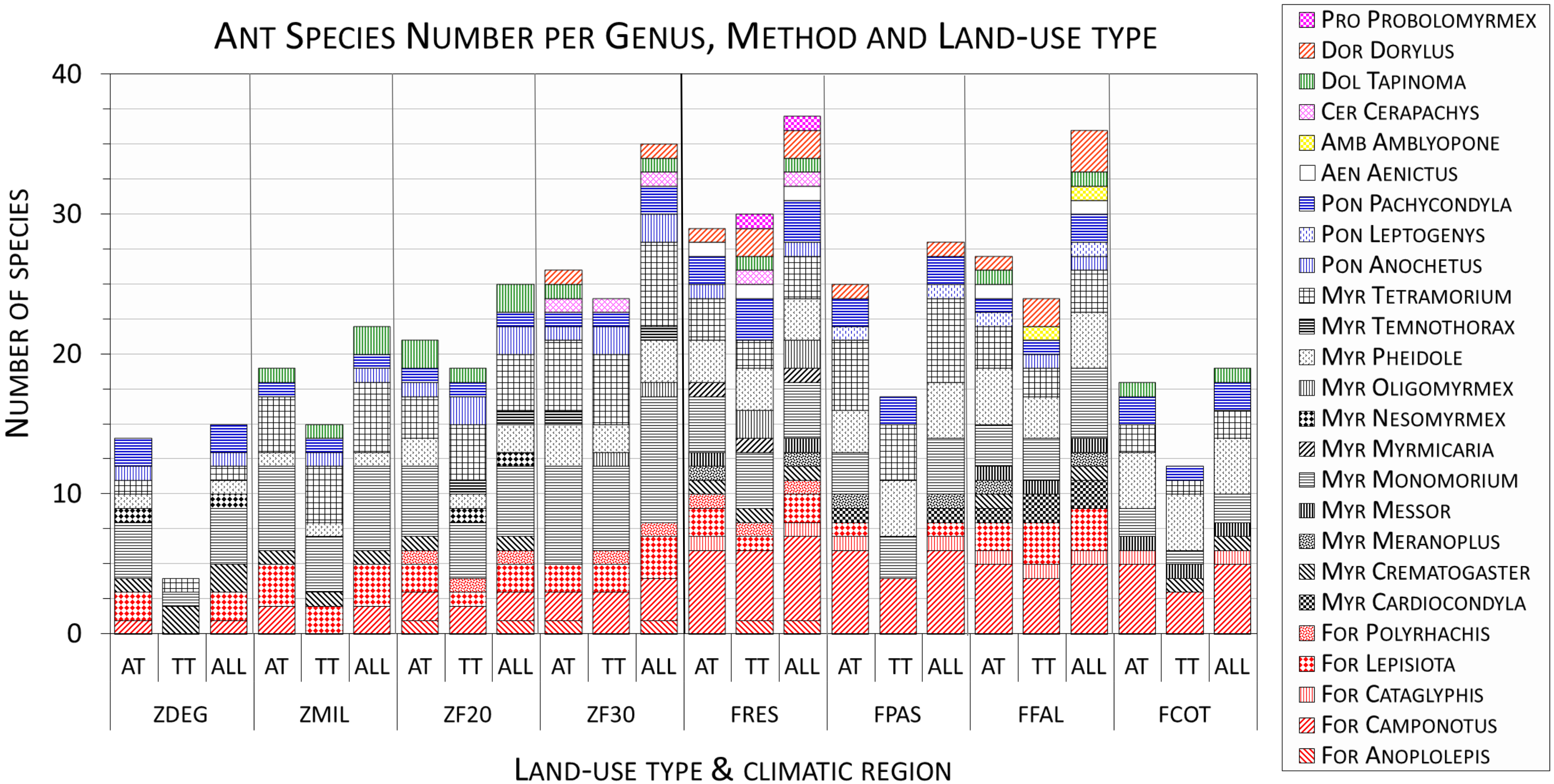

Fig. A5-1: Number of ant species collected per genus and Zaï stage, differentiated according to the sampling methods; in each Zaï stage and in the Pama reserve, four replicate transects were conducted between 2004 and 2008, in the other sites three transects. Three columns are shown per site, each represents a certain protocol part: ant transect (AT) comprising pitfall traps and Winkler sites; termite transect (TT) comprising soil scrapes and microhabitats; and both protocol parts combined (ALL). Each color represents one of nine subfamilies: Amblyoponinae (Amb), Aenictinae (Aen), Formicinae (For), Myrmicinae (Myr), Ponerinae (Pon), Cerapachyinae (Cer), Dolichoderinae (Dol), Proceratinae (Pro), and Dorylinae (Dor). Land-use types are degraded land (ZDeg), millet fields (ZMil), young forest (ZF20), and old Zaï forest (ZF30); Pama reserve (FRes), pasture (FPas), fallow (FFal), cotton field (FCot).

Table A5-2: For the National Park in Pama (FRes), the near-natural ecosystem studied in the North-Sudanese zone of Burkina Faso, the increase in ant species richness was observed (SOB) with increasing sampling effort. The total ant species richness was estimated with six estimators (ICE, Chao2, Jackknife1, Jackknife2, Bootstrap, and Michaelis-Menten-Mean) in relation to an increasing sampling effort. Sampling efficiency was calculated for each estimator by dividing the observed species richness (SOB) through the respective estimated species richness (in %). The last column (mean all) represents the mean of the shown estimators, again including sampling efficiency. Increasing the sampling effort means an increase of the number of sampling units (SUs). For ants, one sampling unit comprises one transect section (10 m^2) plus one pitfall trap plus one 'Winkler-site' (1 m^2)[1].

Ants in FRes		Species-richness estimators (incidence-based)													
SUs	SOB 24	ICE 27	%-eff	Chao2 26	%-eff	Jack1 28	%-eff	Jack2 29	%-eff	Boot 26	%-eff	MMM 26	%-eff	mean all 27	%-eff
1	6.5	30.8	21.2%	30.8	21.2%	6.5	100%	0.0	0%	6.5	100%	0.0	0%	12.4	52.4%
2	10.4	45.5	22.8%	25.1	41.3%	14.2	73.3%	14.2	73.3%	12.3	84.6%	25.4	40.9%	22.8	45.6%
3	13.2	31.4	41.8%	25.3	52.1%	18.5	70.9%	20.7	63.6%	15.7	83.9%	26.6	49.5%	23.0	57.1%
4	15.3	29.8	51.6%	28.3	54.2%	21.8	70.5%	24.9	61.6%	18.3	84.0%	27.6	55.6%	25.1	61.1%
5	16.9	30.4	55.7%	31.2	54.3%	24.0	70.6%	27.7	61.1%	20.1	84.2%	28.1	60.3%	26.9	62.9%
6	18.5	31.1	59.4%	32.0	57.7%	25.9	71.3%	29.9	61.9%	21.8	84.6%	28.7	64.4%	28.2	65.4%
7	19.9	32.8	60.8%	33.1	60.2%	27.9	71.4%	32.2	61.9%	23.5	84.7%	29.5	67.6%	29.8	66.8%
8	21.1	34.2	61.7%	34.5	61.2%	29.5	71.7%	34.0	62.1%	24.9	85.0%	30.2	70.0%	31.2	67.7%
9	22.1	35.0	63.1%	34.8	63.6%	30.6	72.2%	35.2	62.9%	25.9	85.2%	30.8	71.8%	32.0	69.0%
10	23.1	36.0	64.0%	35.3	65.4%	31.7	72.7%	36.2	63.7%	27.0	85.5%	31.3	73.7%	32.9	70.1%
11	23.9	36.7	65.3%	35.8	66.9%	32.7	73.3%	37.1	64.6%	27.9	85.7%	31.8	75.4%	33.6	71.2%
12	24.7	37.5	65.9%	37.2	66.6%	33.6	73.5%	38.1	64.9%	28.8	85.9%	32.2	76.8%	34.6	71.6%
13	25.5	37.8	67.3%	37.0	68.8%	34.3	74.1%	38.6	65.9%	29.5	86.2%	32.6	78.0%	35.0	72.8%
14	26.1	38.2	68.4%	37.5	69.6%	35.0	74.6%	39.3	66.5%	30.2	86.5%	33.0	79.1%	35.5	73.5%
15	26.7	38.6	69.2%	37.9	70.6%	35.7	75.0%	39.9	67.0%	30.9	86.6%	33.4	80.2%	36.0	74.2%
16	27.4	39.1	70.1%	38.3	71.5%	36.4	75.3%	40.6	67.4%	31.5	86.8%	33.7	81.2%	36.6	74.8%
17	28.0	39.5	70.8%	39.0	71.7%	37.0	75.6%	41.2	67.8%	32.1	87.0%	34.0	82.1%	37.1	75.3%
18	28.5	39.5	72.1%	39.2	72.6%	37.5	76.0%	41.6	68.5%	32.6	87.2%	34.3	82.9%	37.4	76.0%
19	29.0	39.5	73.3%	39.4	73.5%	38.0	76.3%	42.0	69.0%	33.2	87.4%	34.6	83.7%	37.8	76.7%

[1] However, only eight ant sampling stations (each comprising one pitfall and one 'Winkler-site') were installed per 50 m transect; two sampling units for ants consequently correspond to one transect section only.

20	29.5	39.6	74.4%	39.7	74.2%	38.4	76.7%	42.3	69.6%	33.6	87.6%	34.9	84.4%	38.1	77.3%
21	29.9	39.6	75.4%	39.8	75.1%	38.8	77.1%	42.5	70.3%	34.1	87.8%	35.2	85.0%	38.3	78.0%
22	30.3	39.6	76.5%	39.7	76.3%	39.1	77.6%	42.6	71.1%	34.5	88.0%	35.4	85.5%	38.5	78.7%
23	30.7	39.8	77.1%	39.7	77.2%	39.4	77.8%	42.9	71.5%	34.8	88.1%	35.7	86.0%	38.7	79.2%
24	31.1	39.9	77.9%	40.0	77.6%	39.7	78.2%	43.0	72.2%	35.2	88.3%	35.9	86.5%	38.9	79.8%
25	31.4	39.9	78.7%	40.1	78.3%	39.9	78.6%	43.1	72.9%	35.5	88.5%	36.1	86.9%	39.1	80.3%
26	31.8	40.1	79.1%	40.2	78.9%	40.2	78.9%	43.3	73.3%	35.8	88.6%	36.3	87.4%	39.3	80.7%
27	32.1	40.2	79.8%	40.3	79.6%	40.5	79.2%	43.5	73.8%	36.1	88.8%	36.5	87.9%	39.5	81.2%
28	32.4	40.4	80.3%	40.7	79.6%	40.8	79.5%	43.7	74.2%	36.5	88.9%	36.7	88.3%	39.8	81.5%
29	32.7	40.5	80.8%	41.0	79.9%	41.0	79.8%	43.9	74.5%	36.7	89.1%	36.9	88.7%	40.0	81.8%
30	33.0	40.6	81.2%	41.1	80.3%	41.2	80.1%	44.1	74.9%	37.0	89.2%	37.1	89.0%	40.2	82.1%
31	33.3	40.7	81.7%	41.2	80.8%	41.4	80.3%	44.3	75.2%	37.2	89.4%	37.2	89.4%	40.3	82.5%
32	33.5	40.8	82.2%	41.2	81.4%	41.6	80.6%	44.4	75.5%	37.5	89.5%	37.4	89.7%	40.5	82.8%
33	33.8	40.9	82.6%	41.3	81.8%	41.8	80.8%	44.5	75.9%	37.7	89.6%	37.5	90.0%	40.6	83.2%
34	34.0	40.9	83.1%	41.4	82.2%	41.9	81.1%	44.7	76.1%	37.9	89.8%	37.7	90.2%	40.7	83.5%
35	34.2	41.0	83.4%	41.3	82.8%	42.1	81.3%	44.9	76.3%	38.1	89.9%	37.8	90.5%	40.9	83.7%
36	34.4	41.1	83.8%	41.5	83.0%	42.2	81.5%	45.1	76.4%	38.2	90.0%	38.0	90.7%	41.0	83.9%
37	34.6	41.1	84.2%	41.6	83.1%	42.3	81.8%	45.2	76.7%	38.4	90.2%	38.1	90.9%	41.1	84.2%
38	34.9	41.4	84.2%	42.2	82.6%	42.6	81.8%	45.6	76.4%	38.6	90.2%	38.2	91.2%	41.4	84.1%
39	35.1	41.7	84.2%	42.6	82.3%	42.9	81.9%	46.0	76.2%	38.9	90.3%	38.3	91.6%	41.7	84.1%
40	35.3	41.8	84.5%	42.7	82.6%	43.0	82.0%	46.3	76.3%	39.1	90.4%	38.5	91.8%	41.9	84.3%
41	35.5	41.9	84.7%	43.0	82.6%	43.3	82.1%	46.6	76.2%	39.3	90.5%	38.6	92.1%	42.1	84.4%
42	35.7	42.0	85.0%	43.3	82.5%	43.4	82.3%	46.9	76.2%	39.4	90.6%	38.7	92.3%	42.3	84.5%
43	35.8	42.0	85.3%	43.3	82.8%	43.5	82.4%	47.0	76.3%	39.5	90.7%	38.8	92.3%	42.3	84.6%
44	36.0	42.1	85.4%	43.5	82.8%	43.6	82.5%	47.3	76.1%	39.7	90.8%	38.9	92.5%	42.5	84.7%
45	36.2	42.3	85.5%	44.1	82.1%	43.8	82.5%	47.7	75.8%	39.8	90.9%	39.0	92.7%	42.8	84.5%
46	36.4	42.5	85.6%	44.4	81.8%	44.0	82.6%	48.1	75.6%	40.0	90.9%	39.1	92.9%	43.0	84.5%
47	36.5	42.5	85.8%	44.8	81.4%	44.1	82.6%	48.3	75.5%	40.1	91.0%	39.2	93.0%	43.2	84.5%
48	36.7	42.8	85.7%	45.2	81.1%	44.4	82.6%	48.8	75.1%	40.3	91.0%	39.3	93.3%	43.5	84.4%
49	36.8	43.0	85.7%	45.8	80.5%	44.6	82.5%	49.3	74.8%	40.4	91.1%	39.4	93.5%	43.7	84.2%
50	37.0	43.2	85.7%	46.1	80.2%	44.8	82.5%	49.7	74.4%	40.6	91.1%	39.5	93.7%	44.0	84.1%

Table A5-3: For the National Park in Pama (FRes), the near-natural ecosystem studied in the North-Sudanese zone of Burkina Faso, the increase in termite species richness was observed (SOB) with increasing sampling effort. The total termite species richness was estimated with six estimators (ICE, Chao2, Jackknife1, Jackknife2, Bootstrap, and Michaelis-Menten-Mean) in relation to an increasing sampling effort. Sampling efficiency was calculated for each estimator by dividing the observed species richness (SOB) through the respective estimated species richness (in %). The last column (mean all) represents the mean of the shown estimators, again including sampling efficiency. Increasing the sampling effort means an increase of the number of sampling units (SUs). For termites, one transect section (2 m x 5 m = 10 m^2) represents on sampling unit.

Termites in FRes		Species-richness estimators (incidence-based)													
RAP-section (sampling area)	SOB 24	ICE 27	%-eff	Chao2 26	%-eff	Jack1 28	%-eff	Jack2 29	%-eff	Boot 26	%-eff	MMM 26	%-eff	mean all 27	%-eff
1 (10 m^2)	4.3	15.8	27.5%	15.8	27.5%	4.3	100%	0.0	0%	4.3	100%	0.0	0%	6.7	64.6%
2 (20 m^2)	7.3	17.8	40.7%	19.0	38.2%	10.1	71.6%	10.1	71.6%	8.7	83.4%	21.9	33.1%	14.6	49.6%
3 (30 m^2)	9.2	19.4	47.5%	18.1	51.1%	13.3	69.4%	14.9	61.9%	11.1	82.9%	21.2	43.5%	16.3	56.5%
4 (40 m^2)	10.8	20.4	53.0%	18.5	58.5%	15.4	70.3%	17.4	62.2%	12.9	83.5%	21.3	50.7%	17.6	61.2%
5 (50 m^2)	12.2	20.7	58.7%	19.1	63.6%	17.0	71.5%	19.1	63.6%	14.4	84.3%	21.7	55.9%	18.7	65.1%
6 (60 m^2)	13.2	20.8	63.3%	20.2	65.0%	18.2	72.5%	20.4	64.6%	15.5	84.9%	22.0	59.9%	19.5	67.5%
7 (70 m^2)	14.1	20.9	67.3%	21.3	65.9%	19.2	73.2%	21.6	65.2%	16.5	85.4%	22.2	63.4%	20.3	69.4%
8 (80 m^2)	14.8	21.1	70.3%	22.3	66.7%	20.1	73.9%	22.5	65.9%	17.3	85.9%	22.4	66.2%	20.9	70.8%
9 (90 m^2)	15.5	21.4	72.3%	23.2	66.8%	20.7	74.6%	23.2	66.6%	17.9	86.4%	22.6	68.6%	21.5	72.0%
10 (100 m^2)	16.0	21.8	73.6%	23.9	67.0%	21.3	75.1%	23.9	66.9%	18.5	86.7%	22.7	70.7%	22.0	72.8%
11 (110 m^2)	16.5	22.1	74.7%	24.6	67.1%	21.8	75.6%	24.5	67.4%	19.0	87.1%	22.8	72.5%	22.5	73.5%
12 (120 m^2)	17.0	22.5	75.4%	25.0	68.0%	22.3	76.0%	25.0	67.9%	19.4	87.3%	22.9	74.2%	22.9	74.3%
13 (130 m^2)	17.4	22.7	76.5%	25.0	69.5%	22.7	76.4%	25.5	68.2%	19.8	87.6%	23.0	75.6%	23.1	75.2%
14 (140 m^2)	17.7	23.1	77.0%	25.3	70.1%	23.1	76.7%	25.9	68.5%	20.2	87.8%	23.1	77.0%	23.4	75.7%
15 (150 m^2)	18.1	23.2	78.0%	25.3	71.5%	23.4	77.2%	26.1	69.3%	20.5	88.1%	23.1	78.2%	23.6	76.6%
16 (160 m^2)	18.4	23.4	78.6%	25.6	71.9%	23.8	77.6%	26.4	69.9%	20.9	88.3%	23.2	79.4%	23.9	77.2%
17 (170 m^2)	18.8	23.8	78.9%	26.1	72.0%	24.1	77.8%	26.7	70.3%	21.2	88.4%	23.3	80.5%	24.2	77.5%
18 (180 m^2)	19.0	24.1	79.1%	26.1	73.0%	24.4	78.1%	27.0	70.6%	21.5	88.6%	23.4	81.4%	24.4	78.0%
19 (190 m^2)	19.3	24.3	79.5%	26.1	74.2%	24.6	78.5%	27.1	71.3%	21.8	88.8%	23.5	82.3%	24.6	78.7%
20 (200 m^2)	19.6	24.6	79.7%	26.2	74.8%	24.9	78.8%	27.3	71.8%	22.0	88.9%	23.6	83.1%	24.8	79.1%
21 (210 m^2)	19.8	24.9	79.7%	26.2	75.7%	25.1	79.1%	27.4	72.3%	22.3	89.0%	23.7	83.9%	24.9	79.6%
22 (220 m^2)	20.1	25.2	79.8%	26.4	75.9%	25.3	79.3%	27.6	72.6%	22.5	89.2%	23.8	84.5%	25.1	79.9%

23 (230 m^2)	20.4	25.5	79.7%	26.6	76.6%	25.6	79.5%	27.9	73.1%	22.8	89.2%	23.8	85.4%	25.4	80.2%
24 (240 m^2)	20.6	25.8	79.9%	26.6	77.3%	25.8	79.8%	28.0	73.6%	23.0	89.4%	23.9	86.0%	25.5	80.7%
25 (250 m^2)	20.8	26.0	80.1%	26.9	77.4%	26.0	80.0%	28.1	73.9%	23.3	89.5%	24.0	86.6%	25.7	80.9%
26 (260 m^2)	21.0	26.2	80.3%	26.8	78.4%	26.2	80.2%	28.3	74.3%	23.5	89.6%	24.1	87.3%	25.9	81.4%
27 (270 m^2)	21.2	26.3	80.8%	26.7	79.4%	26.3	80.6%	28.2	75.1%	23.7	89.7%	24.2	87.6%	25.9	81.9%
28 (280 m^2)	21.4	26.4	81.3%	26.6	80.4%	26.5	80.9%	28.2	75.8%	23.8	89.8%	24.3	88.1%	26.0	82.4%
29 (290 m^2)	21.6	26.4	81.6%	26.7	80.9%	26.6	81.2%	28.3	76.4%	24.0	89.9%	24.4	88.6%	26.1	82.8%
30 (300 m^2)	21. 8	26.6	81.9%	26.9	80.9%	26.8	81.4%	28.4	76.6%	24.2	90.0%	24.5	89.1%	26.2	83.1%
31 …	22.0	26.7	82.4%	26.9	81.6%	26.9	81.7%	28.5	77.1%	24.4	90.1%	24.5	89.5%	26.3	83.5%
32 …	22.1	26.8	82.7%	26.8	82.4%	27.0	81.9%	28.5	77.7%	24.5	90.2%	24.6	89.8%	26.4	83.9%
33 …	22.3	26.8	83.1%	26.8	83.0%	27.1	82.1%	28.5	78.1%	24.6	90.3%	24.7	90.2%	26.4	84.2%
34 …	22.4	26.7	83.6%	26.6	84.1%	27.1	82.6%	28.4	78.8%	24.7	90.5%	24.8	90.3%	26.4	84.8%
35 …	22.5	26.8	84.0%	26.7	84.3%	27.2	82.8%	28.5	79.1%	24.8	90.7%	24.8	90.7%	26.5	85.0%
36 …	22.6	26.9	84.3%	26.9	84.3%	27.3	83.0%	28.6	79.2%	24.9	90.7%	24.9	90.9%	26.6	85.2%
37 …	22.7	26.8	84.8%	26.7	85.3%	27.3	83.3%	28.5	79.8%	25.0	90.9%	25.0	91.1%	26.6	85.7%
38 …	22.9	26.8	85.2%	26.7	85.7%	27.4	83.6%	28.5	80.3%	25.1	91.0%	25.0	91.4%	26.6	86.0%
39 …	23.0	26.9	85.6%	26.6	86.4%	27.4	83.8%	28.5	80.7%	25.2	91.1%	25.1	91.6%	26.6	86.4%
40 …	23.1	26.8	86.0%	26.5	87.0%	27.5	84.1%	28.5	81.1%	25.3	91.2%	25.1	91.8%	26.6	86.7%
41 …	23.2	26.9	86.2%	26.6	87.1%	27.5	84.3%	28.5	81.3%	25.4	91.3%	25.2	92.1%	26.7	86.9%
42 …	23.3	26.9	86.6%	26.5	87.8%	27.6	84.5%	28.5	81.7%	25.5	91.4%	25.3	92.2%	26.7	87.2%
43 …	23.4	26.9	87.0%	26.5	88.3%	27.6	84.7%	28.6	81.9%	25.5	91.6%	25.3	92.4%	26.7	87.5%
44 …	23.5	26.9	87.3%	26.5	88.8%	27.7	84.9%	28.6	82.1%	25.6	91.7%	25.4	92.6%	26.8	87.7%
45 …	23.6	27.0	87.5%	26.5	89.0%	27.7	85.1%	28.7	82.2%	25.7	91.8%	25.4	92.8%	26.8	87.9%
46 …	23.7	27.0	87.8%	26.6	89.1%	27.8	85.3%	28.8	82.3%	25.8	91.9%	25.5	93.0%	26.9	88.1%
47 …	23.7	27.0	87.9%	26.6	89.1%	27.8	85.3%	28.9	82.1%	25.8	91.9%	25.5	93.1%	26.9	88.1%
48 …	23.9	27.1	88.2%	26.6	89.8%	27.9	85.5%	29.0	82.2%	25.9	92.0%	25.6	93.4%	27.0	88.4%
49 (490 m^2)	23.9	27.0	88.6%	26.4	90.5%	27.9	85.7%	29.0	82.6%	26.0	92.1%	25.6	93.5%	27.0	88.7%
50 (500 m^2)	24	27.0	88.9%	26.3	91.3%	27.9	86.0%	28.9	82.9%	26.0	92.2%	25.6	93.6%	27.0	89.0%

Table A5-4: Incidence-based species-richness estimators for ant communities in the Zaï system calculated per RAP-transect, habitat and region (± standard deviation). For each estimator, sampling efficacy (%-eff) was calculated as relation between the number of species observed (SOB) and the respective estimator value, indicating that sampling was very efficient. The column (mean all) represents the mean of all estimators. ICE: incidence-based coverage estimator, Jack1: jackknife-1, Boot: Bootstrap, MMM: Michaelis-Menten mean.

Sub-Sahel zone, Burkina Faso RAP-transect ^{length} Land-use type	SOB	Species-richness estimators for ant communities									
		ICE	%-eff	Jack1	%-eff	Boot	%-eff	MMM	%-eff	mean all	%-eff
ZDeg-1 $^{50\ m}$	8	9 ± 1	89	10 ± 1	80	9 ± 1	89	9	89	9	86
ZDeg-2 $^{50\ m}$	9	12 ± 2	75	12 ± 1	75	10 ± 1	90	11	82	11	80
ZDeg-3 $^{50\ m}$	13	30 ± 0	43	20 ± 3	65	16 ± 0	81	17	76	21	63
ZDeg-4 $^{50\ m}$	8	13 ± 0	62	12 ± 2	67	9 ± 0	85	9	89	11	74
Degraded land (ZDeg)	15	30 ± 0	50	21 ± 3	71	17 ± 0	88	15	100	21	72
ZMil-1 $^{100\ m}$	8	9 ± 0	89	9 ± 1	89	8 ± 0	100	8	100	9	94
ZMil-2 $^{50\ m}$	11	12 ± 0	92	13 ± 1	85	12 ± 1	92	12	92	12	90
ZMil-3 $^{50\ m}$	13	15 ± 0	87	16 ± 1	81	14 ± 1	93	15	87	15	87
ZMil-4 $^{50\ m}$	18	21 ± 2	86	22 ± 3	82	20 ± 1	90	22	82	21	85
Millet field (ZMil)	22	25 ± 0	88	27 ± 3	81	24 ± 0	92	22	100	25	90
ZF20-1 $^{100\ m}$	17	22 ± 0	77	22 ± 3	77	19 ± 0	89	19	89	21	83
ZF20-2 $^{50\ m}$	12	18 ± 0	67	17 ± 2	71	14 ± 0	86	13	92	16	77
ZF20-3 $^{50\ m}$	14	18 ± 2	78	18 ± 1	78	16 ± 1	88	17	82	17	81
ZF20-4 $^{50\ m}$	18	24 ± 0	75	24 ± 2	75	21 ± 1	86	22	82	23	79
Zaï forest 20-yrs (ZF20)	25	31 ± 0	81	31 ± 3	81	28 ± 1	89	26	96	29	86
ZF30-1 $^{100\ m}$	19	22 ± 0	86	23 ± 3	83	21 ± 0	90	21	90	22	87
ZF30-2 $^{50\ m}$	23	39 ± 4	59	33 ± 3	70	27 ± 0	85	30	77	32	71
ZF30-3 $^{50\ m}$	18	21 ± 0	86	23 ± 3	78	20 ± 1	90	20	90	21	86
ZF30-4 $^{50\ m}$	23	34 ± 3	68	31 ± 2	74	27 ± 0	85	29	79	30	76
Zaï forest 30-yrs (ZF30)	35	41 ± 0	85	43 ± 3	81	39 ± 0	90	36	97	40	88
Sub-Sahel zone	41	45 ± 0	91	47 ± 3	87	44 ± 0	93	40	103	44	93

Table A5-5: Incidence-based species-richness estimators for ant communities in the North-Sudanese sites, calculated per RAP-transect, habitat and region (± standard deviation). For each estimator, sampling efficacy (%-eff) was calculated as relation between the number of species observed (SOB) and the respective estimator value, indicating that sampling was very efficient. The last column (mean all) represents the mean of the shown estimators: ICE: incidence-based coverage estimator, Jack1: jackknife-1, Boot: Bootstrap, MMM: Michaelis-Menten mean.

North-Sudan zone, Burkina Faso		Species-richness estimators for ant communities									
RAP-transect ^{length} Land-use type	SOB	ICE	%-eff	Jack1	%-eff	Boot	%-eff	MMM	%-eff	mean all	%-eff
FRes-1 $^{100 m}$	28	40 ± 2	70	38 ± 3	74	32 ± 0	88	32	88	36	79
FRes-2 $^{50 m}$	14	18 ± 0	78	18 ± 2	78	16 ± 0	88	15	93	17	84
FRes-3 $^{50 m}$	18	24 ± 2	75	23 ± 2	78	21 ± 1	86	22	82	23	80
FRes-4 $^{50 m}$	21	26 ± 0	81	26 ± 2	81	23 ± 0	91	26	81	25	83
Pama reserve (FRes)	36	43 ± 0	84	45 ± 3	80	41 ± 0	88	39	92	42	86
FPas-1 $^{100 m}$	18	22 ± 1	82	23 ± 2	78	20 ± 1	90	21	86	22	84
FPas-2 $^{50 m}$	21	33 ± 0	64	29 ± 2	72	25 ± 0	84	26	81	28	74
FPas-3 $^{50 m}$	17	21 ± 1	81	22 ± 2	77	19 ± 0	89	19	89	20	84
Pasture area (FPas)	28	40 ± 0	70	38 ± 3	74	32 ± 0	88	29	97	35	81
FFal-1 $^{100 m}$	19	27 ± 0	70	25 ± 2	76	22 ± 1	86	21	90	24	80
FFal-2 $^{50 m}$	25	30 ± 0	83	31 ± 2	81	28 ± 1	89	29	86	30	85
FFal-3 $^{50 m}$	26	34 ± 2	76	34 ± 2	76	29 ± 1	90	30	87	32	82
Fallow land (FFal)	36	43 ± 0	84	44 ± 3	82	40 ± 0	90	38	95	41	87
FCot-1 $^{100 m}$	11	15 ± 0	73	15 ± 2	73	13 ± 0	85	14	79	14	77
FCot-2 $^{50 m}$	13	16 ± 0	81	17 ± 2	76	15 ± 0	87	16	81	16	81
FCot-3 $^{50 m}$	17	22 ± 2	77	22 ± 2	77	19 ± 1	89	20	85	21	82
Cotton field (FCot)	19	21 ± 0	90	22 ± 2	86	21 ± 0	90	21	90	21	89
North-Sudanese zone	53	61 ± 0	87	63 ± 3	84	57 ± 0	93	52	102	58	91

Table A5-6: Incidence-based species richness estimators for termites in the Zaï system calculated per RAP-transect, habitat and region (± standard deviation SD). For each estimator, sampling efficacy (%-eff) was calculated as relation between the number of species observed (SOB) and the respective estimator value, indicating that sampling was very efficient. The column (mean all) represents the mean of all estimators. ICE: incidence-based coverage estimator, Jack1: jackknife1, Boot: Bootstrap, MMM: Michaelis-Menten mean.

Sub-Sahel zone, Burkina Faso		Species-richness estimators for termite communities									
RAP-transect length Zaï system stage	SOB	ICE	%-eff	Jack1	%-eff	Boot	%-eff	MMM	%-eff	mean all	%-eff
ZDeg-1 50 m	0	0 ± 0	100	0 ± 0	100	0 ± 0	100	0	100	0	100
ZDeg-2 50 m	0	0 ± 0	100	0 ± 0	100	0 ± 0	100	0	100	0	100
ZDeg-3 50 m	1	2 ± 0	67	2 ± 1	53	1 ± 0	74	0	0	1	83
ZDeg-4 50 m	0	0 ± 0	100	0 ± 0	100	0 ± 0	100	0	100	0	100
Degraded land (ZDeg)	1	2 ± 0	67	2 ± 1	51	1 ± 0	74	0	0	1	82
ZMil-1 100 m	8	13 ± 2	63	12 ± 3	68	10 ± 0	82	14	57	12	67
ZMil-2 50 m	6	8 ± 0	80	8 ± 1	77	7 ± 0	88	8	71	8	79
ZMil-3 50 m	8	14 ± 1	59	12 ± 3	69	10 ± 1	84	11	74	11	70
ZMil-4 50 m	11	16 ± 0	70	15 ± 2	75	13 ± 0	86	14	77	14	77
Millet field (ZMil)	16	24 ± 0	68	22 ± 2	73	19 ± 0	87	18	90	20	78
ZF20-1 100 m	8	16 ± 5	50	12 ± 2	68	10 ± 0	82	13	63	13	64
ZF20-2 50 m	7	9 ± 0	75	10 ± 1	72	8 ± 1	86	11	64	10	73
ZF20-3 50 m	7	17 ± 0	40	12 ± 2	61	9 ± 0	79	22	32	15	47
ZF20-4 50 m	14	20 ± 0	69	20 ± 2	69	17 ± 0	82	30	46	22	64
Zaï forest 20-yrs (ZF20)	20	22 ± 0	86	24 ± 3	80	22 ± 1	88	26	74	23	82
ZF30-1 100 m	18	21 ± 0	86	23 ± 2	79	20 ± 1	89	23	80	22	83
ZF30-2 50 m	7	25 ± 0	28	12 ± 2	57	9 ± 0	77	13	55	15	47
ZF30-3 50 m	11	17 ± 2	66	16 ± 2	71	13 ± 0	85	14	80	15	75
ZF30-4 50 m	9	11 ± 0	84	12 ± 1	77	10 ± 0	86	15	59	12	75
Zaï forest 30-yrs (ZF30)	25	35 ± 0	72	34 ± 3	74	29 ± 1	87	28	89	31	80
Sub-Sahelian zone	33	47 ± 0	70	44 ± 4	75	37 ± 0	88	34	96	41	81

Table A5-7: Incidence-based species-richness estimators for termite communities in the North-Sudanese sites, calculated per RAP-transect, habitat and region (± standard deviation). Sampling efficacy (%-eff) was calculated as relation between the number of species observed (SOB) and the respective estimator value, indicating that sampling was very efficient. The mean of all estimators is shown in the last column (mean all). ICE: incidence-based coverage estimator, Jack1: jackknife1, Boot: Bootstrap, MMM: Michaelis-Menten mean.

North-Sudan zone, Burkina Faso		Species-richness estimators for termite communities									
RAP-transect length Land-use type	SOB	ICE	%-eff	Jack1	%-eff	Boot	%-eff	MMM	%-eff	mean all	%-eff
FRes-1 100 m	13	16 ± 0	80	17 ± 2	77	15 ± 1	88	16	83	16	82
FRes-2 50 m	13	16 ± 1	82	17 ± 2	78	15 ± 1	89	17	78	16	81
FRes-3 50 m	17	27 ± 0	62	24 ± 3	70	20 ± 1	85	20	87	23	75
FRes-4 50 m	14	16 ± 0	90	17 ± 1	84	15 ± 1	92	17	83	16	87
Pama reserve (FRes)	24	27 ± 0	89	28 ± 2	86	26 ± 0	92	26	94	27	90
FPas-1 100 m	8	18 ± 0	44	12 ± 2	68	10 ± 0	84	9	87	12	66
FPas-2 50 m	7	12 ± 0	57	10 ± 1	72	8 ± 0	84	11	66	10	68
FPas-3 50 m	4	6 ± 0	67	6 ± 1	69	5 ± 1	82	11	37	7	58
Pasture area (FPas)	14	27 ± 0	53	21 ± 2	67	17 ± 0	82	17	81	20	69
FFal-1 100 m	5	7 ± 1	75	7 ± 1	73	6 ± 0	86	8	65	7	74
FFal-2 50 m	9	12 ± 0	73	13 ± 2	71	11 ± 0	85	15	61	13	72
FFal-3 50 m	7	14 ± 3	50	11 ± 2	66	8 ± 1	83	10	74	11	66
Fallow land (FFal)	13	16 ± 0	79	18 ± 2	73	15 ± 0	87	17	79	16	79
FCot-1 100 m	4	4 ± 0	91	5 ± 1	81	4 ± 0	91	6	72	5	82
FCot-2 50 m	1	1 ± 0	100	1 ± 0	100	1 ± 0	100	1	98	1	100
FCot-3 50 m	4	5 ± 0	87	5 ± 1	82	4 ± 0	91	5	88	5	86
Cotton field (FCot)	5	6 ± 0	91	6 ± 1	84	5 ± 0	93	6	90	6	89
North-Sudanese zone	31	36 ± 0	85	38 ± 3	82	34 ± 0	91	32	97	35	88

Table A5-8: Quality of four incidence-based species richness estimators exemplarily calculated for ant communities in the Zaï system per RAP-transect, habitat and region: three non-parametric estimators ICE, Jackknife 1, Bootstrap, and the asymptotic Michaelis Menten. Bold values are given for the estimator that fitted the data best, italics for the second-best.

Ants in the Zaï system		ICE				Jackknife 1				Bootstrap				Michaelis-Menten Mean			
RAP-transect Zaï stage	SOB	ICE ± *sd*	MD	MSD	MSPD	Jack ± *sd*	MD	MSD	MSPD	Boot ± *sd*	MD	MSD	MSPD	MMM	MD	MSD	MSPD
ZDeg-1$^{50\ m}$	8	9 ± 1	1,2	1,5	0,02	10 ± 1	1,8	3,2	0,05	9 ± 1	**0,7**	**0,5**	**0,01**	*9*	*0,9*	*0,9*	*0,01*
ZDeg-2$^{50\ m}$	9	12 ± 2	2,8	7,8	0,10	12 ± 1	2,7	7,3	0,09	10 ± 1	**1,2**	**1,5**	**0,02**	*11*	*2,1*	*4,5*	*0,06*
ZDeg-3$^{50\ m}$	13	30 ± 0	16,8	281,6	1,67	20 ± 3	7,2	51,8	0,31	16 ± 0	**2,9**	**8,1**	**0,05**	*17*	*4,0*	*16,1*	*0,10*
ZDeg-4$^{50\ m}$	8	13 ± 0	4,6	21,5	0,34	12 ± 2	3,6	13,0	0,20	*9 ± 0*	*1,4*	*2,0*	*0,03*	**9**	**1,3**	**1,7**	**0,03**
Degraded land r^2 SOB *vs.* est	15	30 ± 0 0,9769	6,4	78,1	0,53	21 ± 3 0,9829	3,8	18,8	0,16	**17 ± 0** 0,9959	**1,5**	**3,0**	**0,03**	*15* **0,9976**	*2,1*	*5,8*	*0,05*
ZMil-1$^{100\ m}$	8	9 ± 0	0,5	0,3	0,09	9 ± 1	0,9	0,9	0,82	**8 ± 0**	**0,4**	**0,2**	**0,026**	*8*	*0,4*	*0,2*	*0,031*
ZMil-2$^{50\ m}$	11	12 ± 0	1,0	1,1	1,17	13 ± 1	1,8	3,2	10,50	**12 ± 1**	**0,9**	**0,8**	**0,69**	*12*	*1,0*	*1,0*	*1,04*
ZMil-3$^{50\ m}$	13	15 ± 0	2,0	3,8	14,76	16 ± 1	2,7	7,3	53,14	**14 ± 1**	**1,3**	**1,7**	**2,86**	*15*	*1,6*	*2,6*	*6,55*
ZMil-4$^{50\ m}$	18	21 ± 2	2,8	7,6	58,0	22 ± 3	3,6	13,0	168,0	**20 ± 1**	**1,9**	**3,6**	**12,76**	*22*	*3,8*	*14,6*	*212,9*
Millet field r^2 SOB *vs.* est	22	*25 ± 0* 0,9993	*1,6*	*3,2*	*18,51*	27 ± 3 0,9993	2,3	6,1	58,10	**24 ± 0** **0,9999**	**1,1**	**1,6**	**4,08**	22 0,9988	1,7	4,6	55,14
ZF20-1$^{100\ m}$	17	22 ± 0	5,3	28,4	0,10	22 ± 3	4,8	22,7	0,08	*19 ± 0*	*2,2*	*4,8*	*0,02*	**19**	**2,1**	**4,5**	**0,02**
ZF20-2$^{50\ m}$	12	18 ± 0	5,8	33,3	0,23	17 ± 2	4,5	20,3	0,14	*14 ± 0*	*1,9*	*3,5*	*0,03*	**13**	**1,5**	**2,2**	**0,02**
ZF20-3$^{50\ m}$	14	18 ± 2	4,1	17,0	0,09	18 ± 1	3,6	13,0	0,07	**16 ± 1**	**1,9**	**3,5**	**0,02**	*17*	*3,0*	*8,9*	*0,05*
ZF20-4$^{50\ m}$	19	24 ± 0	5,4	29,6	0,08	24 ± 2	5,4	29,2	0,08	**21 ± 1**	**2,3**	**5,4**	**0,02**	*22*	*2,7*	*7,4*	*0,02*
Young forest r^2 SOB *vs.* est	25	31 ± 0 0,9755	5,2	27,1	0,13	31 ± 3 0,9895	4,6	21,3	0,09	**28 ± 1** **0,9998**	**2,1**	**4,3**	**0,02**	*26* *0,9857*	*2,3*	*5,8*	*0,02*
ZF30-1$^{100\ m}$	19	22 ± 0	2,7	7,1	0,02	23 ± 3	3,8	14,5	0,04	**21 ± 0**	**1,9**	**3,6**	**0,01**	21	*2,4*	*5,9*	*0,02*

ZF30-2 $^{50\ m}$	23	39 ± 4	16,2	263,4	0,50	33 ± 3	9,9	98,0	0,19	**27 ± 0**	**4,2**	**17,8**	**0,03**	*30*	*7,3*	*52,7*	*0,10*
ZF30-3 $^{50\ m}$	18	21 ± 0	3,5	12,1	0,04	23 ± 3	4,5	20,3	0,06	**20 ± 1**	**1,9**	**3,7**	**0,01**	*20*	*2,3*	*5,1*	*0,02*
ZF30-4 $^{50\ m}$	23	34 ± 3	10,6	111,5	0,21	31 ± 2	8,1	65,6	0,12	27 ± 0	3,5	12,3	0,02	29	5,7	31,9	0,06
Old forest r^2 SOB *vs.* est	35	41 ± 0 0,9549	8,2	98,5	0,19	43 ± 3 0,9822	6,6	49,6	0,10	**39 ± 0 0,9957**	**2,9**	**9,3**	**0,02**	*36 0,9897*	*4,4*	*23,9*	*0,05*
Sub-Sahel zone r^2 SOB *vs.* est	41	45 ± 0 0,8557	7,6	79,1	0,29	47 ± 3 0,9770	6,1	38,6	0,08	*44 ± 0 0,9959*	*2,8*	*8,4*	*0,02*	**40 0,9836**	**0,4**	**0,6**	**0,001**
RAP-transect Zaï stage	SOBs	ICE	MD	MSD	MSPD	Jack1	MD	MSD	MSPD	Boot	MD	MSD	MSPD	MMM	MD	MSD	MSPD

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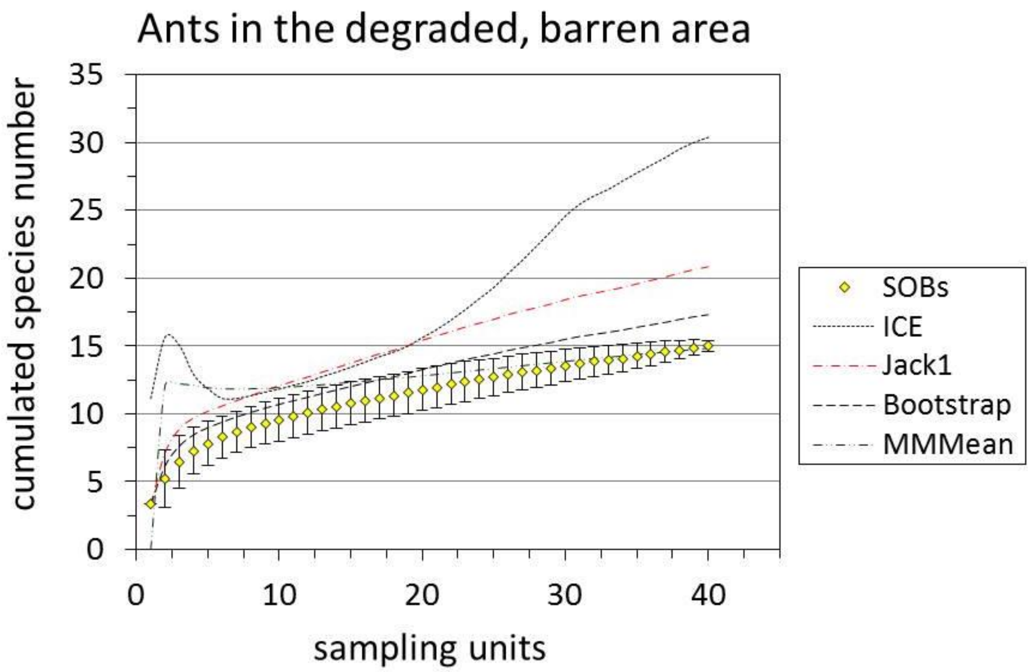


Fig. A5-2: Incidence-based, randomized accumulation rates (with standard deviations) of observed and estimated ant species richness in the degraded, barren area of the Zaï system (sub-Sahel, Burkina Faso) from 2004–2008. Four estimators are shown: the incidence-based coverage estimator (ICE), jackknife 1 (Jack1), Bootstrap, and Michaelis-Menten Mean (MMMean).

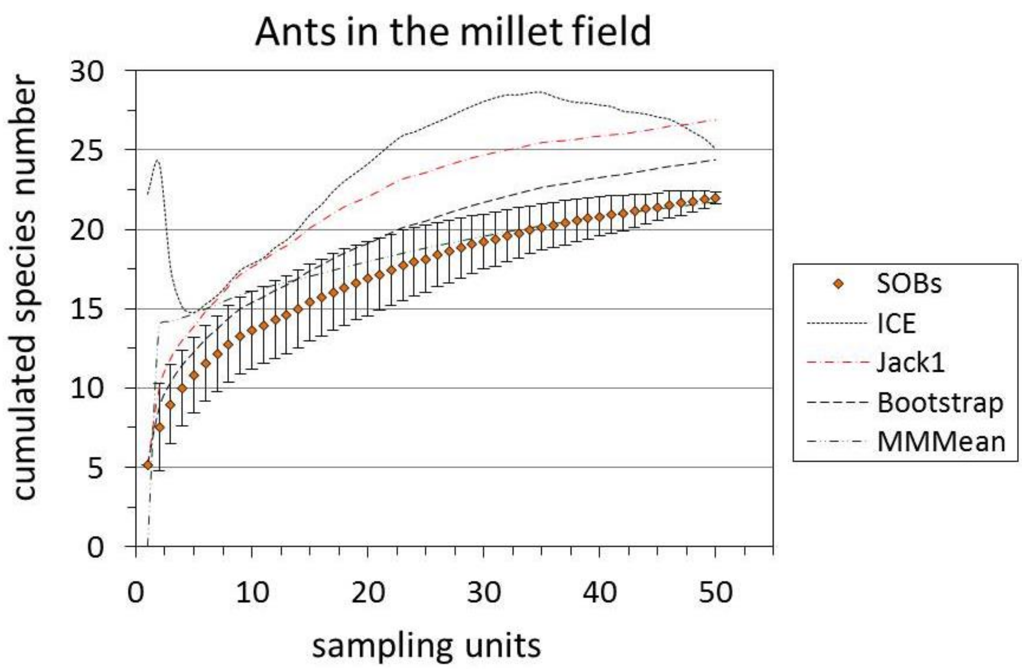


Fig. A5-3: Incidence-based, randomized accumulation rates (with standard deviations) of observed and estimated ant species richness in millet fields cultivated with the Zaï technique (sub-Sahel, Burkina Faso) from 2004–2008. Four estimators are shown: the incidence-based coverage estimator (ICE), jackknife 1 (Jack1), Bootstrap, and Michaelis-Menten Mean (MMMean).

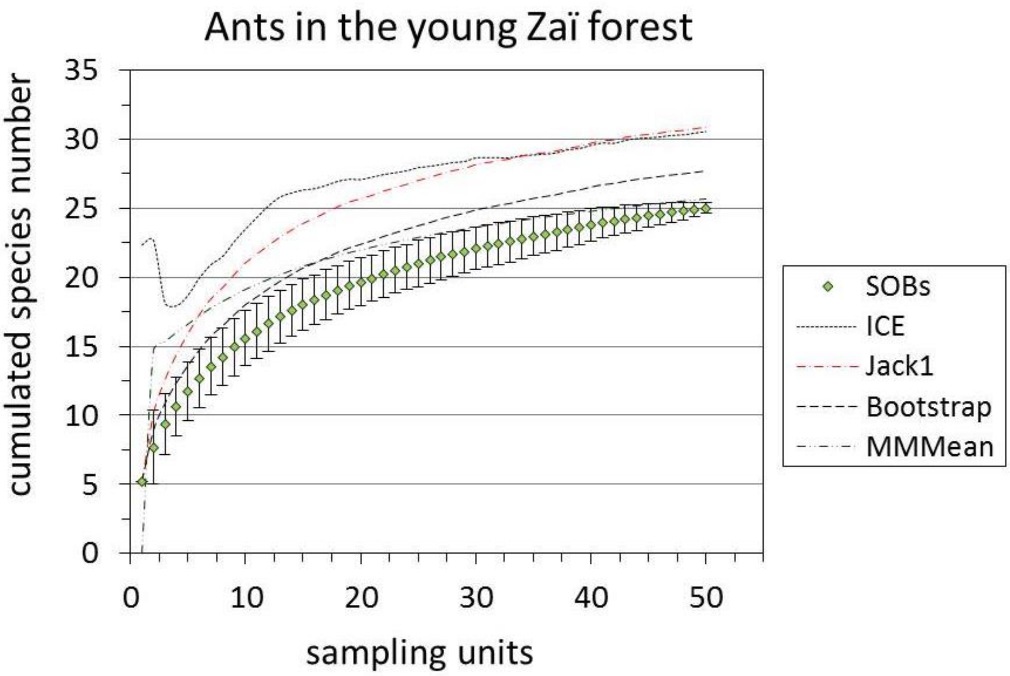


Fig. A5-4: Incidence-based, randomized accumulation rates (with standard deviations) of observed and estimated ant species richness in the young Zaï forest (sub-Sahel, Burkina Faso) from 2004–2008. Four estimators are shown: the incidence-based coverage estimator (ICE), jackknife 1 (Jack1), Bootstrap, and Michaelis-Menten Mean (MMMean).

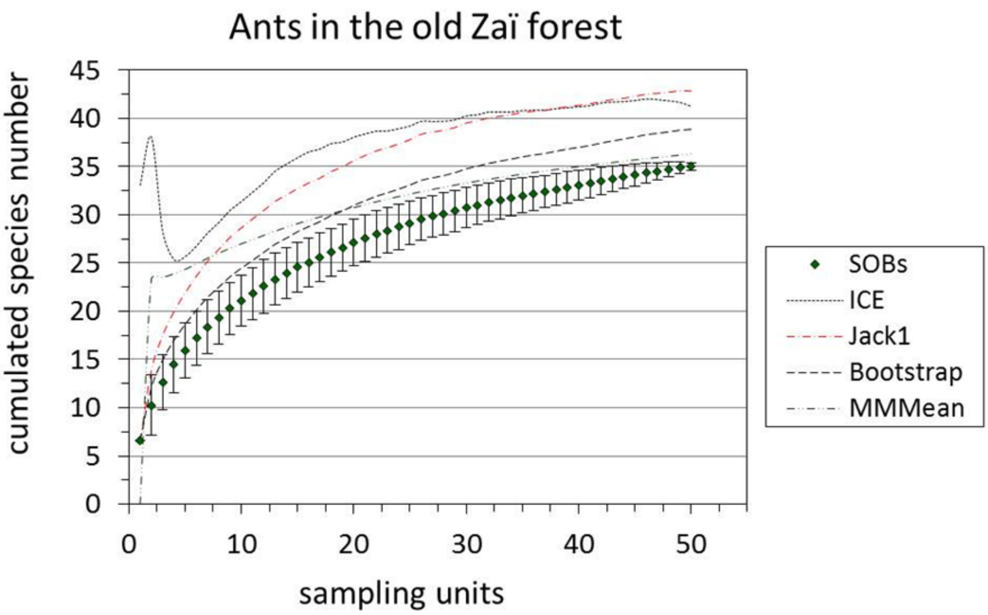


Fig. A5-5: Incidence-based, randomized accumulation rates (with standard deviations) of observed and estimated ant species richness in the old Zaï forest (sub-Sahel, Burkina Faso) from 2004–2008. Four estimators are shown: the incidence-based coverage estimator (ICE), jackknife 1 (Jack1), Bootstrap, and Michaelis-Menten Mean (MMMean).

MEASURES OF WITHIN-HABITAT DIVERSITY OF ANT COMMUNITIES

Land-use intensification gradient in the sub-Sahel region of Burkina Faso (LUI-1)

Table A5-9: Measures of within-habitat or alpha-diversity for ant communities in the Zaï system sites calculated per RAP-transect, per habitat and per region (± standard deviation). SOB: number of species observed.

Sub-Sahel zone, Burkina Faso RAP-transect ^{length} Zaï succession stage	Alpha-(α)-diversity Indices		
	SOB	Shannon-Wiener H'	Simpsons' D
ZDeg-1 $^{50\ m}$	8	1.8 ± 0.1	6.1 ± 0
ZDeg-2 $^{50\ m}$	9	1.9 ± 0	6.9 ± 0
ZDeg-3 $^{50\ m}$	13	2 ± 0	7.3 ± 0
ZDeg-4 $^{50\ m}$	8	2.2 ± 0.1	8.2 ± 0
Degraded land (ZDeg)	15	2.2 ± 0.1	8 ± 0
ZMil-1 $^{100\ m}$	8	1.9 ± 0	6.3 ± 0
ZMil-2 $^{50\ m}$	11	2.2 ± 0	9.5 ± 0
ZMil-3 $^{50\ m}$	13	2.3 ± 0	10.7 ± 0
ZMil-4 $^{50\ m}$	18	2.7 ± 0	15 ± 0
Millet field (ZMil)	22	2.5 ± 0	9.9 ± 0.1
ZF20-1 $^{100\ m}$	17	2.4 ± 0	10 ± 0.2
ZF20-2 $^{50\ m}$	12	2.1 ± 0	8.2 ± 0.2
ZF20-3 $^{50\ m}$	14	2.2 ± 0	7.2 ± 0.3
ZF20-4 $^{50\ m}$	18	2.7 ± 0	14.2 ± 0
Zaï forest 20-yrs (ZF20)	25	2.6 ± 0	10 ± 0
ZF30-1 $^{100\ m}$	19	2.6 ± 0	12.1 ± 0
ZF30-2 $^{50\ m}$	23	2.8 ± 0	16.3 ± 0
ZF30-3 $^{50\ m}$	18	2.7 ± 0	14.8 ± 0
ZF30-4 $^{50\ m}$	23	2.8 ± 0	16.4 ± 0
Zaï forest 30-yrs (ZF30)	35	2.9 ± 0	14.5 ± 0
Sub-Sahel region	41	2.8 ± 0	11.7 ± 0

Land-use intensification gradient in the North-Sudanese region of Burkina Faso (LUI-2)

Table A5-10: Measures of within-habitat (α-) diversity for ant communities in the North-Sudanese sites calculated per RAP-transect, the habitats and the region (± standard deviation). SOB: number of species observed.

North-Sudan zone, Burkina Faso RAP-transect ^{length} Study site	Alpha-(α)-diversity Indices		
	SOB	Shannon-Wiener H’	Simpsons’ D
FRes-1 $^{100\ m}$	28	2.9 ± 0	14.3 ± 0.3
FRes-2 $^{50\ m}$	14	2.3 ± 0	9.9 ± 0.2
FRes-3 $^{50\ m}$	18	2.6 ± 0	13.4 ± 0
FRes-4 $^{50\ m}$	21	2.8 ± 0	15.2 ± 0
Pama reserve (FRes)	36	3.0 ± 0	15.6 ± 0.2
FPas-1 $^{100\ m}$	18	2.6 ± 0	11.7 ± 0.3
FPas-2 $^{50\ m}$	21	2.7 ± 0	14 ± 0
FPas-3 $^{50\ m}$	17	2.6 ± 0	13.5 ± 0
Pasture area (FPas)	28	2.8 ± 0	13.1 ± 0.1
FFal-1 $^{100\ m}$	19	2.5 ± 0	10.8 ± 0
FFal-2 $^{50\ m}$	25	3 ± 0	20.8 ± 0
FFal-3 $^{50\ m}$	26	3 ± 0	20.5 ± 0.4
Fallow land (FFal)	36	3.0 ± 0	16.6 ± 0.2
FCot-1 $^{100\ m}$	11	2 ± 0	5.9 ± 0.2
FCot-2 $^{50\ m}$	13	2.4 ± 0	11.4 ± 0
FCot-3 $^{50\ m}$	17	2.6 ± 0	12.9 ± 0
Cotton field (FCot)	19	2.5 ± 0	10.5 ± 0.1
North-Sudan region	53	3.3 ± 0	18.8 ± 0.1

MEASURES OF WITHIN-HABITAT DIVERSITY OF TERMITE COMMUNITIES

Land-use intensification gradient in the sub-Sahel region of Burkina Faso (LUI-1)

Table A5-11: Measures of within-habitat (α-) diversity for termite communities in the Zaï system sites calculated per RAP-transect, the habitats and the region (± standard deviation). SOB: number of species observed.

Sub-Sahel zone, Burkina Faso RAP-transect ^{length} Zaï succession stage	Alpha-(α)-diversity Indices		
	SOB	Shannon-Wiener H'	Simpsons' D
ZDeg-1 $^{50\ m}$	0	0	0
ZDeg-2 $^{50\ m}$	0	0	0
ZDeg-3 $^{50\ m}$	1	0	0
ZDeg-4 $^{50\ m}$	0	0	0
Degraded land (ZDeg)	1	0	0
ZMil-1 $^{100\ m}$	8	1.9 ± 0	8 ± 1
ZMil-2 $^{50\ m}$	6	1.6 ± 0	5.7 ± 0
ZMil-3 $^{50\ m}$	8	1.8 ± 0	5.8 ± 0.7
ZMil-4 $^{50\ m}$	11	2.1 ± 0.1	7.5 ± 0
Millet field (ZMil)	16	2.3 ± 0	9 ± 0
ZF20-1 $^{100\ m}$	8	1.7 ± 0	4.6 ± 0.5
ZF20-2 $^{50\ m}$	7	1.8 ± 0	7.5 ± 0
ZF20-3 $^{50\ m}$	7	1.8 ± 0	11.3 ± 4.4
ZF20-4 $^{50\ m}$	14	2.5 ± 0.1	19.7 ± 0
Zaï forest 20-yrs (ZF20)	20	2.6 ± 0	12.2 ± 0.4
ZF30-1 $^{100\ m}$	18	2.5 ± 0	10.6 ± 0
ZF30-2 $^{50\ m}$	7	1.5 ± 0.1	3.7 ± 0.3
ZF30-3 $^{50\ m}$	11	2.1 ± 0.1	8.4 ± 0
ZF30-4 $^{50\ m}$	9	2.0 ± 0.1	11.4 ± 0
Zaï forest 30-yrs (ZF30)	25	2.7 ± 0	12 ± 0
Sub-Sahel region	33	2.9 ± 0	15 ± 0

Land-use intensification gradient in the North-Sudanese region of Burkina Faso (LUI-2)

Table A5-12: Measures of within-habitat (α-) diversity for termite communities in the North-Sudanese sites calculated per RAP-transect, the habitats and the region (± standard deviation SD). SOB: number of species observed.

North-Sudan zone, Burkina Faso RAP-transect ^{length} Study site	Alpha-(α)-diversity Indices		
	SOB	Shannon-Wiener H’	Simpsons’ D
FRes-1 $^{100\ m}$	13	2.3 ± 0	8.9 ± 0.3
FRes-2 $^{50\ m}$	13	2.4 ± 0	11.5 ± 0.6
FRes-3 $^{50\ m}$	17	2.5 ± 0	11.5 ± 0
FRes-4 $^{50\ m}$	14	2.5 ± 0	13.1 ± 0
Pama reserve (FRes)	24	2.8 ± 0	13.3 ± 0
FPas-1 $^{100\ m}$	8	1.6 ± 0	8 ± 1
FPas-2 $^{50\ m}$	7	1.6 ± 0	4.4 ± 0.3
FPas-3 $^{50\ m}$	4	1.3 ± 0	7.5 ± 0
Pasture area (FPas)	14	1.9 ± 0	4.8 ± 0
FFal-1 $^{100\ m}$	5	1.4 ± 0.1	4.6 ± 0
FFal-2 $^{50\ m}$	9	2.0 ± 0	10 ± 0
FFal-3 $^{50\ m}$	7	1.6 ± 0	4.6 ± 0.3
Fallow land (FFal)	13	2.2 ± 0	7.5 ± 0.2
FCot-1 $^{100\ m}$	4	1.3 ± 0.1	4.1 ± 0.3
FCot-2 $^{50\ m}$	1	0 ± 0	1 ± 0
FCot-3 $^{50\ m}$	4	1.2 ± 0.1	3.5 ± 0
Cotton field (FCot)	5	1.3 ± 0	3.8 ± 0.1
North-Sudan region	31	2.8 ± 0	12.1 ± 0

PARAMETERS PREDICTING VARIATIONS IN ANT COMMUNITIES

Land-use intensification gradient in the sub-Sahel region (LUI-1)

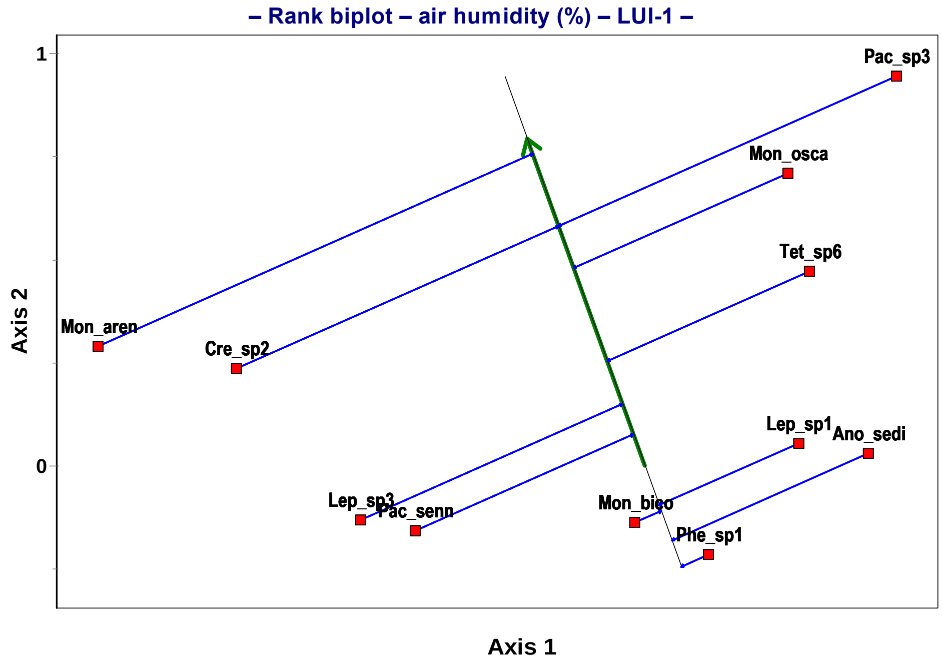


Fig. A5-6: Ranked biplot of common ant species (name abbreviated) to the environmental variable 'percentage air humidity' in the four Zaï stages (sub-Sahel region, Burkina Faso). Results obtained by Canonical Correspondence Analysis.

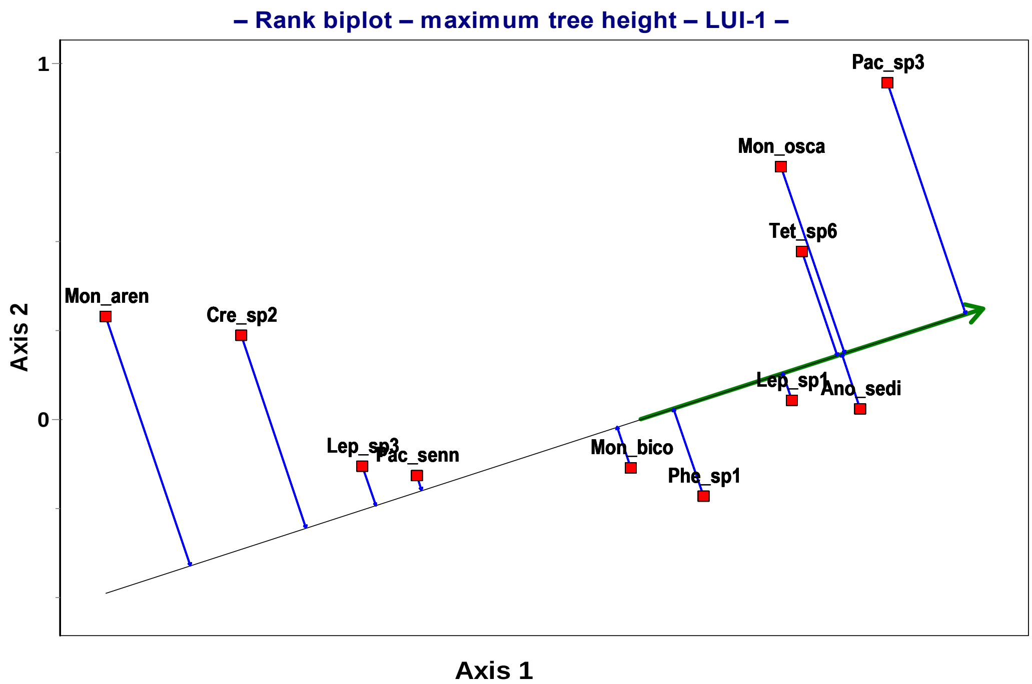


Fig. A5-7: Ranked biplot of common ant species (name abbreviated) to the environmental variable 'maximum tree height' in the four Zaï stages (sub-Sahel region, Burkina Faso). Results obtained by Canonical Correspondence Analysis.

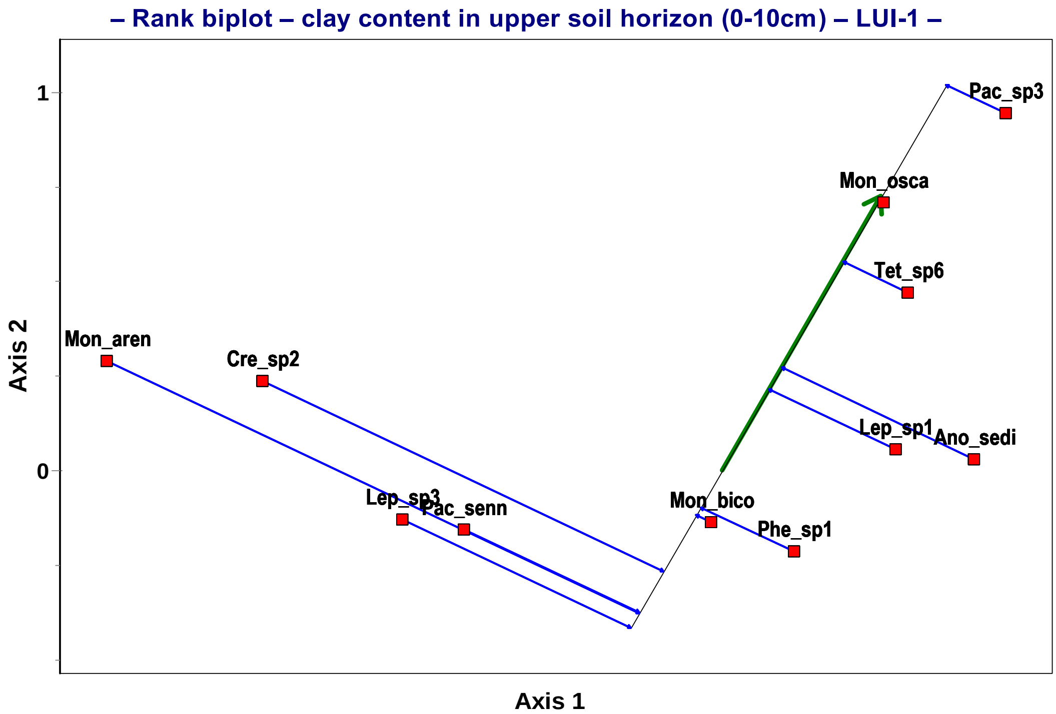


Fig. A5-8: Ranked biplot of common ant species (name abbreviated) to the environmental variable 'clay content in the upper soil horizon (0-10 cm)' in the four Zaï stages (sub-Sahel region, Burkina Faso). Results obtained by Canonical Correspondence Analysis**.**

Ant species: Ano_sedi (0): *Anochetus sedilloti*; Cre_sp2 (1): *Crematogaster* sp.2; Lep_sp1 (2): *Lepisiota* sp.1; Lep_sp3 (3): *Lepisiota* sp.3; Mon_aren (4): *Monomorium areniphilum*; Mon_bico (5): *Monomorium bicolor*; Mon_osca (6): *Monomorium oscaris*; Pac_senn (7): *Pachycondyla senaarensis*; Pac_sp3 (8): *Pachycondyla* sp.3; Phe_sp1 (9): *Pheidole* sp.1; Tet_sp6 (10): *Tetramorium* sp.6.

Land-use intensification gradient in the North-Soudan region (LUI-2)

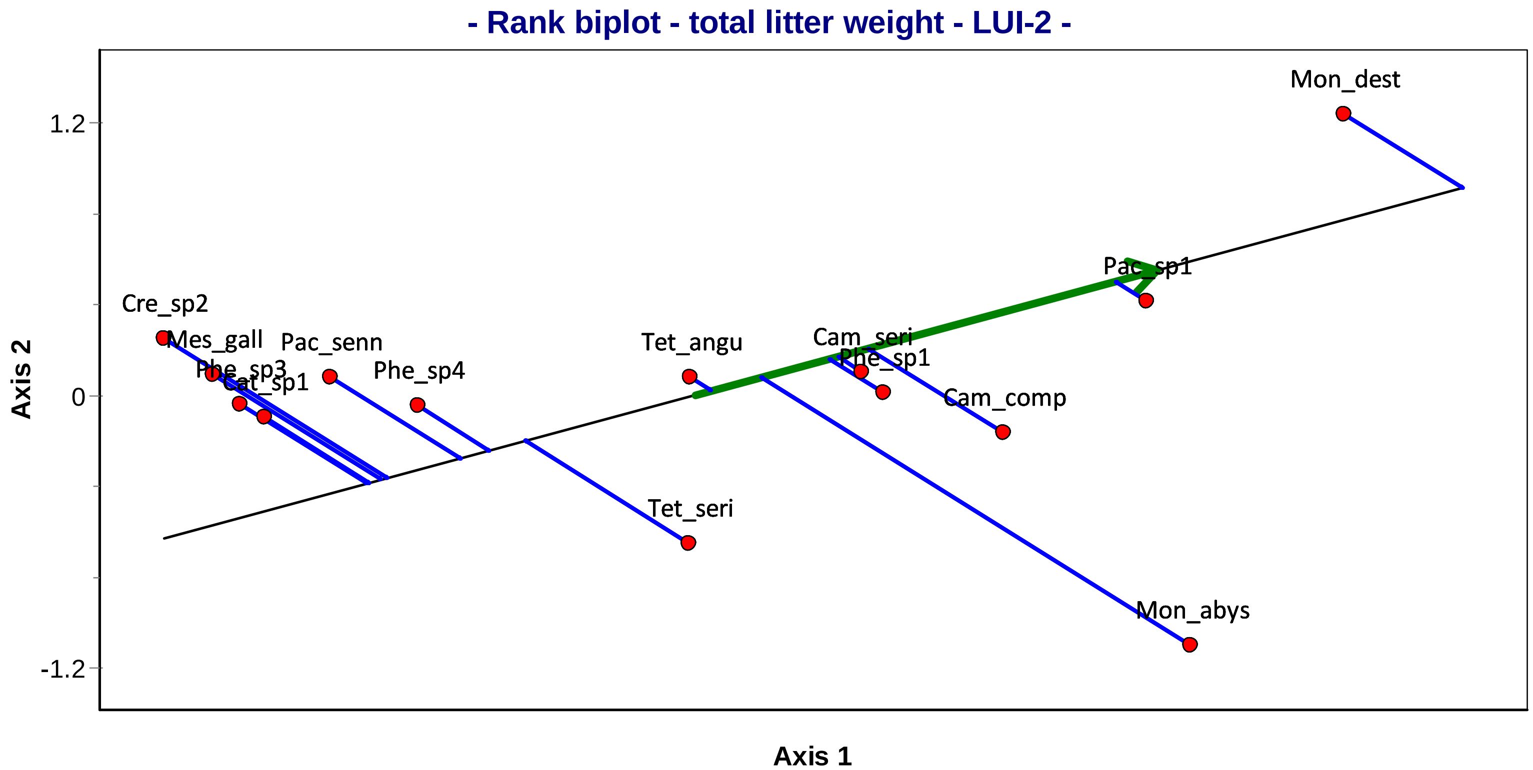


Fig. A5-9: Ranked biplot of common ant species (name abbreviated) to the environmental variable 'total litter weight' in the four North-Sudanese sites (Burkina Faso). Results obtained by Canonical Correspondence Analysis.

Ant species are Camp_comp (0): *Camponotus compressiscapus,* Cam_seri (1): *Camponotus sericeus,* Cat_sp1 (2): *Cataglyphis* sp.1, Cre_sp2 (3): *Crematogaster* sp.2, Mes_gall (4): *Messor galla,* Mon_abys (5): *Monomorium abyssinicum,* Mon_dest (6): *Monomorium destructor,* Pac_senn (7): *Pachycondyla senaarensis,* Pac_sp1 (8): *Pachycondyla* sp.1, Phe_sp1 (9): *Pheidole* sp.1, Phe_sp3 (10): *Pheidole* sp.3, Phe_sp4 (11): *Pheidole* sp.4, Tet_ang (12): *Tetramorium angulinode,* Tet_seri (13): *Tetramorium sericeiventre.*

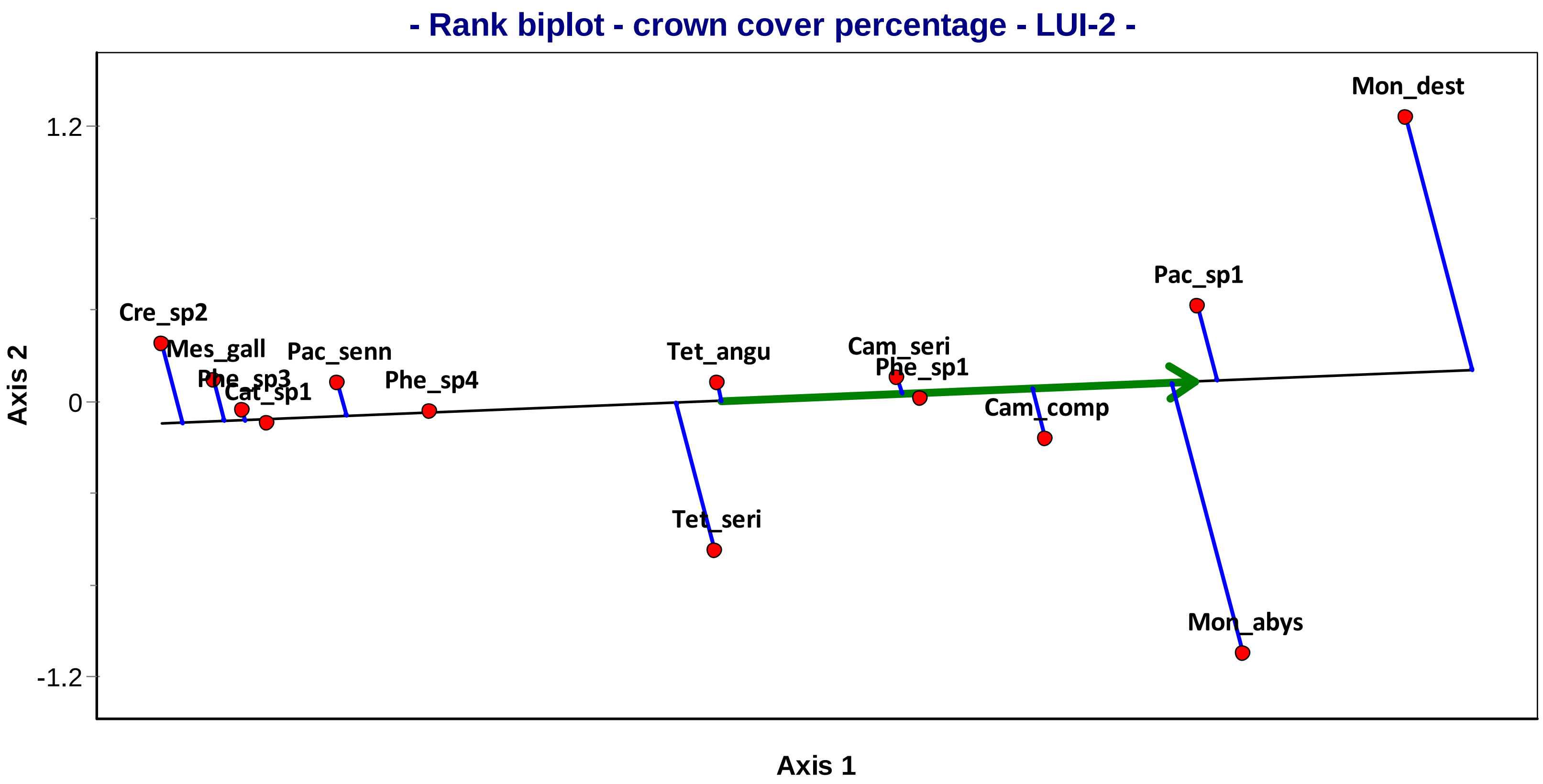


Fig. A5-10: Ranked biplot of common ant species (name abbreviated) to the environmental variable 'crown cover percentages' in the four North-Sudanese sites (Burkina Faso). Results obtained by Canonical Correspondence Analysis. **Ant species** are Camp_comp (0): *Camponotus compressiscapus,* Cam_seri (1): *Camponotus sericeus,* Cat_sp1 (2): *Cataglyphis* sp.1, Cre_sp2 (3): *Crematogaster* sp.2, Mes_gall (4): *Messor galla,* Mon_abys (5): *Monomorium abyssinicum,* Mon_dest (6): *Monomorium destructor,* Pac_senn (7): *Pachycondyla senaarensis,* Pac_sp1 (8): *Pachycondyla* sp.1, Phe_sp1 (9): *Pheidole* sp.1, Phe_sp3 (10): *Pheidole* sp.3, Phe_sp4 (11): *Pheidole* sp.4, Tet_ang (12): *Tetramorium angulinode,* Tet_seri (13): *Tetramorium sericeiventre.*

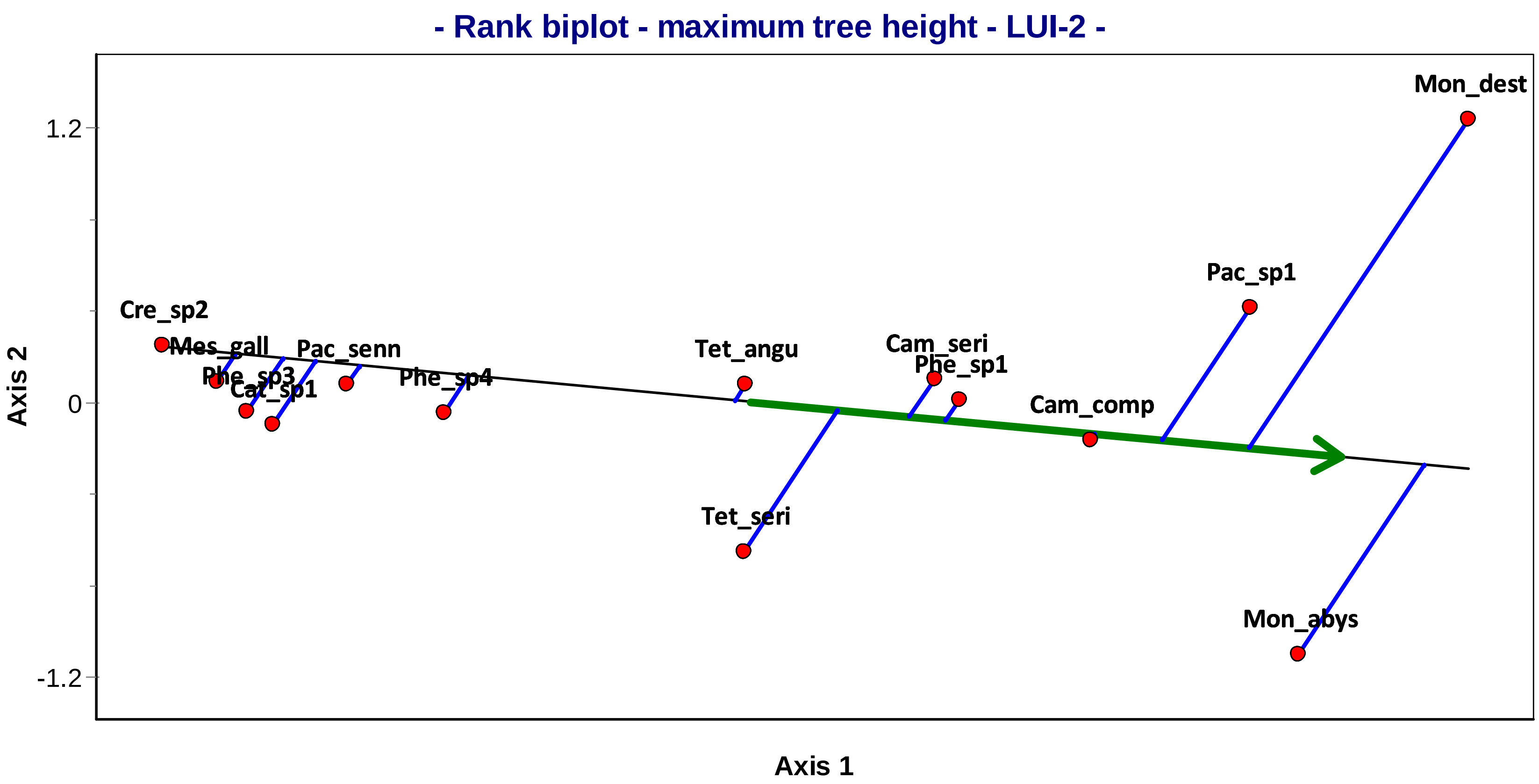


Fig. A5-11: Ranked biplot of common ant species (name abbreviated) to the environmental variable 'maximum tree height' in the four North-Sudanese sites (Burkina Faso). Results obtained by Canonical Correspondence Analysis. **Ant species** are Camp_comp (0): *Camponotus compressiscapus,* Cam_seri (1): *Camponotus sericeus,* Cat_sp1 (2): *Cataglyphis* sp.1, Cre_sp2 (3): *Crematogaster* sp.2, Mes_gall (4): *Messor galla,* Mon_abys (5): *Monomorium abyssinicum,* Mon_dest (6): *Monomorium destructor,* Pac_senn (7): *Pachycondyla senaarensis,* Pac_sp1 (8): *Pachycondyla* sp.1, Phe_sp1 (9): *Pheidole* sp.1, Phe_sp3 (10): *Pheidole* sp.3, Phe_sp4 (11): *Pheidole* sp.4, Tet_ang (12): *Tetramorium angulinode,* Tet_seri (13): *Tetramorium sericeiventre.*

PARAMETERS PREDICTING VARIATIONS IN TERMITE COMMUNITIES

Land-use intensification gradient in the sub-Sahel region (LUI-1)

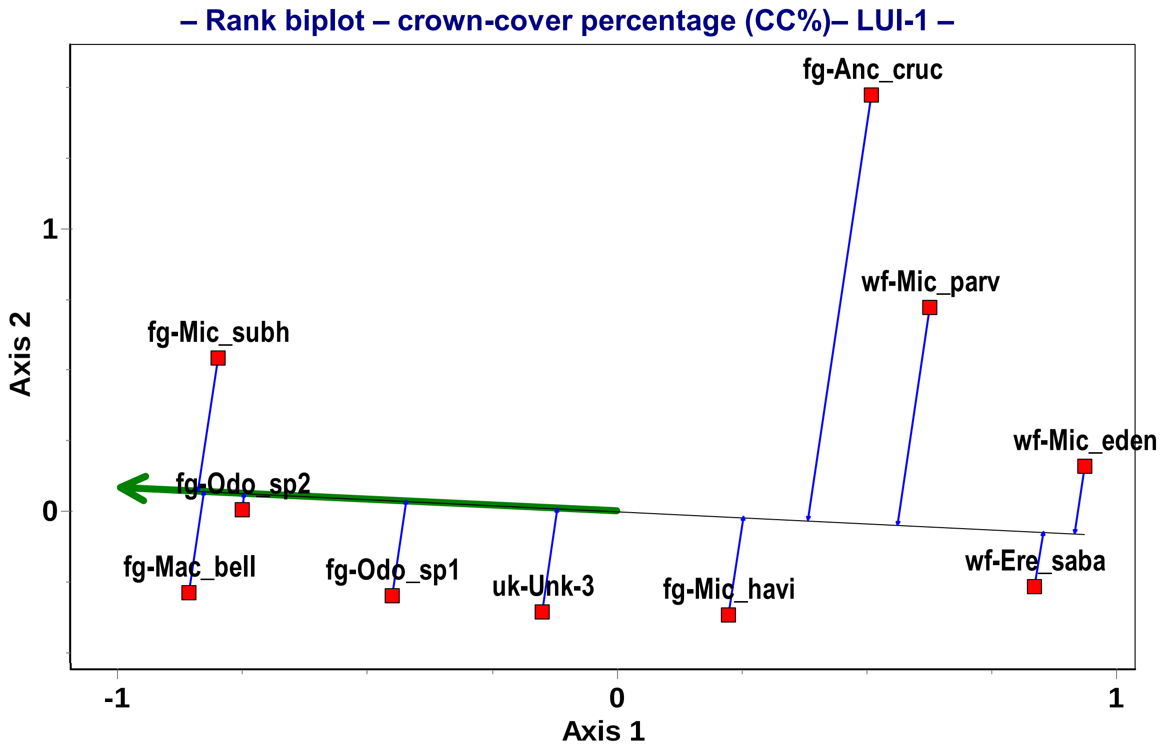


Fig. A5-12: Ranked biplot of common termite species (name abbreviated) to the environmental variable 'crown-cover percentage' in the four Zaï stages (sub-Sahel region, Burkina Faso). Results obtained by Canonical Correspondence Analysis.

Termite species are fg-Anc_cruc (1): *Ancistrotermes crucifer*, sf-Cub_subc (2): *Cubitermes subcrenulatus*, wf-Ere_saba (3): *Eremotermes sabaeus*, fg-Mac_bell (4): *Macrotermes bellicosus*, wf-Mic_eden (5): *Microcerotermes edentatus*, wf-Mic_parv (6): *Microcerotermes parvus*, fg-Mic_havi (7): *Microtermes havilandi*, fg-Mic_subh (8): *Microtermes subhyalinus*, fg-Odo_sp1 (9):*Odontotermes* sp.1, fg-Odo_sp2 (10): *Odontotermes* sp.2. The first two letters indicate the functional group fg: fungus-growers, wf: wood-feeders, sf: soil-feeders, uk: unknown.

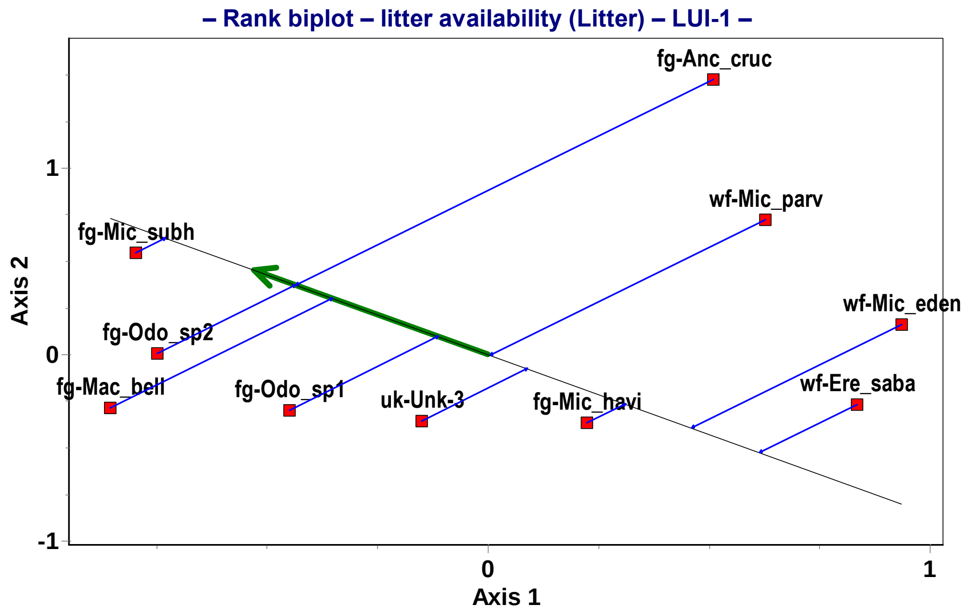


Fig. A5-13: Ranked biplot of common termite species (name abbreviated) to the environmental variable 'litter-availability' in the four Zaï stages (sub-Sahel region, Burkina Faso). Results obtained by Canonical Correspondence Analysis.

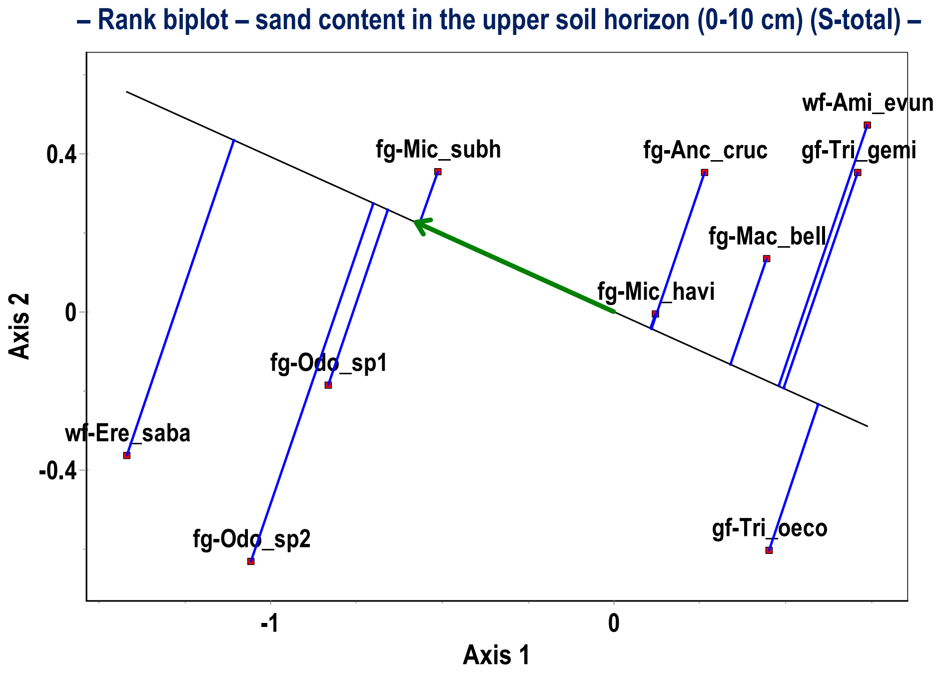


Fig. A5-14: Ranked biplot of common termite species (name abbreviated) to the environmental variable 'sand-content in the upper soil horizon (0-10 cm)' in the four Zaï stages (sub-Sahel region, Burkina Faso). Results obtained by Canonical Correspondence Analysis. **Termite species** are fg-Anc_cruc (1): *Ancistrotermes crucifer*, sf-Cub_subc (2): *Cubitermes subcrenulatus*, wf-Ere_saba (3): *Eremotermes sabaeus*, fg-Mac_bell (4): *Macrotermes bellicosus*, wf-Mic_eden (5): *Microcerotermes edentatus*, wf-Mic_parv (6): *Microcerotermes parvus*, fg-Mic_havi (7): *Microtermes havilandi*, fg-Mic_subh (8): *Microtermes subhyalinus*, fg-Odo_sp1 (9): *Odontotermes* sp.1, fg-Odo_sp2 (10): *Odontotermes* sp.2. The first two letters indicate the **functional group** fg: fungus-growers, wf: wood-feeders, uk: unknown.

Land-use intensification gradient in the North-Soudan region (LUI-2)

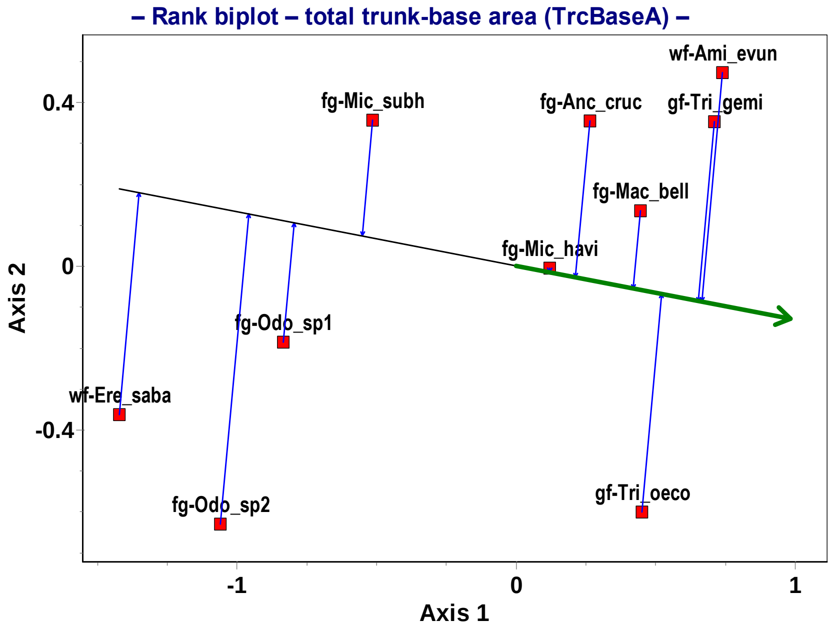


Fig. A5-15: Ranked biplot of common termite species (name abbreviated) to the environmental variable 'total area covered by the main tree trunks' in the four North-Sudanese habitats (Burkina Faso). Results obtained by Canonical Correspondence Analysis.

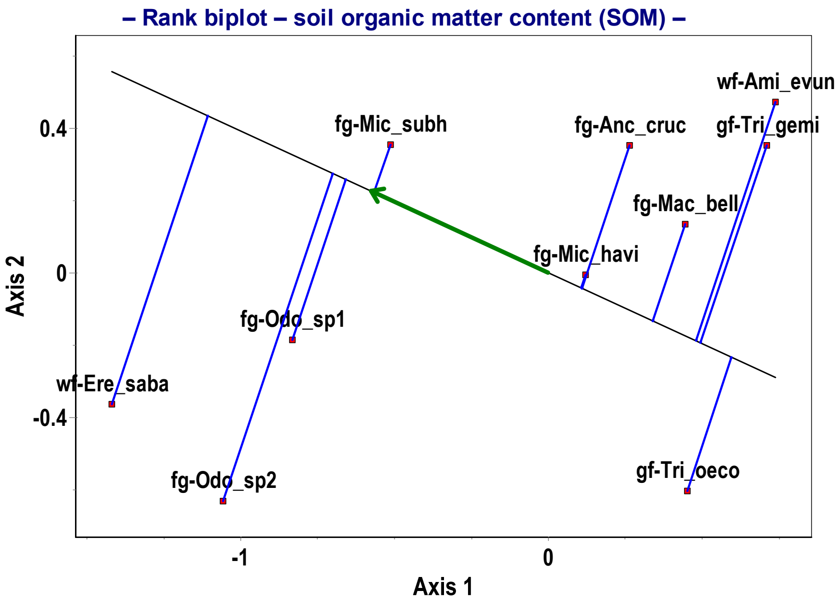


Fig. A5-16: Ranked biplot of common termite species (name abbreviated) to the environmental variable 'soil organic matter in the sub-surface soil (0-10 cm)' in the four North-Sudanese habitats (Burkina Faso). Results obtained by CCA. **Termite species** are wf-Ami_evun (0): *Amitermes evuncifer*, fg-Anc_cruc (1): *Ancistrotermes crucifer*, wf-Ere_saba (2): *Eremotermes sabaeus,* fg-Mac_bell (3): *Macrotermes bellicosus*, fg-Mic_havi (4): *Microtermes havilandi,* fg-Mic_subh (5): *Microtermes subhyalinus*, fg-Odo_sp1 (6): *Odontotermes* sp.1, fg-Odo_sp2 (7): *Odontotermes* sp.2, gf-Tri_gemi (8): *Trinervitermes geminatus*, gf-Tri_oeco (9): *Trinervitermes oeconomus*. The first two letters indicate the **functional group** fg: fungus-growers, wf: wood-feeders and gf: grass-feeders.

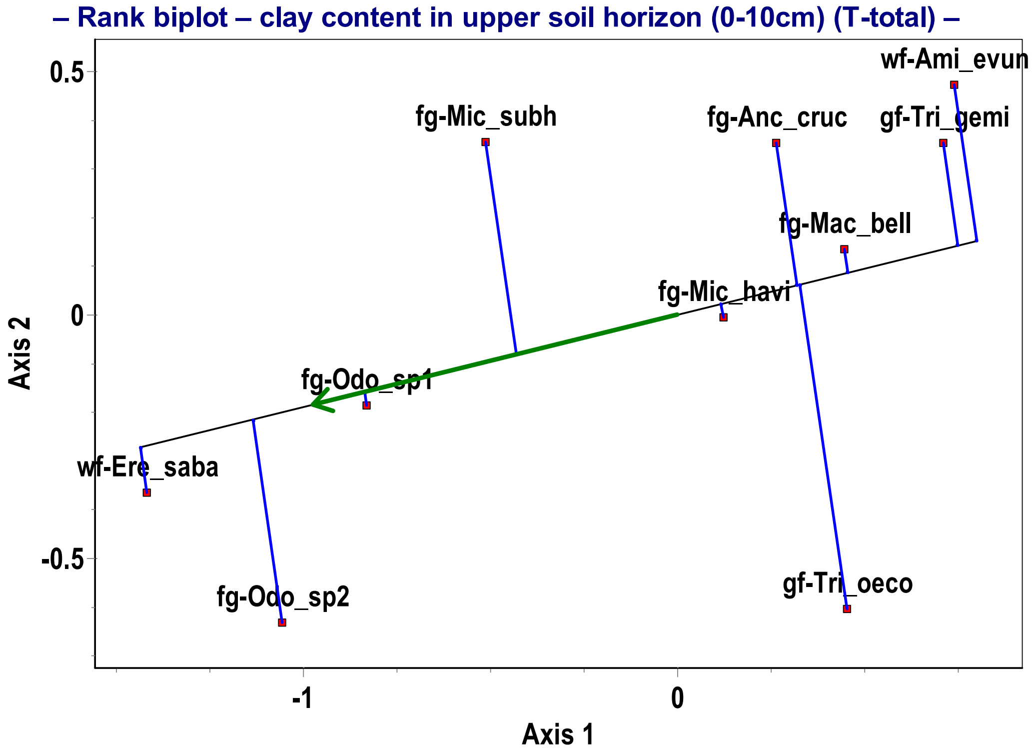


Fig. A5-17: Ranked biplot of common termite species (name abbreviated) to the environmental variable 'clay content in the sub-surface soil (0-10 cm)' in the four North-Sudanese habitats (Burkina Faso). Results obtained by Canonical Correspondence Analysis.

Termite species are wf-Ami_evun (0): *Amitermes evuncifer,* fg-Anc_cruc (1): *Ancistrotermes crucifer,* wf-Ere_saba (2): *Eremotermes sabaeus,* fg-Mac_bell (3): *Macrotermes bellicosus*, fg-Mic_havi (4): *Microtermes havilandi,* fg-Mic_subh (5): *Microtermes subhyalinus,* fg-Odo_sp1 (6): *Odontotermes* sp.1, fg-Odo_sp2 (7): *Odontotermes* sp.2, gf-Tri_gemi (8): *Trinervitermes geminatus,* gf-Tri_oeco (9): *Trinervitermes oeconomus.* The first two letters indicate the **functional group** fg: fungus-growers, wf: wood-feeders and gf: grass-feeders.

ANOSIM AND SIMPER FOR ANT COMMUNITIES

Analyzed in CAP-4 (Community Analysis Package, Pisces Conservation Ltd. 2007)

Land-use intensification gradient in the sub-Sahel region of Burkina Faso (LUI-1)

Results of ANOSIM

Table A5-13: Analysis of Similarities (ANOSIM) for groups formed by transects that were conducted in the same land-use type (replicate-transects) for ant communities in four main succession stages of the Zaï-system in Ouahigouya (sub-Sahel zone, Burkina Faso).

Full Data ANOSIM				
Sample Statistic R	No Randomizations	P Value	Level %	No >= Obs
0.523	1,000	< 0.001	0.1	1

Pairwise Tests						
1st Group	2nd Group	Permutations	P Value	Level %	No >= Obs	Test Statistic R
ZF20 (4)	ZF30 (4)	35	0.16	31.43	11	0.177
ZF20 (4)	ZDeg (4)	35	0.01	2.86	1	0.771
ZF20 (4)	ZMil (4)	35	0.01	2.86	1	0.427
ZF30 (4)	ZDeg (4)	35	0.01	2.86	1	0.91
ZF30 (4)	ZMil (4)	35	0.01	2.86	1	0.58
ZDeg (4)	ZMil (4)	35	0.01	2.86	1	0.58

Results of SIMPER

Table A5-14: A) – D) Average SIMALIRITY WITHIN groups resulting from 'Similarity Percentages' (SIMPER) for groups formed by replicate-transects for ant communities in four main succession stages of the Zaï-system in Ouahigouya (sub-Sahel zone, Burkina Faso).

A)

Degraded land, ZDeg Average Similarity 60.7

Ant species	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
Mon_bico	67.5	27.4	45.1	45.1
Phe_sp1	47.5	11.3	18.6	63.7
Mon_aren	40.0	8.9	14.6	78.3
Mon_abys	20.0	5.6	9.2	87.5
Cre_sp2	35.0	5.0	8.3	95.8

B)

Millet field, ZMil Average Similarity 69.5

Ant species	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
Mon_bico	87.5	21.3	30.6	30.6
Phe_sp1	75.0	17.7	25.4	56.0
Lep_sp1	53.8	10.8	15.5	71.6
Cre_sp2	50.0	7.0	10.0	81.6
Mon_abys	33.8	6.1	8.7	90.3

C)

Young Zaï forest, ZF20 Average Similarity 74.4

Ant species	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
Phe_sp1	91.3	23.9	32.2	32.2
Mon_bico	82.5	22.9	30.8	62.9
Lep_sp1	42.5	9.4	12.7	75.6
Mon_abys	31.3	6.0	8.1	83.7
Ano_sedi	25.0	4.6	6.2	90.0
Cam_seri	16.3	2.7	3.6	93.6

D)

Old Zaï forest, ZF30 Average Similarity 74.0

Ant species	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
Phe_sp1	83.8	19.6	26.5	26.5
Mon_bico	75.0	17.4	23.5	50.0
Lep_sp1	73.8	14.3	19.4	69.4
Tet_angu	41.3	5.8	7.9	77.2
Ano_sedi	23.8	4.6	6.2	83.5
Pac_sp3	27.5	3.9	5.3	88.8
Tet_sp6	30.0	3.4	4.6	93.3

Table A5-15: A) – F) Average DISSIMALIRITY BETWEEN groups resulting from 'Similarity Percentages' (SIMPER) for groups formed by replicate-transects for ant communities in four main succession stages of the Zaï-system in Ouahigouya (sub-Sahel zone, Burkina Faso).

A)

ZF20 with ZF30 Average Dissimilarity 28.3

	ZF20	ZF30			
Ant species	Ave. Abundance	Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Tet_angu	20	41	4	15	15
Lep_sp1	43	74	4	15	30
Pac_sp3	0	28	4	13	43
Mon_abys	31	24	3	11	53
Tet_sp6	15	30	3	10	64
Mon_vona	20	10	2	7	71
Cam_seri	16	11	2	6	76
Phe_sp1	91	84	2	5	82
Mon_osca	5	13	2	5	87
Ano_sedi	25	24	1	5	92

B)

ZF20 with ZDeg — Average Dissimilarity 52.0

Ant species	ZF20 Ave. Abundance	ZDeg Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Phe_sp1	91	48	8	15	15
Lep_sp1	43	3	7	13	28
Mon_aren	0	40	7	13	41
Cre_sp2	3	35	6	11	52
Ano_sedi	25	3	4	8	59
Mon_vona	20	0	3	6	65
Tet_angu	20	0	3	6	71
Mon_abys	31	20	3	6	77
Cam_seri	16	0	3	5	82
Mon_bico	83	68	2	5	87
Tet_sp6	15	0	2	5	91

C)

ZF20 with ZMil — Average Dissimilarity 33.7

Ant species	ZF20 Ave. Abundance	ZMil Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Cre_sp2	3	50	6	18	18
Pac_senn	5	40	5	14	32
Tet_angu	20	24	4	11	43
Lep_sp1	43	54	3	9	52
Ano_sedi	25	5	3	8	60
Phe_sp1	91	75	2	7	67
Mon_vona	20	8	2	6	73
Cam_seri	16	8	2	6	80
Mon_abys	31	34	2	6	86
Tet_sp6	15	13	2	5	91

D)

ZF30 with ZDeg — Average Dissimilarity 57.5

Ant species	ZF30 Ave. Abundance	ZDeg Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Lep_sp1	74	3	11	19	19
Tet_angu	41	0	6	11	30
Mon_aren	0	40	6	10	40
Phe_sp1	84	48	6	10	50
Cre_sp2	0	35	5	9	60
Tet_sp6	30	0	4	8	67
Pac_sp3	28	5	4	7	74
Ano_sedi	24	3	3	6	80
Mon_abys	24	20	3	5	85
Cam_seri	11	0	2	3	89
Mon_osca	13	0	2	3	92

E)

ZF30 with ZMil		Average Dissimilarity	36.9		
	ZF30	ZMil			
Ant species	Ave. Abundance	Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Cre_sp2	0	50	6	16	16
Tet_angu	41	24	5	12	28
Pac_senn	1	40	4	12	40
Pac_sp3	28	0	3	9	49
Lep_sp1	74	54	3	8	57
Tet_sp6	30	13	3	8	65
Mon_abys	24	34	3	7	72
Ano_sedi	24	5	2	7	79
Cam_seri	11	8	2	4	83
Mon_bico	75	88	2	4	88
Mon_osca	13	5	2	4	92

F)

ZDeg with ZMil		Average Dissimilarity	48		
	ZDeg	ZMil			
Ant species	Ave. Abundance	Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Lep_sp1	3	54	9	18	18
Cre_sp2	35	50	6	12	31
Mon_aren	40	3	6	12	43
Pac_senn	3	40	6	12	55
Phe_sp1	48	75	5	11	66
Tet_angu	0	24	3	7	73
Mon_bico	68	88	3	7	79
Mon_abys	20	34	3	6	85
Tet_sp6	0	13	2	4	89
Lep_sp3	10	8	1	2	91

Land-use intensification gradient in the North-Soudan region of Burkina Faso (LUI-2)

Results of ANOSIM

Table A5-16: Analysis of Similarities (ANOSIM) for groups formed by transects that were conducted in the same land-use type (replicate-transects) for ant communities in four land-uses near Fada N'Gourma (Gourma province, North-Sudan region of Burkina Faso).

Pairwise Tests						
Sample Statistic		No Randomizations		P Value	Level %	No >= Obs
0.754		1,000		< 0.001	0.1	1
Pairwise Tests						
1st Group	2nd Group	Permutations	P value	Level %	No >= Obs	Statistic R
FCot (3)	FFal (3)	10	0.05	10.00	1	0.33
FCot (3)	FPas (3)	10	0.05	10.00	1	0.93
FCot (3)	FRes (4)	35	0.03	2.86	1	0.85
FFal (3)	FPas (3)	10	0.05	10.00	1	1.00
FFal (3)	FRes (4)	35	0.03	2.86	1	1.00
FPas (3)	FRes (4)	35	0.06	5.71	2	0.67

Results of SIMPER

Table A5-17: A) – D) Average SIMALIRITY WITHIN groups resulting from 'Similarity Percentages' (SIMPER) for groups formed by replicate-transects for ant communities in four land-uses near Fada N'Gourma (Gourma province, North-Sudan region of Burkina Faso).

A)

Cotton field, FCot Average Similarity 59.4

Name	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
Pac_senn	63.3	16.0	26.9	26.9
Mes_gall	63.3	15.2	25.6	52.4
Phe_sp1	30.0	6.4	10.7	63.2
Phe_sp4	35.0	6.0	10.1	73.3
Cam_seri	50.0	5.8	9.7	83.0
Cat_sp1	33.3	4.1	6.9	89.9
Phe_sp3	11.7	2.0	3.4	93.3

B)

Fallow, FFal Average Similarity 78.9

Name	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
Mes_gall	90.0	16.4	20.8	20.8
Pac_senn	68.3	13.1	16.6	37.3
Cam_seri	71.7	12.8	16.2	53.5
Phe_sp1	71.7	11.7	14.8	68.4
Phe_sp4	60.0	9.9	12.6	81.0
Tet_angu	48.3	8.2	10.4	91.3

C)

Pasture area, FPas Average Similarity 73.0

Name	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
Phe_sp1	83.3	23.2	31.8	31.8
Cam_seri	78.3	20.2	27.7	59.5
Mon_abys	55.0	10.1	13.8	73.3
Cam_comp	28.3	6.3	8.6	81.9
Tet_seri	36.7	5.6	7.7	89.6
Pac_sp1	13.3	2.9	4.0	93.5

D)

Pama reserve, FRes Average Similarity 77.3

Name	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
Cam_seri	91.3	28.2	36.5	36.5
Phe_sp1	75.0	21.5	27.8	64.3
Mon_dest	30.0	6.7	8.7	73.1
Cam_comp	20.0	6.6	8.6	81.6
Tet_angu	22.5	6.6	8.6	90.2

Table A5-18: A) – F) Average DISSIMALIRITY BETWEEN groups resulting from 'Similarity Percentages' (SIMPER) for groups formed by replicate-transects for ant communities in four land-uses near Fada N'Gourma (Gourma province, North-Sudan region of Burkina Faso).

A)

FCot With FFal Average Dissimilarity 35.2

Name	FCot Ave. Abundance	FFal Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Phe_sp1	30	72	5	15	15
Tet_angu	15	48	4	12	27
Cam_seri	50	72	4	12	39
Phe_sp4	35	60	4	11	50
Mes_gall	63	90	4	10	60
Cat_sp1	33	23	4	10	70
Tet_seri	7	30	3	9	79
Cre_sp2	2	17	2	5	85
Phe_sp3	12	17	2	5	90
Pac_senn	63	68	2	5	94

B)

FCot With FPas Average Dissimilarity 63.6

Name	FCot Ave. Abundance	FPas Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Mes_gall	63	0	9	15	15
Pac_senn	63	5	9	14	29
Phe_sp1	30	83	9	13	42
Mon_abys	0	55	8	13	55
Cam_seri	50	78	6	9	65
Tet_seri	7	37	5	8	72
Cat_sp1	33	3	4	7	79
Phe_sp4	35	18	4	6	85
Cam_comp	8	28	3	5	90
Tet_angu	15	23	3	5	95

C)

FCot With FRes Average Dissimilarity 60.9

Name	FCot Ave. Abundance	FRes Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Mes_gall	63	4	9	15	15
Pac_senn	63	11	9	15	30
Cam_seri	50	91	8	13	43
Phe_sp1	30	75	8	13	56
Mon_dest	0	30	5	8	64
Cat_sp1	33	1	5	8	72
Pac_sp1	7	29	4	7	79
Phe_sp4	35	9	4	7	86
Tet_angu	15	23	2	4	89
Cam_comp	8	20	2	3	93

D)

FFal With FPas Average Dissimilarity 47.9

Name	FFal Ave. Abundance	FPas Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Mes_gall	90	0	11	22	22
Pac_senn	68	5	7	15	38
Mon_abys	3	55	6	12	50
Phe_sp4	60	18	5	10	60
Tet_seri	30	37	3	6	67
Tet_angu	48	23	3	6	73
Cat_sp1	23	3	2	5	78
Cam_comp	10	28	2	5	82
Cre_sp2	17	0	2	4	86
Phe_sp1	72	83	2	4	90

E)

FFal With FRes Average Dissimilarity 51.7

Name	FFal Ave. Abundance	FRes Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Mes_gall	90	4	11	21	21
Pac_senn	68	11	7	14	34
Phe_sp4	60	9	6	12	47
Mon_dest	0	30	4	7	54
Tet_seri	30	1	3	7	61
Pac_sp1	2	29	3	7	67
Tet_angu	48	23	3	6	74
Cat_sp1	23	1	3	5	79
Cam_seri	72	91	2	5	83
Phe_sp1	72	75	2	4	88
Cre_sp2	17	0	2	4	92

F)

FPas With FRes Average Dissimilarity 34.0

Name	FPas Ave. Abundance	FRes Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
Mon_abys	55	8	7	21	21
Tet_seri	37	1	5	16	37
Mon_dest	0	30	5	14	50
Pac_sp1	13	29	3	9	59
Tet_angu	23	23	3	7	67
Cam_seri	78	91	2	7	74
Phe_sp4	18	9	2	7	81
Pac_senn	5	11	2	6	87
Phe_sp1	83	75	2	5	92

ANOSIM AND SIMPER FOR TERMITE COMMUNITIES

Land-use intensification gradient in the sub-Sahel region of Burkina Faso (LUI-1)

Results of ANOSIM

Table A5-19: Analysis of Similarities (ANOSIM) for groups formed by transects that were conducted in the same land-use type (replicate-transects) for termite communities in four main succession stages of the Zaï-system in Ouahigouya (Yatenga province, sub-Sahel zone, Burkina Faso).

Full Data ANOSIM				
Sample Statistic R	No Randomizations	P Value	Level %	No >= Obs
0.806	1000	< 0.001	0.1	1

Pairwise Tests						
1st Group	2nd Group	Permutations	P Value	Level %	No >= Obs	Test Statistic R
ZDeg (4)	ZF20 (4)	35	0.01	2.86	1	1
ZDeg (4)	ZF30 (4)	35	0.01	2.86	1	1
ZDeg (4)	ZMil (4)	35	0.01	2.86	1	1
ZF20 (4)	ZF30 (4)	35	0.21	42.86	15	0.05
ZF20 (4)	ZMil (4)	35	0.04	8.57	3	0.60
ZF30 (4)	ZMil (4)	35	0.01	2.86	1	0.82

Results of SIMPER

Table A5-20: A) – D) Average SIMALIRITY WITHIN groups resulting from 'Similarity Percentages' (SIMPER) for groups formed by replicate-transects for termite communities in four main succession stages of the Zaï-system in Ouahigouya (Yatenga province, sub-Sahel zone, Burkina Faso).

A)

Degraded land, ZDeg Average Similarity 83.3

Termite species	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
fg-Odo_sp4	6.3	83.3	100.0	100.0

B)

Millet field, ZMil Average Similarity 40.0

Termite species	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
fg-Mic_havi	38.8	9.5	23.8	23.8
wf-Ere_saba	32.5	8.0	20.1	43.9
wf-Ami_evun	18.8	7.7	19.2	63.1
wf-Mic_eden	32.5	7.4	18.4	81.5
uk-Unk-3	17.5	3.6	9.0	90.5

C)

Young Zaï forest, ZF20 Average Similarity 32.5

Termite species	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
fg-Mic_havi	26.3	9.5	29.1	29.1
fg-Odo_sp1	15.0	4.7	14.3	43.5
fg-Mic_subh	17.5	4.4	13.5	57.0
uk-Unk-3	10.0	3.4	10.5	67.5
wf-Mic_ther	7.5	3.4	10.4	77.9
fg-Odo_sp2	12.5	3.4	10.4	88.3
sf-Ano_sp1	6.3	1.7	5.3	93.6

D)

Old Zaï forest, ZF30 Average Similarity 38.6

Termite species	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
fg-Mic_subh	46.3	12.6	32.6	32.6
fg-Mac_bell	30.0	6.3	16.3	49.0
fg-Mic_havi	22.5	4.4	11.4	60.3
fg-Mic_sp1	30.0	4.4	11.4	71.7
uk-Unk-3	25.0	3.1	7.9	79.7
sf-Unk-1_sf	17.5	2.0	5.2	84.8
fg-Odo_sp1	10.0	1.9	4.8	89.7
wf-Ere_saba	5.0	1.1	2.8	92.5

Table A5-21: A) – F) Average DISSIMALIRITY BETWEEN groups resulting from 'Similarity Percentages' (SIMPER) for groups formed by transects that were conducted in the same land-use type (replicate-transects) for termite communities in four main succession stages of the Zaï-system in Ouahigouya (Yatenga province, sub-Sahel zone, Burkina Faso).

A)

ZDeg with ZMil Average Dissimilarity 100.0

	ZDeg	ZMil			
Termite species	Ave. Abundance	Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
fg-Mic_havi	0	39	21	21	21
wf-Ere_saba	0	33	16	16	37
wf-Mic_eden	0	33	16	16	53
wf-Ami_evun	0	19	11	11	65
wf-Mic_parv	0	19	11	11	75
uk-Unk-3	0	18	9	9	84
fg-Anc_cruc	0	8	4	4	89
fg-Odo_sp4	6	0	4	4	93

B)

ZDeg with ZF30 Average Dissimilarity 100.0

Termite species	ZDeg Ave. Abundance	ZF30 Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
fg-Mic_subh	0	46	23	23	23
fg-Mac_bell	0	30	11	11	34
fg-Mic_sp1	0	30	11	11	45
uk-Unk-3	0	25	9	9	54
fg-Mic_havi	0	23	9	9	63
sf-Unk-1_sf	0	18	8	8	70
sf-Ano_sp1	0	16	5	5	75
fg-Odo_sp1	0	10	4	4	80
wf-Ami_evun	0	9	3	3	83
wf-Ere_saba	0	5	3	3	86
wf-Mic_parv	0	6	3	3	89
fg-Odo_sp4	6	0	3	3	92

C)

ZDeg with ZF20 Average Dissimilarity 98.4

Termite species	ZDeg Ave. Abundance	ZF20 Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
fg-Mic_havi	0	26	20	20	20
fg-Odo_sp1	0	15	11	12	32
fg-Mic_subh	0	18	11	11	43
fg-Odo_sp2	0	13	8	8	51
uk-Unk-3	0	10	7	7	58
sf-Ano_sp1	0	6	6	6	64
wf-Mic_ther	0	8	5	5	69
fg-Mic_sp1	0	10	5	5	74
wf-Mic_eden	0	5	5	5	79
fg-Odo_sp4	6	3	4	4	83
sf-Unk-1_sf	0	8	4	4	87
fg-Mac_bell	0	6	4	4	91

D)

ZF20 with ZF30 Average Dissimilarity 65.7

Termite species	ZF20 Ave. Abundance	ZF30 Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
fg-Mic_subh	18	46	10	16	16
fg-Mic_sp1	10	30	7	11	27
fg-Mac_bell	6	30	6	10	36
fg-Mic_havi	26	23	6	9	45
uk-Unk-3	10	25	5	8	53
sf-Unk-1_sf	8	18	5	8	60
sf-Ano_sp1	6	16	5	7	68
fg-Odo_sp1	15	10	3	5	73
fg-Odo_sp2	13	5	3	5	78
wf-Ami_evun	0	9	2	3	82
wf-Mic_ther	8	0	2	3	85
wf-Mic_eden	5	3	2	3	88
wf-Mic_parv	4	6	2	3	90

E)

ZF20 with ZMil Average Dissimilarity 76.1

Termite species	ZF20 Ave. Abundance	ZMil Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
fg-Mic_havi	26	39	10	13	13
wf-Mic_eden	5	33	9	12	25
wf-Ere_saba	3	33	9	12	37
wf-Ami_evun	0	19	6	8	45
wf-Mic_parv	4	19	6	7	52
fg-Mic_subh	18	0	5	7	59
fg-Odo_sp1	15	3	5	6	66
uk-Unk-3	10	18	4	5	71
fg-Odo_sp2	13	0	4	5	76
fg-Mic_sp1	10	3	3	4	80
fg-Anc_cruc	0	8	2	3	84
wf-Mic_ther	8	0	2	3	87
sf-Ano_sp1	6	0	2	3	90

F)

ZF30 with ZMil Average Dissimilarity 75.7

Termite species	ZF30 Ave. Abundance	ZMil Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
fg-Mic_subh	46	0	12	16	16
wf-Mic_eden	3	33	8	10	26
fg-Mic_havi	23	39	7	9	36
fg-Mac_bell	30	0	7	9	45
fg-Mic_sp1	30	3	7	9	54
wf-Ere_saba	5	33	6	8	62
uk-Unk-3	25	18	5	7	68
sf-Unk-1_sf	18	0	4	6	74
wf-Mic_parv	6	19	4	6	80
wf-Ami_evun	9	19	4	5	85
sf-Ano_sp1	16	0	3	4	89
fg-Anc_cruc	5	8	3	3	93

Land-use intensification gradient in the North-Soudan region of Burkina Faso (LUI-2)

Results of ANOSIM

Table A5-22: Analysis of Similarities (ANOSIM) for groups formed by transects that were conducted in the same land-use type (replicate-transects) for termite communities in four land-uses near Fada N'Gourma (Gourma province, North-Sudan region of Burkina Faso).

Full Data ANOSIM						
Sample Statistic		No Randomizations	P Value	Level %	No >= Obs	
0.600		1000	< 0.001	0.1	1	
Pairwise Tests						
1st Group	2nd Group	Permutations	P value	Level %	No >= Obs	Statistic R
FCot (3)	FFal (3)	10	0.15	30.0	3	0.074
FCot (3)	FPas (3)	10	0.05	10.0	1	0.519
FCot (3)	FRes (4)	35	0.03	2.9	1	0.815
FFal (3)	FPas (3)	10	0.05	10.0	1	0.630
FFal (3)	FRes (4)	35	0.03	2.9	1	0.852
FPas (3)	FRes (4)	35	0.03	2.9	1	0.611

Results of SIMPER

Table A5-23: A) – D) Average SIMALIRITY WITHIN groups resulting from 'Similarity Percentages' (SIMPER) for groups formed by replicate-transects for termite communities in four land-uses near Fada N'Gourma (Gourma province, North-Sudan region of Burkina Faso).

A)

Cotton field, FCot Average Similarity 28.3

Termite spp.	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
fg-Mic_havi	45.0	18.4	65.0	65.0
fg-Mic_subh	31.7	7.1	25.0	90.0
wf-Ere_saba	10.0	2.8	10.0	100.0

B)

Fallow, FFal Average Similarity 33.3

Termite spp.	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
fg-Mic_subh	45.0	18.0	53.9	53.9
fg-Odo_sp1	16.7	6.8	20.5	74.5
fg-Odo_sp2	15.0	4.3	12.8	87.3
uk-Unk-3	10.0	2.5	7.6	94.9

C)

Pasture area, FPas Average Similarity 32.6

Termite spp.	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
gf-Tri_oeco	51.7	23.0	70.5	70.5
wf-Mic_parv	13.3	4.0	12.4	82.9
fg-Mic_havi	25.0	4.0	12.4	95.3

D)

Pama reserve, FRes   Average Similarity   49.9

Termite spp.	Ave. Abundance	Ave. Similarity	% Contribution	Cumulative %
wf-Mic_parv	56.3	9.0	18.0	18.0
gf-Tri_oeco	52.5	8.7	17.4	35.4
fg-Mic_subh	43.8	8.4	16.9	52.3
fg-Mic_havi	48.8	6.0	11.9	64.2
gf-Tri_gemi	47.5	5.3	10.6	74.8
fg-Anc_cruc	40.0	3.5	6.9	81.8
wf-Mic_eden	35.0	1.9	3.8	85.6
uk-Unk-3	17.5	1.5	3.0	88.6
gf-Tri_occi	28.8	1.5	3.0	91.6

Table A5-24: A) – F) Average DISSIMALIRITY BETWEEN groups resulting from 'Similarity Percentages' (SIMPER) for groups formed by replicate-transects for termite communities in four land-uses near Fada N'Gourma (Gourma province, North-Sudan region of Burkina Faso).

A)

FCot with FFal   Average Dissimilarity   73.1

	FCot	FFal			
Termite spp.	Ave. Abundance	Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
fg-Mic_havi	45	10	16	22	22
fg-Mic_subh	32	45	12	17	39
wf-Ere_saba	10	13	7	9	48
fg-Odo_sp1	0	17	6	9	57
fg-Mic_sp1	20	0	6	9	66
fg-Odo_sp2	0	15	6	8	74
uk-Unk-3	2	10	5	7	80
fg-Anc_cruc	0	13	5	6	86
wf-Mic_parv	0	13	4	6	92

B)

FCot with FPas   Average Dissim   81.9

	FCot	FPas			
Termite spp.	Ave. Abundance	Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
gf-Tri_oeco	0	52	21	26	26
fg-Mic_havi	45	25	17	21	47
fg-Mic_subh	32	5	12	14	61
fg-Mic_sp1	20	0	7	8	70
wf-Mic_parv	0	13	5	6	76
wf-Ere_saba	10	3	4	5	81
fg-Mac_bell	0	7	4	5	86
fg-Odo_sp2	0	7	2	3	89
wf-Ful_coat	0	3	2	3	92

C)

FCot with FRes — Average Dissimilarity 81.3

Termite spp	FCot Ave. Abundance	FRes Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
wf-Mic_parv	0	56	11	13	13
gf-Tri_oeco	0	53	9	11	25
gf-Tri_gemi	0	48	8	9	34
fg-Mic_havi	45	49	6	8	42
fg-Anc_cruc	0	40	6	8	49
wf-Mic_eden	0	35	5	7	56
fg-Mic_subh	32	44	5	7	62
gf-Tri_occi	0	29	4	5	68
fg-Mac_bell	0	16	3	4	72
fg-Mic_sp1	20	0	3	4	76
uk-Unk-3	2	18	3	4	79
gf-Tri_trin	0	18	3	3	83
wf-Ere_saba	10	0	2	2	85
gf-Tri_togo	0	10	2	2	87
wf-Mic_parv	0	9	1	2	89
fg-Anc_cavi	0	8	1	2	91

D)

FFal with FPas — Average Dissimilarity 80.7

Termite spp.	FFal Ave. Abundance	FPas Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
gf-Tri_oeco	3	52	17	21	21
fg-Mic_subh	45	5	14	17	39
fg-Mic_havi	10	25	8	10	48
wf-Mic_parv	13	13	6	8	56
fg-Odo_sp2	15	7	5	6	62
fg-Odo_sp1	17	3	5	6	68
uk-Unk-3	10	0	5	6	74
wf-Ere_saba	13	3	5	6	80
fg-Anc_cruc	13	0	4	5	85
fg-Mac_bell	3	7	4	5	90
wf-Ful_coat	0	3	2	2	92

E)

FFal with FRes Average Dissimilarity 74.2

	FFal	FRes			
Termite spp.	Ave. Abundance	Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
wf-Mic_parv	13	56	9	12	12
gf-Tri_oeco	3	53	8	11	22
gf-Tri_gemi	0	48	7	9	32
fg-Mic_havi	10	49	6	9	40
fg-Anc_cruc	13	40	5	7	48
wf-Mic_eden	3	35	5	7	54
gf-Tri_occi	0	29	4	6	60
fg-Mic_subh	45	44	4	5	65
fg-Mac_bell	3	16	3	4	69
gf-Tri_trin	0	18	3	3	72
fg-Odo_sp1	17	5	3	3	76
fg-Odo_sp2	15	0	2	3	79
uk-Unk-3	10	18	2	3	82
wf-Ere_saba	13	0	2	3	85
gf-Tri_togo	0	10	2	2	87
wf-Mic_parv	0	9	1	2	89
fg-Anc_cavi	0	8	1	2	90

F)

FPas with FRes Average Dissimilarity 71.6

	FPas	FRes			
Termite spp.	Ave. Abundance	Ave. Abundance	Ave Dissim	% Contribution	Cumulative %
wf-Mic_parv	13	56	9	12	12
gf-Tri_gemi	2	48	7	10	22
fg-Mic_subh	5	44	7	9	31
fg-Anc_cruc	0	40	6	8	40
fg-Mic_havi	25	49	6	8	48
wf-Mic_eden	0	35	5	7	55
gf-Tri_oeco	52	53	4	6	61
gf-Tri_occi	0	29	4	6	67
uk-Unk-3	0	18	3	4	71
fg-Mac_bell	7	16	3	4	75
gf-Tri_trin	0	18	3	4	79
gf-Tri_togo	0	10	2	2	81
wf-Mic_parv	0	9	1	2	83
fg-Anc_cavi	0	8	1	2	85
wf-Ful_coat	3	6	1	2	87
sf-Ano_sp1	0	5	1	2	89
wf-Ami_guin	3	5	1	2	90

APPENDIX – CHAPTER 7

RAPID ASSESSMENT OF BIOGENIC STRUCTURES OF TERMITES, ANTS AND EARTHWORMS – WORKING STEPS

Fig. A7-1: Wooden frame of 1 m^2, by means of a rope subdivided into a grid of 100 quadratic meshes (each 10 cm^2). Every 5–10 m, the frame was placed on the ground and all visible epigeal soil structures were mapped according to the constructing taxon, genus or functional group.

Fig. A7-2: In the second step, after mapping, a wooden frame without grid delimited the square meter in which all biogenic soil structures were collected, air-dried and finally weighed according to the constructing taxon, genus or functional group.

Fig. A7-3: Close-up of soil-sheetings that were collected within the frame of 1 m^2 according to the constructing taxon, genus or functional group (left) and of openings of foraging holes underneath soil-sheetings (right).

<u>LAND-USE INTENSIFICATION GRADIENT IN THE SUB-SAHEL REGION IN BURKINA FASO</u>

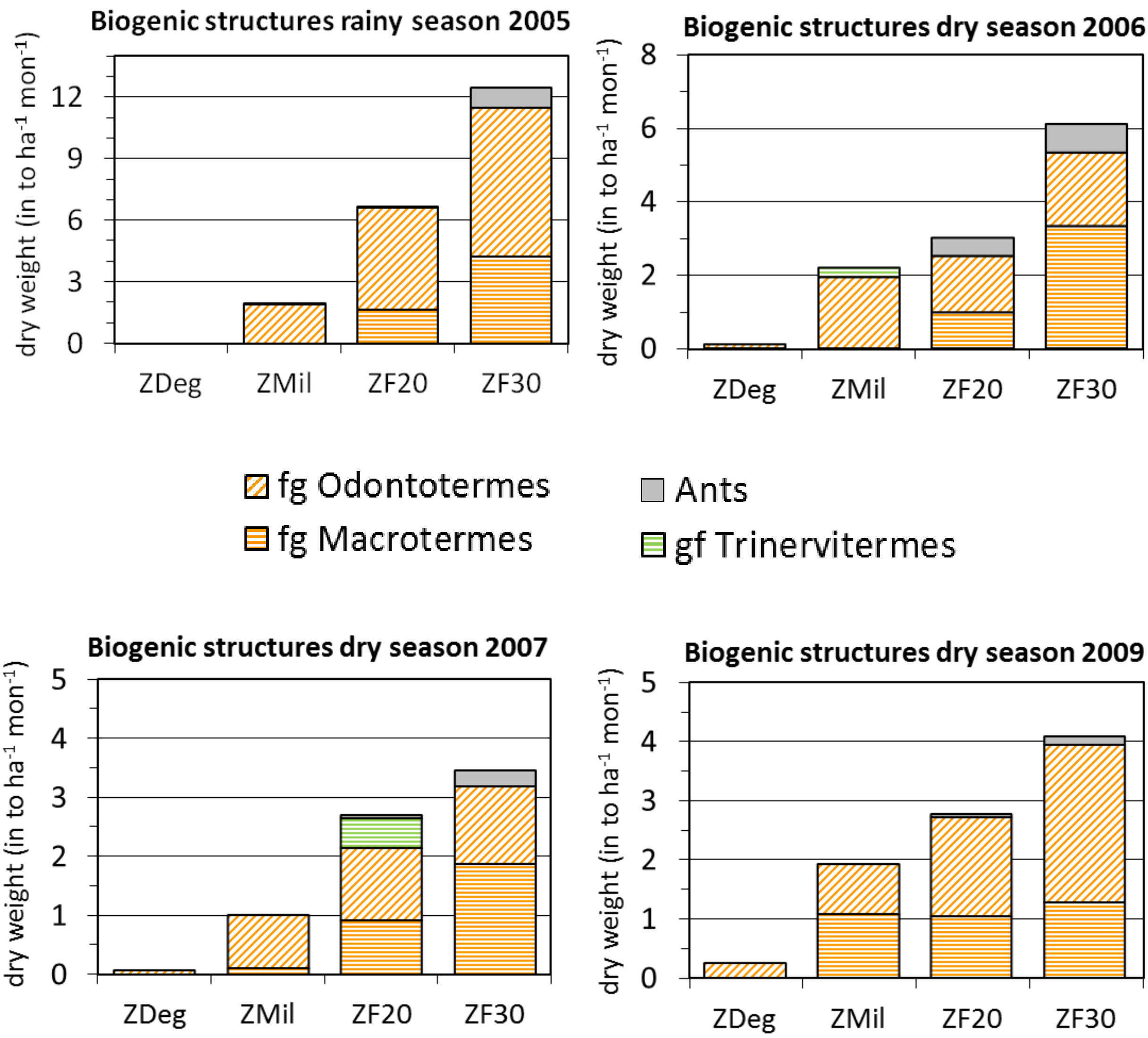
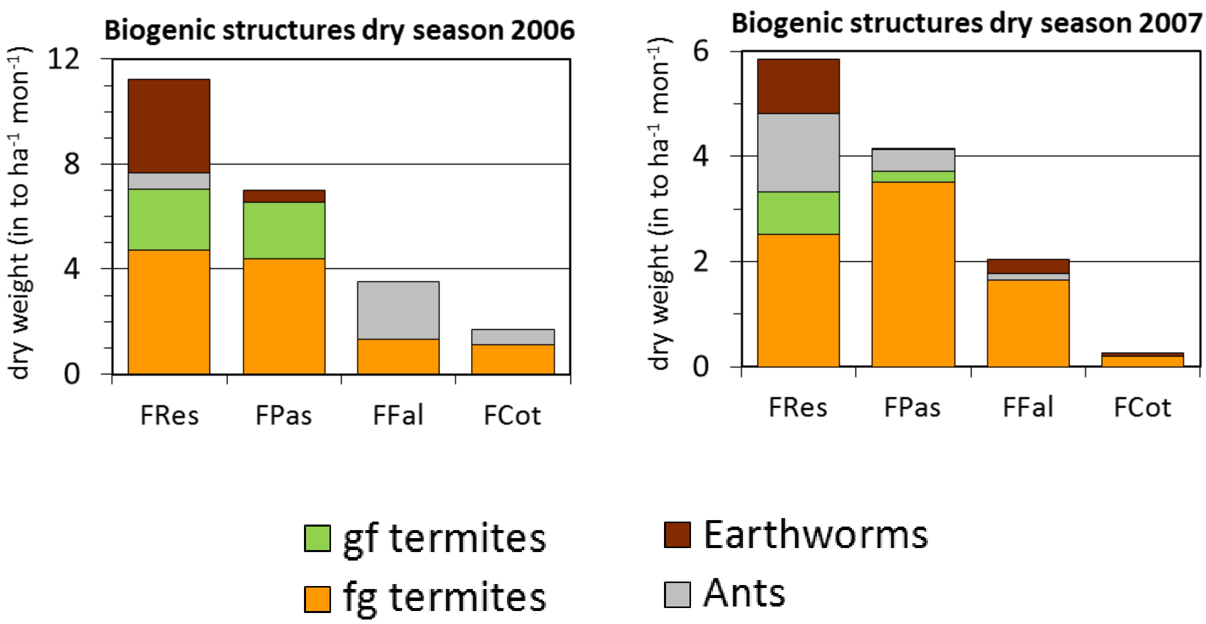


Fig. A7-4: Dry weight of biogenic soil structures in tons per hectare, month and Zaï stage, constructed by termites and ants during one rainy season (2005) and three dry seasons (2006, 2007, 2009); per season, year and site, 10 plots (1 m^2) were assessed; in 2006 it were 20 plots. Habitats are ZDeg: degraded area, ZMil: millet field, ZF20: young Zaï forest, ZF30: old Zaï forest. Functional groups of termites are fg: fungus-growers and gf: grass-feeders.

LAND-USE INTENSIFICATION GRADIENT IN THE SUB-SAHEL REGION IN BURKINA FASO



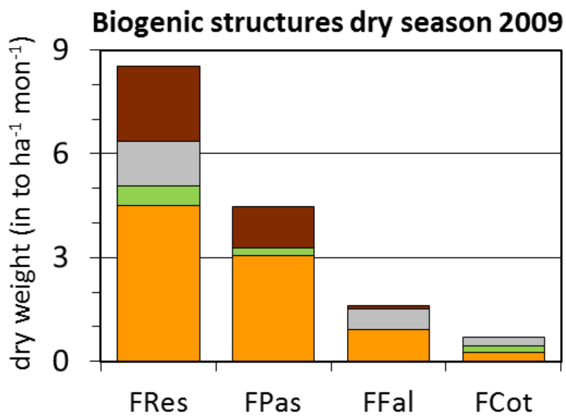


Fig. A7-5: Dry weight of biogenic soil structures in tons per hectare, month and land-use type, constructed by termites, ants and earthworms during three dry seasons (2006, 2007, 2009): per year and site, 10 plots (each 1 m^2) were assessed, in 2006 it were 20 plots. Habitats are FRes: Pama reserve, FPas: pasture area, FFal: fallow, FCot: cotton fields. Functional groups of termites are fg: fungus-growers and gf: grass-feeders.

Table A7-1: For each Zaï stage in Ouahigouya (sub-Sahel region, Burkina Faso), the total quantity of soil possibly bioturbated by termites until 2009 to construct their epigeal biogenic structures, is calculated for the dry season months (ca. 62% of the year) and the rainy season months (ca. 38% of the year). A standard protocol (BS-transects) was followed during three dry seasons (2006, 2007, 2009) and one rainy season (2005) to rapidly assess the epigeal biogenic structures of termites and ants. Per season, year and site 10 plots (1 m^2) were sampled, in 2006 it were 20 plots; the means were taken in the following calculation. Habitats are ZDeg: degraded land, ZMil: millet fields, ZF20: young forest, ZF30: old forest.

Soil turn-over by termites		Mean dry weight of biogenic structures $N_{\text{dry season}}$ = 40; $N_{\text{rainy season}}$ = 10		Bulk density ρ_{soil}	Growth of soil layer				Total growth of soil layer until 2009	
Zaï stage & season		to ha^{-1} mon^{-1}	kg m^{-2} mon^{-1}	kg·m^{-3}	m mon^{-1}	cm mon^{-1}	cm $season^{-1}$	cm $year^{-1}$	Layer since initial habitat stage (in cm)	
ZDeg	Dry seasons	0.1328	0.01328	1640	0.0000081	0.00081	0.00603	0.006		**0.00**
	Rainy season	0.0014	0.00014		0.0000001	0.00001	0.00005			
ZMil	Dry seasons	1.6707	0.16707	1640	0.0001019	0.01019	0.07581	0.129	11 years x 0.129 cm	**1.42**
	Rainy season	1.9087	0.19087		0.0001164	0.01164	0.05308			
ZF20	Dry seasons	2.6943	0.26943	1620	0.0001663	0.01663	0.12373	0.309	(4 years x 0.129 cm) + (16 years x 0.309 cm)	**5.46**
	Rainy season	6.5869	0.65869		0.0004066	0.04066	0.18541			
ZF30	Dry seasons	4.1433	0.41433	1600	0.0002590	0.02590	0.19270	0.520	(4 years x 0.129 cm) + (16 years x 0.309 cm) + (10 years x 0.520 cm)	**10.66**
	Rainy season	11.4940	1.14940		0.0007184	0.07184	0.32759			

ρ_{soil} Mean soil bulk density assessed with the 'Volumen-Ersatzmethode' (volume substitution method) in five soil profiles per Zaï stage.
Two distinct seasons the sub-Sahel region: 62% of the year is dry season, 38% is rainy season (site history and climate see Chapter 2.1.1.

APPENDIX – CHAPTER 8

SOME PHOTOS ILLUSTRATING THE EXPERIMENTAL BLOCKS

A)

B)

C)

D)

Fig. A8-1: Illustrated are some of the experimental blocks installed in four main succession stages of Zaï system in Ouahigouya (sub-Sahel region, northern Burkina Faso); here of the rainy season run in October 2005. Shown are three blocks, one located in the old Zaï forest (A), in the young Zaï forest (B), and in the millet field (C). In (D), the compost sub-quadrat of the block in (C) in the millet field is shown.

GRANULAR STRUCTURE OF SOIL-SHEETINGS & CONSTRUCTION-BEHAVIOR OF *ODONTOTERMES*

A)

B)

C)

D)

E)

F)

Fig. A8-2: Shown are: A) a hay quadrat in the young Zaï forest completely covered with *Odontotermes*-sheetings (dry season 2006); B)–D) close-ups of the sheetings constructed in the hay-plot shown in A). Together, the photos in A)–D) illustrate the termites' 'soil-sheeting construction-behavior': When foraging in hay, *Odontotermes* started from below and built then, from bottom to top, several layers of sheetings sometimes resulting in a height of more than 10 cm. E) Close-up of *Odontotermes*-workers while foraging in hay. F) Close-up of *Odontotermes*-sheetings constructed on compost. Together, the photos in D–F) illustrate the granular structure of *Odontotermes*-sheetings.

GRANULAR STRUCTURE OF SOIL-SHEETINGS & CONSTRUCTION-BEHAVIOR OF *MACROTERMES*

A)

B)

C)

D)

E)

F)

Fig. A8-3: Shown are first two hay-quadrats of the old Zaï forest where the hay-amendment was completely consumed; in A) of the rainy season run in 2005, the plot is completely covered with *Macrotermes*-sheetings; in B) a plot of the dry season run in 2006 where *Macrotermes* was foraging during the night and where most of the ground was visible since only some sheeting-spots were present. In C), D) close-ups of *Macrotermes* workers foraging in hay during the night while being surveyed by soldiers (no continuous sheeting-cover constructed). Together, the photos in A–D) illustrate the termites' 'soil-sheeting construction-behavior': *Macrotermes* usually built just one thick layer of sheetings with a height of only few centimeters (0.5 to maximal 5 cm). And E–F), illustrate the granular structure of *Macrotermes*-sheetings, constructed in E) a hay-plot and F) a compost-plot.

DOUBLE RING INFILTROMETER USED TO MEASURE THE SOILS' WATER INFILTRATION CAPACITY

A)

B)

Fig. A8-4: A) Double-ring infiltration conducted simultaneously in a sub-quadrat with recent termite activity (here: compost) and in the control-plot of the same experimental block (degraded area, ZDeg); and **B)** one of two sub-quadrats in which an infiltration measurement was simultaneously conducted in the young Zaï forest (ZF20) (both dry season 2006). In both photos, *Macrotermes* mound-soil was used to seal the base of the outer ring. In most cases, the clayey mound-soil had to be used at some point of the measurement to ensure that the water in the outer ring did not start to leak sideward at the rings' base.

DYNAMICS OF FORAGING AND SOIL-SHEETING ESTABLISHMENT IN SINGLE QUADRATS

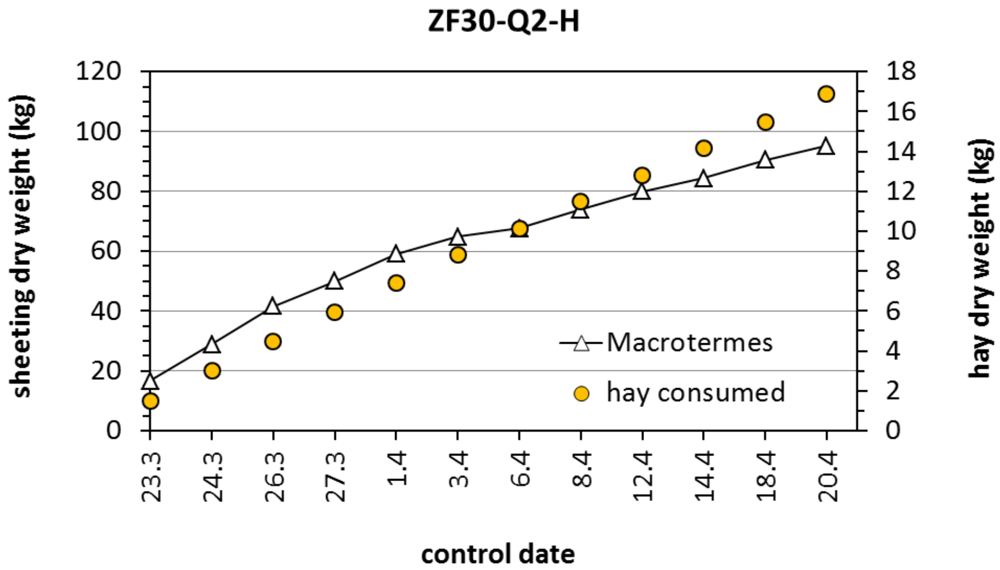


Fig. A8-5: The increasing dry weight of soil-sheetings constructed by *Macrotermes* during the experimental 4-weeks duration (dry season 2006) and the cumulated quantity of hay taken during this time is shown for the second hay-quadrat of the old Zaï forest (ZF30).

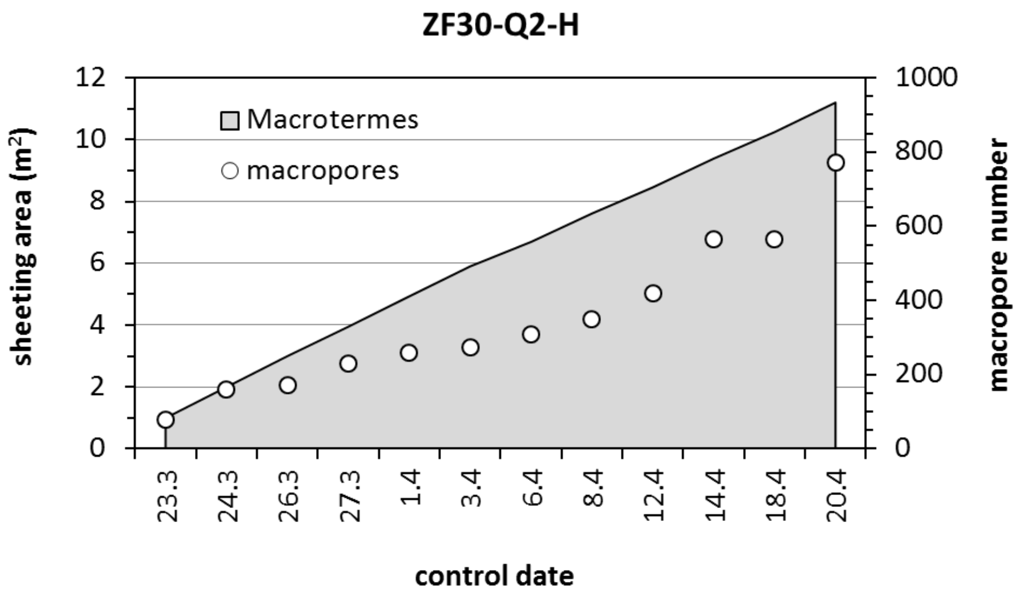


Fig. A8-6: The increase in sheeting-area and macropores constructed by *Macrotermes* during the experimental 4 weeks duration (dry season 2006) is shown for the second hay-quadrat of the old Zaï forest (ZF30).

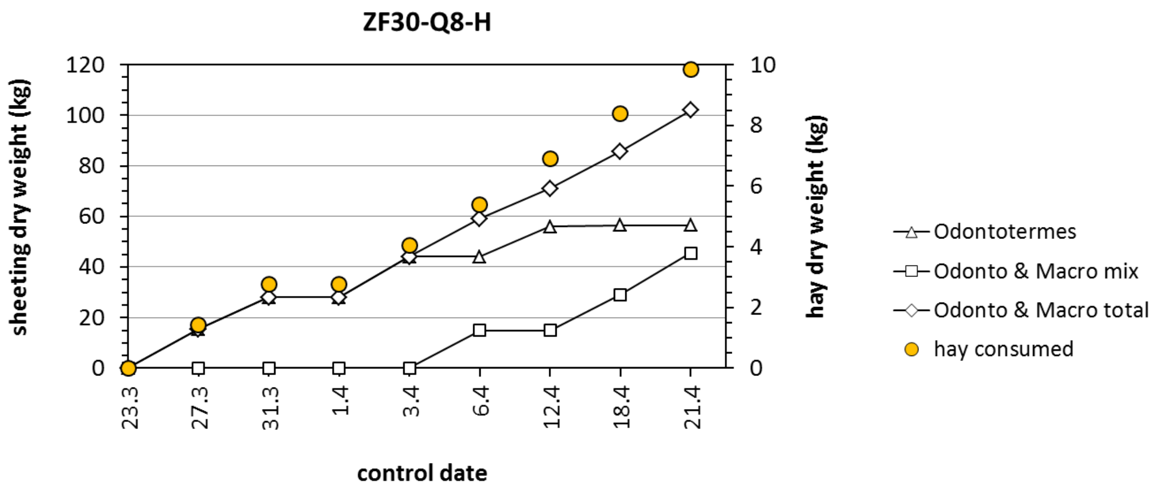


Fig. A8-7: The increasing dry weight of soil-sheetings constructed by *Odontotermes* and *Macrotermes* during the experimental 4-weeks duration (dry season 2006) and the cumulated quantity of hay taken during this time is shown for the eighth hay-quadrat of the old Zaï forest (ZF30).

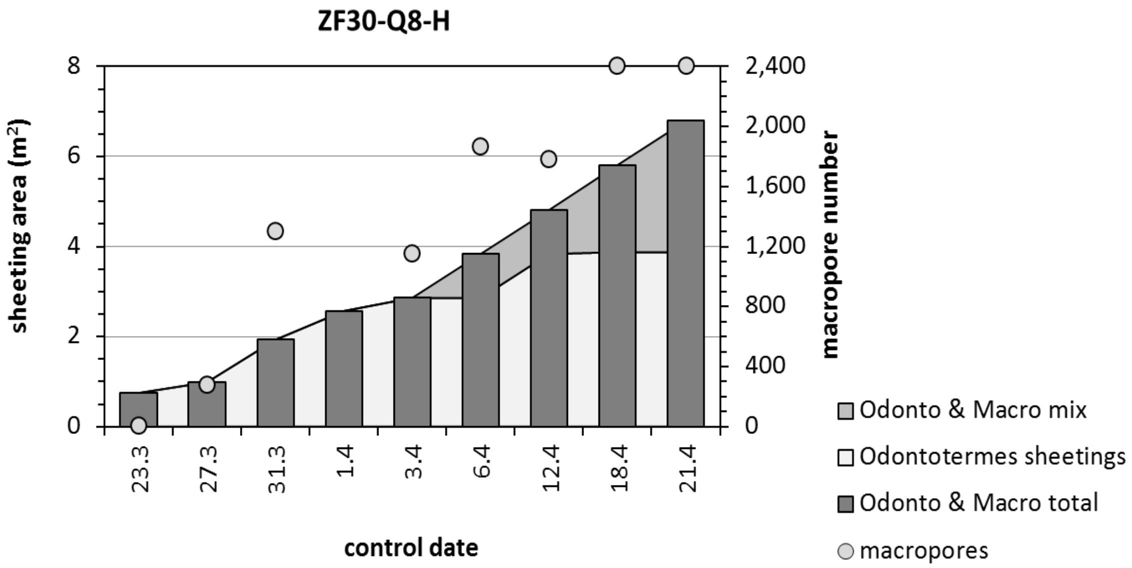


Fig. A8-8: The increase in sheeting-area and macropores constructed by *Odontotermes* and *Macrotermes* during the experimental 4-weeks duration (dry season 2006) is shown for the eighth hay-quadrat of the old Zaï forest (ZF30).

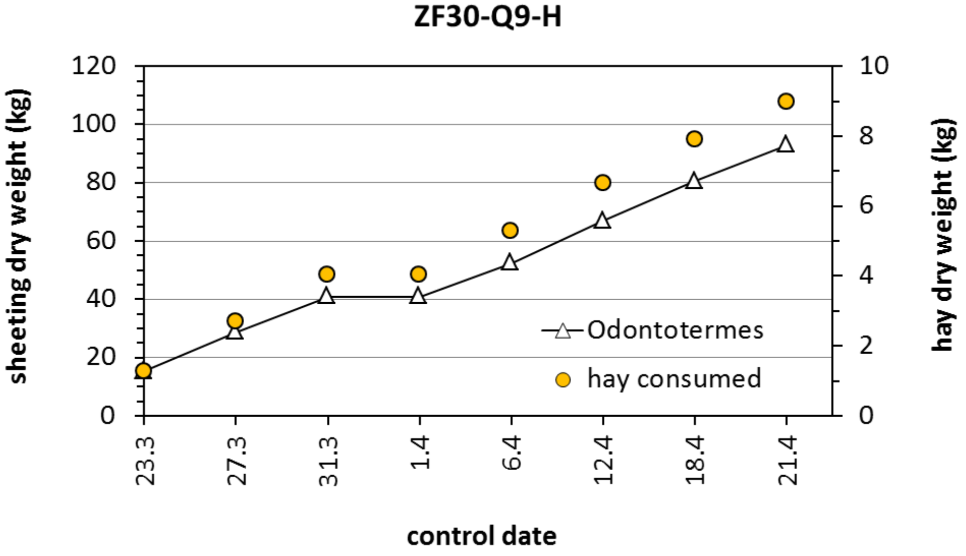


Fig. A8-9: The increasing dry weight of soil-sheetings constructed by *Odontotermes* during the experimental 4-weeks duration (dry season 2006) and the cumulated quantity of hay taken during this time is shown for the ninth hay-quadrat of the old Zaï forest (ZF30).

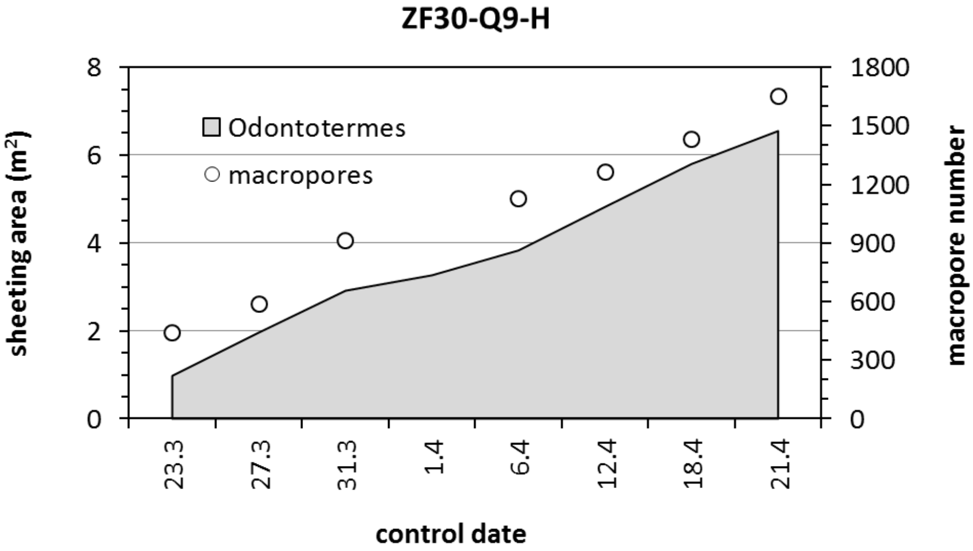
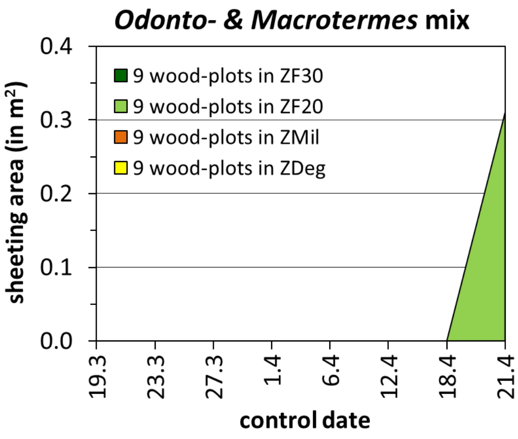


Fig. A8-10: The increase in sheeting-area and macropores constructed by *Odontotermes* during the experimental 4-weeks duration (dry season 2006) is shown for the ninth hay-quadrat of the old Zaï forest (ZF30).

DYNAMICS OF FORAGING AND SOIL-SHEETING ESTABLISHMENT IN ALL REPLICATE-QUADRATS



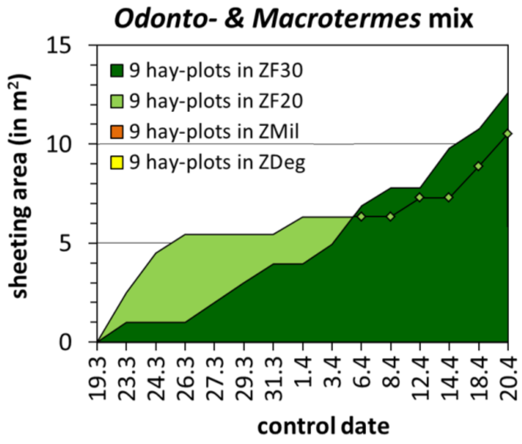
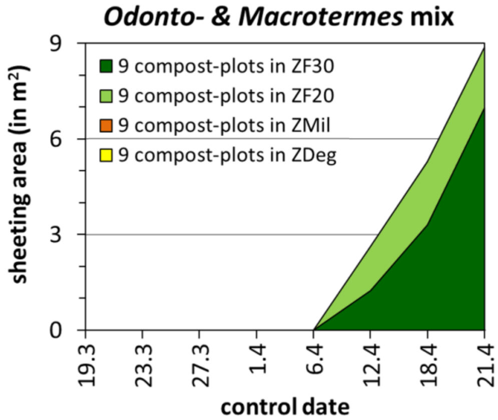


Fig. A8-11: Cumulated increase in sheeting-area constructed during the experimental 4-weeks duration by *Odontotermes* and *Macrotermes* together (sheeting-mix, not possible to separate), shown per Zaï stage for all wood--plots combined; and in **Fig. A8-12:** for all hay-plots combined (dry season 2006).



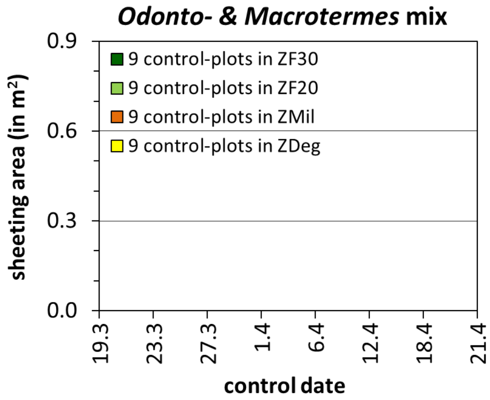
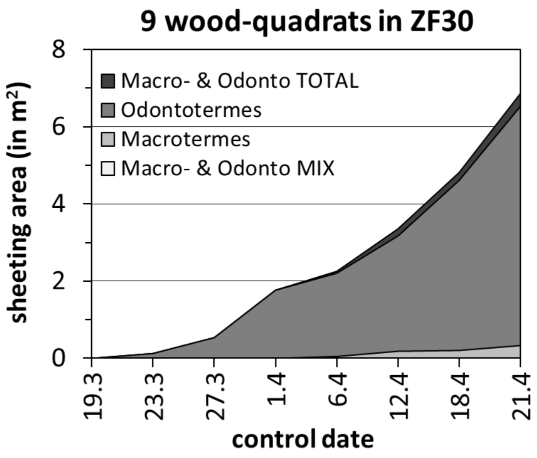


Fig. A8-13: Cumulated increase in sheeting-area constructed during the experimental 4-weeks duration by *Odontotermes* and *Macrotermes* together (sheeting-mix, not possible to separate), shown per Zaï stage for all compost-plots combined; and in **Fig. A8-14:** for all control-plots combined (dry season 2006).

Study sites are: degraded area (ZDeg), millet field (ZMil), young Zaï forest (ZF20), old Zaï forest (ZF30).

Sheetings which could not be separated into the constructing taxa will be called 'mixed sheetings'.

In the following eight figures, different grey-scales are used for each sheeting-type: sheetings of *Odontotermes* and *Macrotermes* in total are dark grey, the 'mixed sheetings' are white; sheetings of *Odontotermes* and *Macrotermes* have grey scales in between.



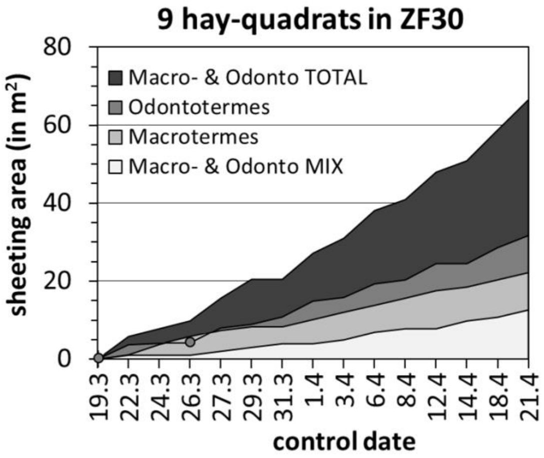
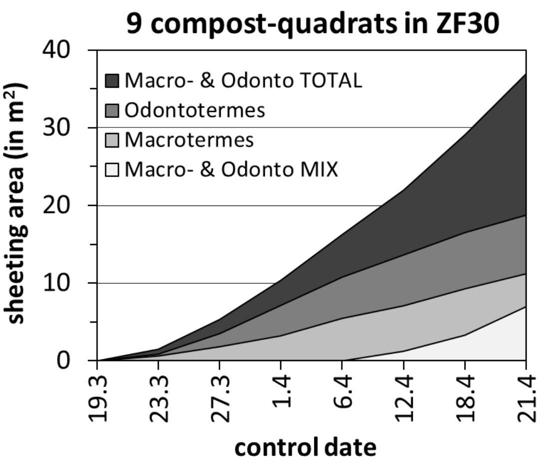


Fig. A8-15: Cumulated increase in sheeting-area constructed during the experimental 4-weeks duration by foraging termites, shown per type (*Macrotermes*, *Odontotermes*, mix, total) for all wood-plots combined; and in **Fig. A8-16:** for all hay-plots of the old Zaï forest (ZF30) combined (dry season 2006).



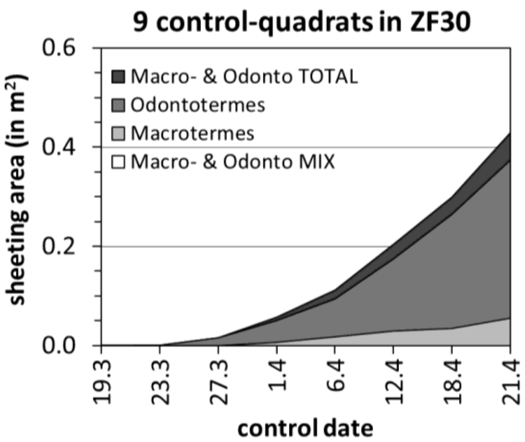
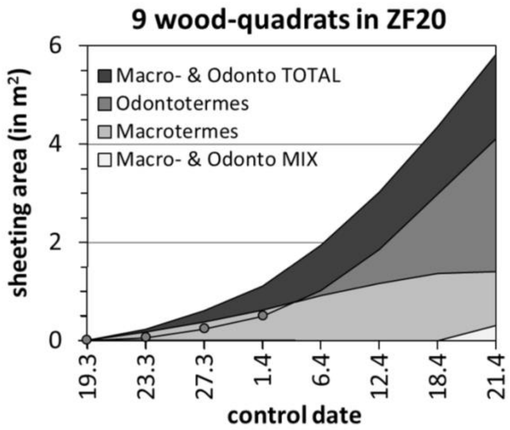


Fig. A8-17: Cumulated increase in sheeting-area constructed during the experimental 4-weeks duration by foraging termites, shown per type (*Macrotermes*, *Odontotermes*, mix, total) for all compost-plots combined; and in **Fig. A8-18:** for all control-plots of the old Zaï forest (ZF30) combined (dry season 2006).



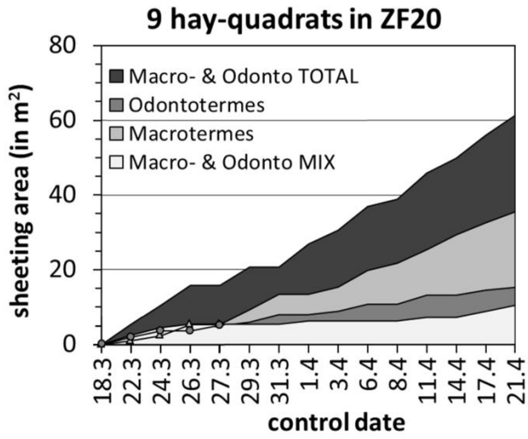
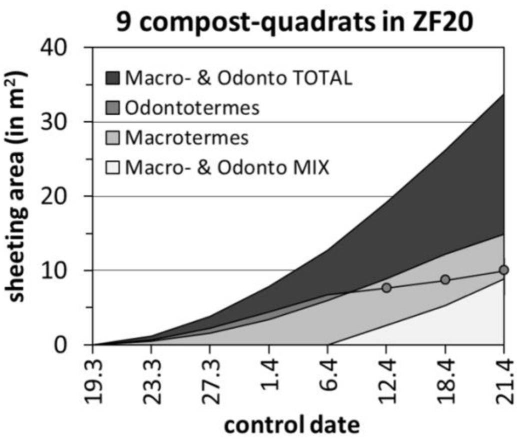


Fig. A8-19: Cumulated increase in sheeting-area constructed by foraging termites during the 4-weeks duration of the dry season run (2006), shown per sheeting-type (*Macrotermes*, *Odontotermes*, mix, total) for all wood-plots combined; and in **Fig. A8-20:** for all hay-plots of the young Zaï forest (ZF20) combined.



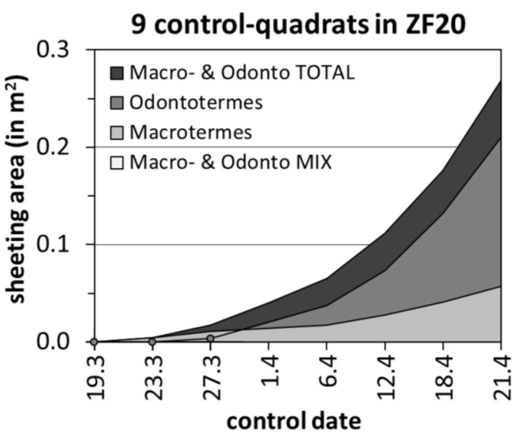
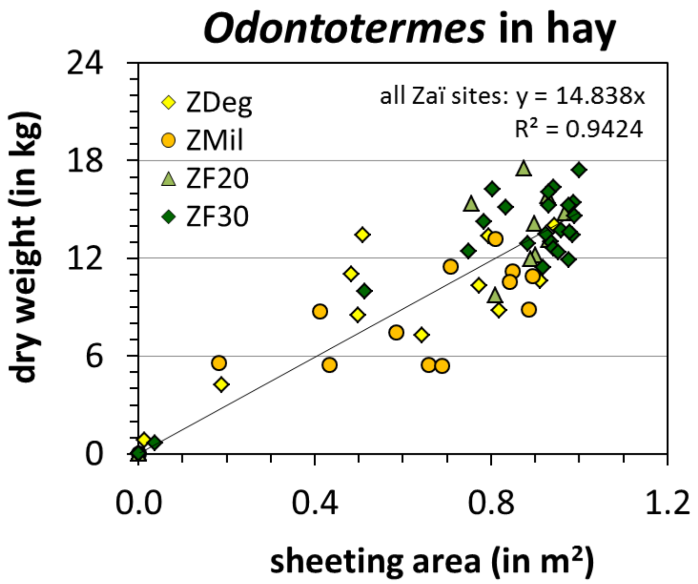


Fig. A8-21: Cumulated increase in sheeting-area constructed by foraging termites during the 4-weeks duration of the dry season run (2006), shown per sheeting-type (*Macrotermes, Odontotermes*, mix, total) for all compost-plots combined; and in **Fig.** A8-**22:** for all control-plots of the young Zaï forest (ZF20) combined.

<u>CORRELATION BETWEEN AREA AND WEIGHT OF SHEETINGS BUILT IN HAY (DRY SEASON 2006)</u>

For both genera, the correlation-equations were calculated 1) for all Zaï sites combined, and 2) for each Zaï stage separately; the resulting equations are shown 1) in the scatter plots, and 2) beside the scatter plots.

(A)



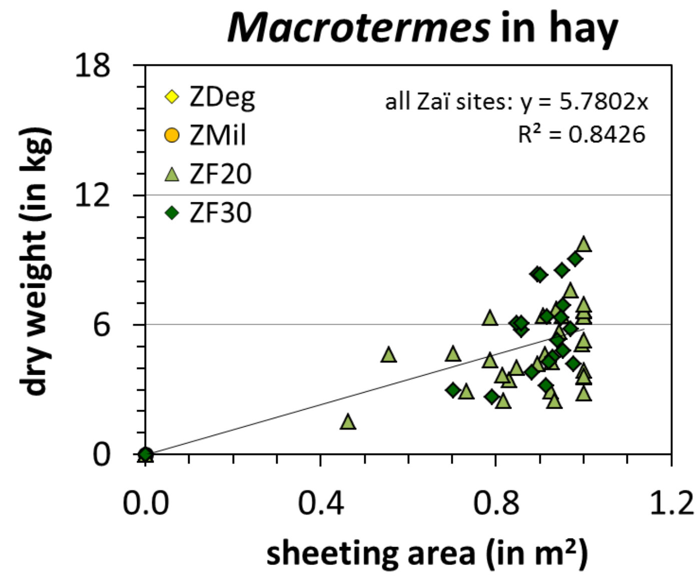
ZDeg: $y = 14.661x$, $R^2 = 0.7378$

ZMil: $y = 12.631x$, $R^2 = 0.5911$

ZF20: $y = 15.618x$, $R^2 = 0.9682$

ZF30: $y = 15.286x$, $R^2 = 0.9717$

(B)



ZF20: $y = 5.47x$, $R^2 = 0.7984$

ZF30: $y = 6.2741x$, $R^2 = 0.8801$

Fig. A8-23: Correlation between the area and the dry weight of sheetings built during the experimental 4-weeks duration of the dry season run (2006), shown for *Odontotermes*-sheetings **(A)**, and for *Macrotermes*-sheetings (**B).**

Study sites are: degraded area (ZDeg), millet field (ZMil), young Zaï forest (ZF20), old Zaï forest (ZF30).

DIAMETER OF FORAGING HOLES (MACROPORES) OF *MACROTERMES* AND *ODONTOTERMES*

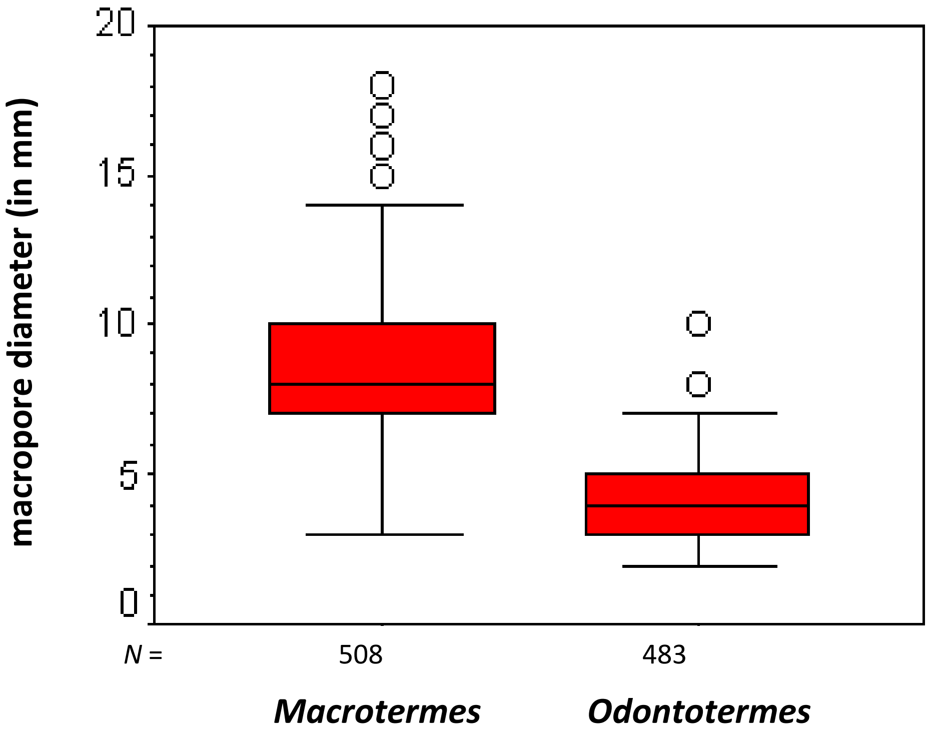


Fig. A8-24: Diameter of macropores illustrated for plots where either *Macrotermes* or *Odontotermes* species were foraging. The diameter was measured at the end of the experimental 4-weeks duration and before placing new material on a plot where 100% of the offered hay was consumed by termites.

NOW:

PHYSICOCHEMICAL PARAMETERS OF SOIL-SHEETINGS BUILT BY *ODONTOTERMES* AND *MACROTERMES* SPECIES

Table A8-1: Comparisons of control-plot topsoil with sheetings constructed by *Odontotermes* or *Macrotermes* on compost (Cp), hay (H) or wood (W), and with topsoil of Cp- or H-plots after 4 weeks foraging activity (rainy season 05). Given are means (*M*) ± standard deviations (*SD*), the mean difference (Δ), 95% confidence interval of Δ and the *p*-value (paired-samples *t* test; ns for $p > 0.05$). All Zaï sites combined.

		Soil parameter	CN-ratio		SOM (g kg^{-1})		pH_{KCl}		N total (g kg^{-1})		P total (g kg^{-1})	
		Paired-samples	***M* ± *SD***	**Δ 95% CI**	***M* ± *SD***	**Δ 95% CI**	***M* ± *SD***	**Δ 95% CI**	***M* ± *SD***	**Δ 95% CI**	***M* ± *SD***	**Δ 95% CI**
Rainy season 2005	***Odontotermes***	**Control-plot**	9.3 ± 2.7	Δ 1.19	10.2 ± 4.6	Δ -85.74	5.1 ± 1	Δ -2.26	0.65 ± 0.29	Δ -6.47	0.27 ± 0.08	Δ -3.09
		Sheetings in Cp	8.1 ± 1.5	-0.9 / 3.3	96 ± 8.7	-91.8 / -79.6	7.3 ± 0.1	-2.8 / -1.7	7.12 ± 1.86	-7.61 / -5.32	3.35 ± 0.85	-3.6 / -2.57
		N=13	ns		*p*<0.0001		*p*<0.0001		*p*<0.0001		*p*<0.0001	
		Control-plot	9.7 ± 2.2	Δ -4.61	10.1 ± 5.7	Δ -5.35	4.8 ± 0.6	Δ -0.39	0.6 ± 0.28	Δ -0.05	0.27 ± 0.05	Δ -0.06
		Sheetings in H	14.3 ± 3.6	-6.7 / -2.5	15.5 ± 6.5	-7.8 / -3	5.2 ± 0.5	-0.5 / -0.3	0.64 ± 0.27	-0.14 / 0.04	0.32 ± 0.15	-0.13 / 0.02
		N=19[1]	*p*=0.0002		*p*=0.0002		*p*<0.0001		ns		ns	
		Control-plot	9.7 ± 2.8	Δ -0.67	10.2 ± 5.3	Δ 0.24	5.1 ± 0.8	Δ -0.53	0.63 ± 0.3	Δ 0.06	0.27 ± 0.09	Δ 0.01
		Sheetings in W	10.4 ± 1.3	-2.2 / 0.8	10 ± 2.7	-1.9 / 2.4	5.6 ± 0.7	-0.8 / -0.3	0.57 ± 0.16	-0.08 / 0.21	0.26 ± 0.08	-0.05 / 0.06
		N=19	ns		ns		*p*=0.0003		ns		ns	
	Macrotermes	**Control-plot**	10.6 ± 3.6	Δ 2.24	10.9 ± 3.8	Δ -40.17	5.2 ± 0.5	Δ -2	0.64 ± 0.23	Δ -2.88	0.25 ± 0.07	Δ -1.06
		Sheetings in Cp	8.4 ± 0.5	-2.7 / 7.2	51.1 ± 8.7	-54.5 / -25.8	7.2 ± 0.1	-2.8 / -1.1	3.52 ± 0.44	-3.75 / -2.01	1.32 ± 0.15	-1.29 / -0.83
		N=4	ns		*p*=0.003		*p*=0.005		*p*=0.002		p=0.0007	
		Control-plot	9.5 ± 3	Δ -5.82	10.8 ± 4.2	Δ -2.01	5.4 ± 0.9	Δ -0.04	0.7 ± 0.31	Δ 0.19	0.27 ± 0.12	Δ 0.06
		Sheetings in H	15.3 ± 3.6	-8.6 / -3	12.8 ± 2.8	-4.1 / 0	5.4 ± 0.5	-0.6 / 0.5	0.51 ± 0.17	0.02 / 0.35	0.21 ± 0.08	-0.02 / 0.14
		N=9	*p*=0.001		ns		ns		*p*=0.03		ns	
		Control-plot	13.5 ± 2.3	Δ 1.1	11.2 ± 4.2	Δ -3.79	5.1 ± 0.5	Δ -0.78	0.52 ± 0.3	Δ -0.17	0.24 ± 0.08	Δ -0.06
		Sheetings in W	12.4 ± 1.7	-8.7 / 10.9	15 ± 6	-8.6 / 1	5.9 ± 0.1	-2.1 / 0.6	0.69 ± 0.19	-0.52 / 0.17	0.29 ± 0.02	-0.23 / 0.11
		N=3	ns		ns		ns		ns		ns	
	Topsoil	**Control-plot**	9.2 ± 2.6	Δ -1.05	10.1 ± 4.4	Δ -0.77	5.1 ± 0.9	Δ -0.19	0.66 ± 0.27	Δ 0.03	0.27 ± 0.07	Δ -0.06
		Compost-plot	10.2 ± 2.4	-2.4 / 0.4	10.9 ± 3.6	-2.5 / 1	5.3 ± 0.6	-0.5 / 0.1	0.63 ± 0.19	-0.1 / 0.16	0.32 ± 0.07	-0.12 / 0
		N=15	ns		ns		ns		ns		ns	
		Control-plot	9.8 ± 2.4	Δ -1.14	10.4 ± 5.3	Δ 0.76	5 ± 0.7	Δ 0.21	0.63 ± 0.3	Δ 0.09	0.27 ± 0.08	Δ 0.03
		Hay-plot	10.9 ± 2.9	-2.2 / -0.1	9.7 ± 4.1	-0.4 / 1.9	4.8 ± 0.5	0.1 / 0.4	0.54 ± 0.23	0 / 0.18	0.24 ± 0.08	-0.01 / 0.07
		N=27	*p*=0.03		ns		*p*=0.01		*p*=0.05		ns	

Table A8-2: Comparisons of control-plot topsoil with sheetings constructed by *Odontotermes* or *Macrotermes* on compost (Cp), hay (H) or wood (W), and with topsoil of Cp- or H-plots after 4 weeks foraging activity (dry season 06). Given are means (*M*) ± standard deviations (*SD*), the mean difference (Δ), 95% confidence interval of Δ and the *p*-value (paired-samples *t* test; ns for *p* > 0.05). All Zaï sites combined.

		Soil parameter	**CN-ratio**		**SOM (g kg^{-1})**		**pH$_{KCl}$**		**N total (g kg^{-1})**		**P total (g kg^{-1})**	
		Paired-samples	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**
Dry season 2006	***Odontotermes***	**Control-plot**	13.7 ± 4.3	Δ 0.1	12.9 ± 6.1	Δ -31.55	5.2 ± 0.6	Δ -2.03	0.57 ± 0.26	Δ -1.34	0.27 ± 0.07	Δ -0.33
		Sheetings in Cp	13.6 ± 2.6	-2.4 / 2.6	44.4 ± 15.7	-38.5 / -24.6	7.2 ± 0.5	-2.4 / -1.7	1.91 ± 0.6	-1.59 / -1.09	0.59 ± 0.18	-0.42 / -0.23
		N=19[1]	ns		*p*<0.00001		*p*<0.00001		*p*<0.00001		*p*<0.00001	
		Control-plot	12.4 ± 2.6	Δ 0.18	11.6 ± 5.4	Δ -4.56	5.1 ± 0.6	Δ -0.47	0.57 ± 0.3	Δ -0.22	0.29 ± 0.07	Δ 0
		Sheetings in H	12.2 ± 2	-1.2 / 1.6	16.1 ± 5.9	-5.9 / -3.2	5.6 ± 0.4	-0.6 / -0.3	0.79 ± 0.35	-0.32 / -0.12	0.29 ± 0.09	-0.05 / 0.05
		N=20[2]	ns		*p*<0.00001		*p*=0.00002		*p*=0.0002		ns	
		Control-plot	12.7 ± 4.6	Δ 0.83	13.1 ± 6.5	Δ -2.96	5.3 ± 0.5	Δ -0.5	0.61 ± 0.26	Δ -0.19	0.26 ± 0.07	Δ -0.04
		Sheetings in W	11.9 ± 2.3	-1.6 / 3.3	16 ± 9	-5.6 / -0.3	5.8 ± 0.4	-0.7 / -0.3	0.8 ± 0.41	-0.33 / -0.05	0.3 ± 0.11	-0.08 / 0.01
		N=20	ns		*p*=0.03		*p*=0.00005		*p*=0.01		ns	
	Macrotermes	**Control-plot**	12.9 ± 1.7	Δ 0.3	11.6 ± 3.8	Δ -31.72	5.4 ± 0.5	Δ -2.09	0.53 ± 0.17	Δ -1.47	0.22 ± 0.04	Δ -0.31
		Sheetings in Cp	12.6 ± 1.3	-1.3 / 1.9	43.3 ± 10.3	-37.4 / -26	7.5 ± 0.3	-2.3 / -1.9	2 ± 0.45	-1.72 / -1.22	0.53 ± 0.11	-0.37 / -0.24
		N=10[3]	ns		*p*<0.00001		*p*<0.00001		*p*<0.00001		*p*<0.00001	
		Control-plot	12.8 ± 1.1	Δ -3.89	9.8 ± 3.3	Δ -8.51	5.6 ± 0.6	Δ -0.18	0.45 ± 0.17	Δ -0.19	0.2 ± 0.04	Δ 0
		Sheetings in H	16.7 ± 2.5	-6 / -1.8	18.3 ± 3.9	-12.2 / -4.8	5.7 ± 0.6	-0.7 / 0.4	0.64 ± 0.13	-0.35 / -0.03	0.2 ± 0.05	-0.04 / 0.04
		N=8	*p*=0.003		*p*<0.001		ns		*p*=0.03		ns	
		Control-plot	13.1 ± 1.5	Δ -0.36	14.1 ± 4.4	Δ -5.37	5.5 ± 0.5	Δ -0.22	0.62 ± 0.17	Δ -0.21	0.22 ± 0.05	Δ -0.05
		Sheetings in W	13.5 ± 2.1	-3.2 / 2.4	19.5 ± 5.9	-10 / -0.8	5.7 ± 0.4	-0.7 / 0.3	0.83 ± 0.19	-0.4 / -0.01	0.26 ± 0.07	-0.13 / 0.03
		N=6	ns		*p*=0.03		ns		*p*=0.04		ns	
	Topsoil	**Control-plot**	13.5 ± 3.8	Δ 3.68	12.8 ± 5.7	Δ -3.01	5.3 ± 0.6	Δ -0.69	0.57 ± 0.25	Δ -0.35	0.26 ± 0.07	Δ -0.07
		Compost-plot	9.9 ± 1.8	1.9 / 5.5	15.8 ± 6	-5.2 / -0.8	6 ± 0.7	-0.9 / -0.5	0.92 ± 0.31	-0.43 / -0.27	0.33 ± 0.13	-0.12 / -0.03
		N=25	*p*=0.0003		*p*<0.01		*p*<0.00001		*p*<0.00001		*p*=0.002	
		Control-plot	12.7 ± 2.1	Δ -0.07	11.4 ± 4.9	Δ -0.98	5.3 ± 0.6	Δ -0.04	0.55 ± 0.28	Δ -0.03	0.27 ± 0.08	Δ -0.02
		Hay-plot	12.8 ± 2.6	-1.1 / 1	12.4 ± 5.2	-2.7 / 0.7	5.3 ± 0.6	-0.2 / 0.1	0.57 ± 0.22	-0.11 / 0.06	0.28 ± 0.09	-0.04 / 0.01
		N=26[7]	ns		ns		ns		ns		ns	

[1] CN-ratio: *N*=13

Table A8-3: Comparisons of control-plot topsoil with sheetings constructed by *Odontotermes* or *Macrotermes* on compost (Cp), hay (H) or wood (W), and with topsoil of Cp- or H-plots after 4 weeks foraging activity (rainy season 05). Given are means (*M*) ± standard deviations (*SD*), the mean difference (Δ), 95% confidence interval of Δ and the *p*-value (paired-samples *t* test; ns for $p > 0.05$). All Zaï sites combined.

		Soil parameter	EC (mS cm^{-1})		Coarse sand (%)		Middle sand (%)		Fine sand (%)		Sand total (%)	
		Paired-samples	*M ± SD*	Δ 95% CI	M ± SD	Δ 95% CI	*M ± SD*	Δ 95% CI	*M ± SD*	Δ 95% CI	*M ± SD*	Δ 95% CI
Rainy season 2005	*Odontotermes*	**Control-plot**	48 ± 19	Δ -675	9 ± 2.6	Δ -0.4	19.1 ± 6.7	Δ 0.6	27.4 ± 3.7	Δ 2.4	55.4 ± 9.3	Δ 2.6
		Sheetings in Cp	723 ± 98	-735 / -615	9.4 ± 2.7	-1.7 / 1	18.5 ± 4.5	-1.4 / 2.5	25 ± 2.4	0.1 / 4.7	52.8 ± 5.9	-0.1 / 5.4
		N=13	*p*<0.0001		ns		ns		*p*=0.04		*p*<0.0001	
		Control-plot	48 ± 20	Δ -22	7.4 ± 3.5	Δ -0.2	16.3 ± 8.5	Δ -2.4	28.5 ± 9.7	Δ -2.1	55.4 ± 11.8	Δ -1.3
		Sheetings in H	70 ± 21	-32 / -13	7.6 ± 3.7	-1.9 / 1.5	18.7 ± 6.6	-5.1 / 0.3	30.6 ± 5.2	-6.6 / 2.4	56.6 ± 9.5	-4.5 / 2
		N=16[2]	*p*<0.0001		ns		ns		ns		*p*<0.0001	
		Control-plot	45 ± 17	Δ -69	8 ± 3.8	Δ 1.1	17 ± 7.5	Δ -1.5	28.4 ± 9.5	Δ -0.2	56.7 ± 8.4	Δ 2.7
		Sheetings in W	114 ± 49	-95 / -44	6.9 ± 5.3	-1.4 / 3.7	18.5 ± 5.4	-4.6 / 1.5	28.6 ± 3.9	-4.5 / 4	54 ± 6.5	-1 / 6.5
		N=19	*p*=0.00002		ns		ns		ns		ns	
	Macrotermes	**Control-plot**	42 ± 5	Δ -385	8 ± 2	Δ -1.1	17.3 ± 5.5	Δ -3.1	28.1 ± 2.3	Δ 0.5	53.5 ± 8.3	Δ -3.8
		Sheetings in Cp	426 ± 51	-460 / -310	9.2 ± 0.3	-4.6 / 2.3	20.5 ± 1.6	-10.4 / 4.1	27.7 ± 1.6	-3 / 3.9	57.3 ± 1.9	-17.5 / 9.9
		N=4	*p*=0.005		ns		ns		ns		*p*=0.0005	
		Control-plot	43 ± 11	Δ -19	8.7 ± 2.8	Δ -1.6	19.4 ± 5.7	Δ -3	27.9 ± 5.1	Δ -0.1	56.1 ± 8	Δ -4.7
		Sheetings in H	61 ± 12	-30 / -7	10.3 ± 2.8	-4.7 / 1.6	22.4 ± 5.5	-5.7 / -0.4	28 ± 3.5	-3.5 / 3.4	60.7 ± 6.3	1.00
		N=9	*p*=0.006		ns		*p*=0.03		ns		*p*=0.006	
		Control-plot	36 ± 8	Δ -73	6.3 ± 4.5	Δ -0.7	17.8 ± 5.9	Δ -2.7	29.1 ± 4.8	Δ 0.8	53.1 ± 9.4	Δ -2.6
		Sheetings in W	110 ± 9	-98 / -48	7 ± 2.9	-11.3 / 9.9	20.5 ± 2.8	-13.6 / 8.2	28.2 ± 4.9	-6 / 7.7	55.7 ± 3.4	-29.5 / 24.4
		N=3	*p*=0.006		ns		ns		ns		ns	
	Topsoil	**Control-plot**	47 ± 17	Δ -15	8.8 ± 2.5	Δ -1	18.6 ± 6.4	Δ -1.1	27.7 ± 3.6	Δ -0.6	55.1 ± 8.8	Δ -2.7
		Compost-plot	63 ± 21	-28 / -2	9.8 ± 2	-2.7 / 0.7	19.7 ± 5.4	-2.9 / 0.6	28.3 ± 3	-2.3 / 1.1	57.8 ± 7.2	-6.1 / 0.6
		N=15	*p*=0.02		ns		ns		ns		ns	
		Control-plot	47 ± 17	Δ 2	7.6 ± 3.2	Δ -1.2	17.3 ± 7.8	Δ -1.5	28.5 ± 8.2	Δ -1.6	55.7 ± 10.5	Δ -1.8
		Hay-plot	45 ± 14	-3 / 7	8.8 ± 3	-2.3 / -0.2	18.7 ± 6.8	-3.4 / 0.4	30.1 ± 5.4	-4.6 / 1.5	57.5 ± 10.6	-4.4 / 0.8
		N=24[8]	ns		*p*=0.03		ns		ns		ns	

Table A8-4: Comparisons of control-plot topsoil with sheetings constructed by *Odontotermes* or *Macrotermes* on compost (Cp), hay (H) or wood (W), and with topsoil of Cp- or H-plots after 4 weeks foraging activity (dry season 06). Given are means (*M*) ± standard deviations (*SD*), the mean difference (Δ), 95% confidence interval of Δ and the *p*-value (paired-samples *t* test; ns for $p > 0.05$). All Zaï sites combined.

		Soil parameter	**EC (mS cm^{-1})**		**Coarse sand (%)**		**Middle sand (%)**		**Fine sand (%)**		**Sand total (%)**	
		Paired-samples	***M ± SD***	**Δ 95% CI**	**M ± SD**	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**
Dry season 2006	***Odontotermes***	**Control-plot**	59 ± 21	Δ -1171	6.9 ± 3	Δ 0.2	16.8 ± 5.6	Δ -0.8	29.5 ± 4.9	Δ 2.1	53.4 ± 9.1	Δ 1.8
		Sheetings in Cp	1230 ±462	-1395 / -947	6.6 ± 3	-1.2 / 1.6	17.6 ± 4.7	-2.3 / 0.7	27.4 ± 3.7	0.4 / 3.8	51.6 ± 7.4	-1 / 4.6
		N=19	*p*<0.00001		ns		ns		*p*=0.02		ns	
		Control-plot	56 ± 19	Δ -121	7.6 ± 2.8	Δ 0.7	18.1 ± 6.5	Δ -0.9	28.1 ± 2.6	Δ 0.5	54.1 ± 9.7	Δ 1.1
		Sheetings in H	177 ± 67	-152 / -89	6.9 ± 2.5	-0.3 / 1.7	19 ± 6.9	-2.5 / 0.7	27.6 ± 3	-0.8 / 1.8	53 ± 9.9	-1.5 / 3.7
		N=20	*p*<0.00001		ns		ns		ns		ns	
		Control-plot	57 ± 22	Δ -107	6.7 ± 3	Δ -0.8	16.7 ± 6.3	Δ -2.7	29.6 ± 5.3	Δ 0.9	53.1 ± 10.5	Δ -2.6
		Sheetings in W	164 ± 77	-141 / -73	7.5 ± 3.6	-2 / 0.4	19.4 ± 6.5	-4.3 / -1.1	28.7 ± 4.6	-0.8 / 2.6	55.7 ± 10.7	-5.6 / 0.4
		N=20	*p*=0.00005		ns		*p*=0.003		ns		ns	
	Macrotermes	**Control-plot**	48 ± 20	Δ -1169	6.8 ± 2.2	Δ 0.5	20.9 ± 6.6	Δ 0.3	30.8 ± 5	Δ 1.6	58.5 ± 11.3	Δ 2.5
		Sheetings in Cp	1218 ± 427	-1472 / -867	6.2 ± 2.1	-1 / 2.1	20.6 ± 4.7	-1.7 / 2.3	29.2 ± 3.7	-1.6 / 4.9	56 ± 7.3	-1.2 / 6.1
		N=10	*p*=0.00001		ns		ns		ns		ns	
		Control-plot	41 ± 18	Δ -116	6.4 ± 2.9	Δ -1.1	21.7 ± 6.5	Δ 1.2	33.8 ± 7	Δ 4.6	61.8 ± 10.9	Δ 4.7
		Sheetings in H	156 ± 57	-161 / -71	7.5 ± 3	-3.2 / 1	20.4 ± 4.2	-2.4 / 4.9	29.2 ± 5	0.1 / 9	57.1 ± 7.4	-0.2 / 9.6
		N=8	*p*=0.0005		ns		ns		*p*=0.05		ns	
		Control-plot	53 ± 19	Δ -124	5 ± 1.6	Δ -2.7	15.7 ± 2.1	Δ 0.2	29.5 ± 6.1	Δ 3.8	50.2 ± 7.1	Δ 1.3
		Sheetings in W	177 ± 81	-207 / -41	7.7 ± 4.6	-7.3 / 1.9	15.5 ± 3.6	-3.9 / 4.3	25.7 ± 5.5	-0.3 / 8	48.9 ± 9.6	-9.3 / 11.9
		N=6	*p*=0.01		ns		ns		ns		ns	
	Topsoil	**Control-plot**	56 ± 22	Δ -107	6.8 ± 2.9	Δ -0.5	17.9 ± 6.1	Δ -0.2	29.8 ± 5.2	Δ 0.8	54.7 ± 10.4	Δ 0.3
		Compost-plot	162 ± 76	-140 / -73	7.3 ± 2.8	-1.5 / 0.5	18 ± 5.2	-1.4 / 1.1	28.9 ± 4.7	-0.5 / 2.2	54.4 ± 9.4	-2.1 / 2.7
		N=25	*p*<0.00001		ns		ns		ns		ns	
		Control-plot	52 ± 20	Δ -21	7.1 ± 2.7	Δ 0.4	18.7 ± 6.4	Δ -0.4	29.8 ± 5.2	Δ 1.1	55.6 ± 10.3	Δ 1.3
		Hay-plot	73 ± 30	-34 / -8	6.7 ± 2.3	-0.6 / 1.3	19.1 ± 6.2	-1.7 / 0.9	28.7 ± 4	-0.6 / 2.7	54.3 ± 9.4	-0.9 / 3.6
		N=26	*p*=0.002		ns		ns		ns		ns	

[2] P total: *N*=19

Table A8-5: Comparisons of control-plot topsoil with sheetings constructed by *Odontotermes* or *Macrotermes* on compost (Cp), hay (H) or wood (W), and with topsoil of Cp- or H-plots after 4 weeks foraging activity (rainy season 05). Given are means (*M*) ± standard deviations (*SD*), the mean difference (Δ), 95% confidence interval of Δ and the *p*-value (paired-samples *t* test; ns for $p > 0.05$). All Zaï sites combined.

		Soil parameter	**Coarse silt (%)**		**Middle silt (%)**		**Fine silt (%)**		**Silt total (%)**		**Clay (%)**	
		Paired-samples	***M ± SD***	**Δ 95% CI**	**M ± SD**	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**
Rainy season 2005	***Odontotermes***	**Control-plot**	20.6 ± 5.7	Δ 1.4	5.6 ± 1.6	Δ -1	3.4 ± 0.8	Δ -1.5	29.6 ± 7.2	Δ -1.1	15 ± 5.5	Δ -1.5
		Sheetings in Cp	19.1 ± 3	-1.2 / 4.1	5.9 ± 2	-1.7 / -0.4	4.9 ± 0.8	-2.1 / -0.9	30.7 ± 4.3	-3.8 / 1.5	16.5 ± 2.5	-4.4 / 1.4
		N=13	ns		*p*=0.004		*p*=0.0001		ns		ns	
		Control-plot	21.1 ± 7.9	Δ -0.8	5.4 ± 2.2	Δ 0.1	2.6 ± 1.1	Δ 0	31 ± 8	Δ 1	13.7 ± 5.9	Δ 0.3
		Sheetings in H	22 ± 5.1	-4 / 2.4	5.3 ± 1.1	-0.9 / 1.1	2.6 ± 0.7	-0.7 / 0.7	30 ± 6.7	-1.8 / 3.8	13.4 ± 4.4	-1.6 / 2.2
		N=16	ns		ns		ns		ns		ns	
		Control-plot	20.1 ± 7.9	Δ 0.2	5.3 ± 2.1	Δ -0.2	2.8 ± 1.1	Δ -0.7	29.9 ± 7.9	Δ 0.9	13.4 ± 3.5	Δ -3.6
		Sheetings in W	20 ± 5.5	-3 / 3.3	5.5 ± 1.6	-1 / 0.6	3.4 ± 0.9	-1.2 / -0.1	29.1 ± 7.3	-1.7 / 3.5	17 ± 4.6	-6.9 / -0.4
		N=19[1]	ns		ns		*p*=0.02		ns		*p*=0.03	
	Macrotermes	**Control-plot**	22.8 ± 7.1	Δ 2.3	5.9 ± 2	Δ 0.3	3.8 ± 0.6	Δ 0.6	32.5 ± 8.8	Δ 3.3	14 ± 3.6	Δ 0.6
		Sheetings in Cp	20.5 ± 2.5	-5.3 / 9.9	5.6 ± 0.5	-2.1 / 2.7	3.2 ± 0.5	0 / 1.3	29.2 ± 2.7	-6.6 / 13.1	13.5 ± 3.2	-4.9 / 6.1
		N=4	ns		ns		ns		ns		ns	
		Control-plot	19.6 ± 6.1	Δ 1.2	5.2 ± 1.6	Δ 0.4	3.5 ± 0.9	Δ 0.8	28.3 ± 7.3	Δ 2.5	15.6 ± 6.1	Δ 2.2
		Sheetings in H	18.4 ± 4.9	-1.7 / 4.2	4.7 ± 1.4	-0.3 / 1.1	2.7 ± 0.9	0.1 / 1.5	25.9 ± 6.3	-0.8 / 5.7	13.4 ± 5.4	-2.6 / 7.1
		N=9	ns		ns		*p*=0.03		ns		ns	
		Control-plot	22.8 ± 8.7	Δ 6.3	5.6 ± 1.9	Δ 1	3.3 ± 0.8	Δ 0.4	31.7 ± 9.7	Δ 7.7	15.2 ± 3.3	Δ -5.1
		Sheetings in W	16.5 ± 4.8	-6.2 / 18.8	4.6 ± 0.9	-2.8 / 4.8	2.9 ± 0.8	-1.1 / 1.9	24 ± 4.8	-7.7 / 23	20.3 ± 6.1	-19.9 / 9.7
		N=3	ns		ns		ns		ns		ns	
	Topsoil	**Control-plot**	21.2 ± 5.7	Δ 1.1	5.7 ± 1.6	Δ 0.7	3.5 ± 0.8	Δ 0.2	30.4 ± 7.2	Δ 2.1	14.5 ± 5.3	Δ 0.6
		Compost-plot	20.1 ± 4.8	-1.6 / 3.9	5 ± 1.3	0.1 / 1.3	3.2 ± 0.8	-0.2 / 0.6	28.4 ± 5.9	-1.1 / 5.2	13.8 ± 4.3	-1.7 / 3
		N=15	ns		*p*=0.03		ns		ns		ns	
		Control-plot	21 ± 7.6	Δ 0.6	5.4 ± 2.1	Δ 0.4	2.8 ± 1.1	Δ 0	30.4 ± 8.1	Δ 2.2	13.8 ± 5.2	Δ -0.4
		Hay-plot	20.4 ± 5.5	-1.6 / 2.7	5 ± 1.6	-0.3 / 1	2.7 ± 0.9	-0.5 / 0.6	28.2 ± 7.8	0.4 / 4.1	14.3 ± 5.7	-2 / 1.1
		N=24[8]	ns		ns		ns		*p*=0.02		ns	

Table A8-6: Comparisons of control-plot topsoil with sheetings constructed by *Odontotermes* or *Macrotermes* on compost (Cp), hay (H) or wood (W), and with topsoil of Cp- or H-plots after 4 weeks foraging activity (dry season 06). Given are means (*M*) ± standard deviations (*SD*), the mean difference (Δ), 95% confidence interval of Δ and the *p*-value (paired-samples *t* test; ns for $p > 0.05$). All Zaï sites combined.

		Soil parameter	**Coarse silt (%)**		**Middle silt (%)**		**Fine silt (%)**		**Silt total (%)**		**Clay (%)**	
		Paired-samples	***M ± SD***	**Δ 95% CI**	**M ± SD**	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**
Dry season 2006	***Odontotermes***	**Control-plot**	23.7 ± 6.3	Δ 1.3	6 ± 1.9	Δ -0.2	3.4 ± 0.8	Δ 0.3	33.6 ± 8.2	Δ 1.7	13 ± 4.3	Δ -3.5
		Sheetings in Cp	22.4 ± 3.8	-0.4 / 2.9	5.8 ± 2.5	-1.1 / 0.6	3.1 ± 0.8	-0.3 / 0.8	31.8 ± 5.6	-0.5 / 4	16.5 ± 3.5	-5.2 / -1.9
		N=19	ns		ns		ns		ns		*p*=0.0002	
		Control-plot	22.9 ± 6.9	Δ 1.3	5.8 ± 1.9	Δ 0.3	3.3 ± 0.8	Δ 0.5	32.4 ± 9	Δ 2.2	13.5 ± 4.5	Δ -3.2
		Sheetings in H	21.7 ± 6.5	-0.1 / 2.6	5.4 ± 1.4	-0.3 / 0.9	2.8 ± 0.8	0.2 / 0.9	30.2 ± 7.9	0.3 / 4.1	16.7 ± 6	-5.6 / -0.9
		N=20	ns		ns		*p*=0.004		*p*=0.03		*p*=0.01	
		Control-plot	24.3 ± 7.5	Δ 2.6	6.3 ± 2.3	Δ 0.7	3.4 ± 0.9	Δ 0.5	34 ± 10	Δ 3.8	12.9 ± 3.8	Δ -1.2
		Sheetings in W	21.7 ± 6.4	1.1 / 4.2	5.6 ± 2.1	0.1 / 1.3	2.9 ± 0.9	0.2 / 0.8	30.2 ± 8.8	1.8 / 5.8	14.1 ± 5	-3.9 / 1.5
		N=20	ns		*p*=0.003		*p*=0.03		*p*=0.003		*p*=0.0007	
	Macrotermes	**Control-plot**	22.6 ± 7.4	Δ 1.9	5.8 ± 2.5	Δ -0.2	3.5 ± 0.6	Δ 0.6	31.8 ± 10.1	Δ 2.3	9.6 ± 2.3	Δ -4.8
		Sheetings in Cp	20.7 ± 6.2	-0.3 / 4.1	6 ± 1.7	-1.2 / 0.7	2.9 ± 0.7	0.1 / 1.1	29.6 ± 7.9	-0.4 / 5	14.4 ± 2.6	-7 / -2.5
		N=10	ns		ns		*p*=0.03		ns		*p*=0.001	
		Control-plot	21.9 ± 7.5	Δ 0.1	4.8 ± 1.8	Δ -0.3	3.2 ± 0.8	Δ 0.4	29.9 ± 9.8	Δ 0.1	8.3 ± 2	Δ -4.8
		Sheetings in H	21.8 ± 5.9	-3.7 / 3.9	5.1 ± 1.3	-1.4 / 0.7	2.9 ± 0.7	-0.5 / 1.2	29.7 ± 7.1	-4.4 / 4.7	13.1 ± 2.6	-7.5 / -2.2
		N=8	ns		ns		ns		ns		*p*=0.004	
		Control-plot	25.9 ± 6.5	Δ 2.9	7 ± 1.8	Δ -0.1	3.9 ± 0.3	Δ 0.5	36.8 ± 7.6	Δ 3.3	13 ± 6.6	Δ -4.6
		Sheetings in W	23 ± 3.4	-0.9 / 6.7	7.2 ± 2.8	-2.3 / 2	3.3 ± 1.6	-1.1 / 2.2	33.5 ± 6.6	-2.9 / 9.5	17.7 ± 6.7	-9.5 / 0.3
		N=6	ns		ns		ns		ns		ns	
	Topsoil	**Control-plot**	23.5 ± 6.8	Δ 0.1	5.9 ± 2.1	Δ -0.1	3.4 ± 0.8	Δ 0.1	33.2 ± 9	Δ 0.6	12.1 ± 4.2	Δ -0.9
		Compost-plot	23.4 ± 5.4	-1.5 / 1.8	6.1 ± 1.8	-0.6 / 0.4	3.3 ± 1	-0.4 / 0.6	32.6 ± 7.7	-1.4 / 2.5	13 ± 4	-2 / 0.2
		N=26	ns		ns		ns		ns		ns	
		Control-plot	22.7 ± 7.1	Δ 1.5	5.5 ± 2	Δ -0.1	3.3 ± 0.8	Δ -0.6	32.3 ± 9.1	Δ 0.7	12.1 ± 4.6	Δ -2
		Hay-plot	21.2 ± 6.3	0 / 3	5.6 ± 1.8	-0.5 / 0.4	3.9 ± 1.9	-1.3 / 0.2	31.6 ± 8.5	-1.1 / 2.4	14.1 ± 5.9	-4 / 0
		N=26	ns		ns		ns		ns		ns	

[2] P total: *N*=19

Table A8-7: Comparisons of control-plot topsoil with sheetings constructed by *Odontotermes* or *Macrotermes* on compost (Cp), hay (H) or wood (W), and with topsoil of Cp- or H-plots after 4 weeks foraging activity (dry season 06). Given are means (M) ± standard deviations (SD), the mean difference (Δ), 95% confidence interval of Δ and the p-value (paired-samples t test; ns for $p > 0.05$). All Zaï sites combined.

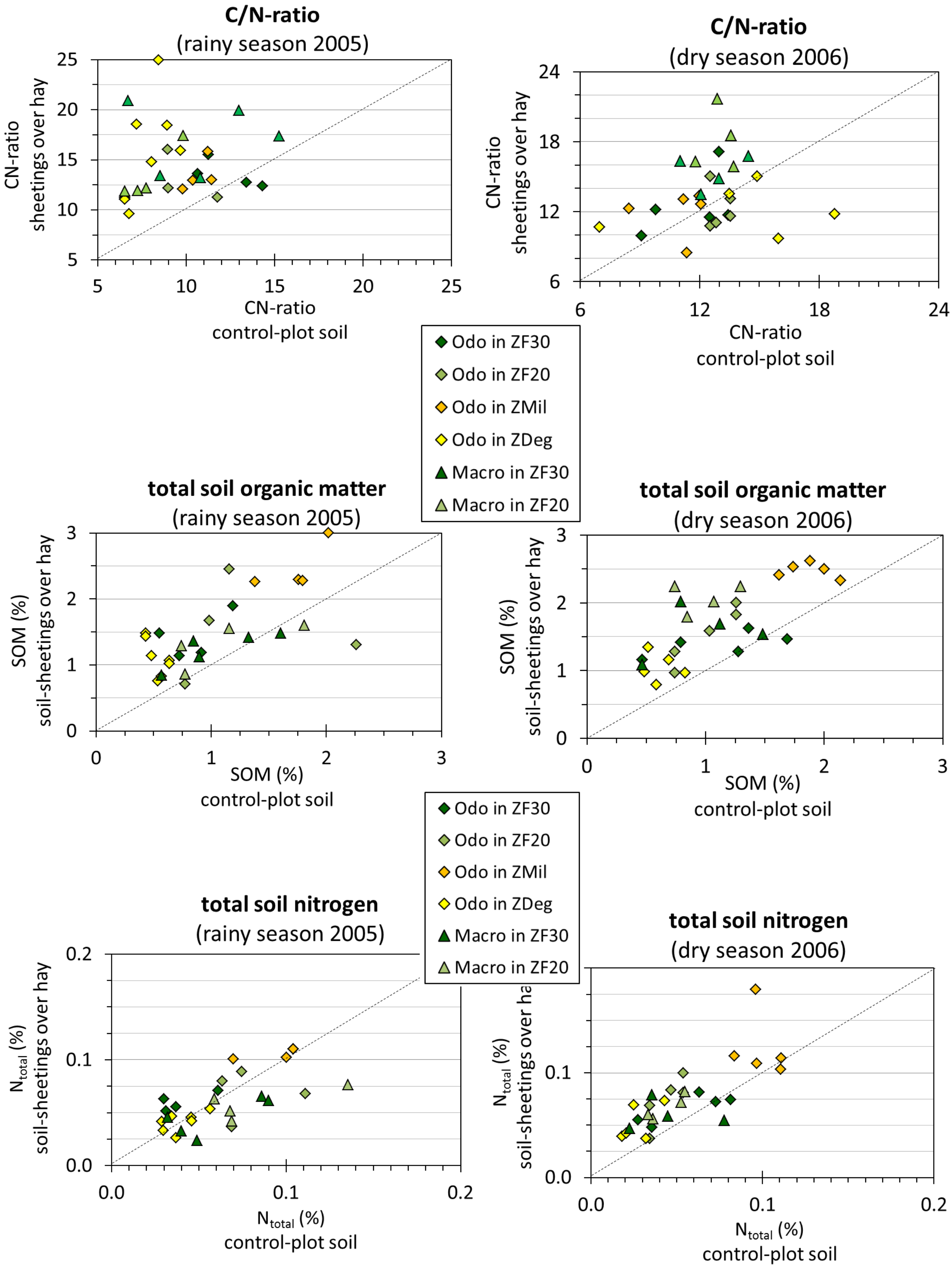
		Soil parameter	P_CAL (mg 100 g^{-1})		K_CAL (mg 100 g^{-1})		BS (%)		$CEC_{pH\ 8.1}$ ($mmol_c\ kg^{-1}$)	
		Paired-samples	***M* ± *SD***	**Δ 95% CI**	***M* ± *SD***	**Δ 95% CI**	***M* ± *SD***	**Δ 95% CI**	***M* ± *SD***	**Δ 95% CI**
Dry season 2006	***Odontotermes***	**Control-plot**	0.36 ± 0.14	Δ -8.41	11 ± 5.4	Δ -212.1	46.3 ± 13	Δ -46	69 ± 21.8	Δ -65.2
		Sheetings in Cp	8.77 ± 3.55	-10.17 / -6.66	223.2 ± 105.4	-264 / -160.3	92.3 ± 13.7	-55.6 / -36.3	134.2 ± 40.7	-84 / -46.3
		N=18[3]	p<0.00001		p<0.00001		p<0.00001		p<0.00001	
		Control-plot	0.33 ± 0.11	Δ -0.6	11.2 ± 6.1	Δ -17.5	47 ± 12.8	Δ -7.6	66.2 ± 21.5	Δ -14.6
		Sheetings in H	0.93 ± 0.36	-0.8 / -0.41	28.7 ± 6	-20 / -14.9	54.6 ± 11.3	-12.3 / -3	80.7 ± 25.5	-21.2 / -7.9
		N=17[4]	p<0.00001		p<0.00001		p=0.003		p=0.0002	
		Control-plot	0.49 ± 0.42	Δ -0.24	12.7 ± 6.4	Δ -7.3	49.1 ± 11.4	Δ -7.9	69.2 ± 24.2	Δ -7.7
		Sheetings in W	0.73 ± 0.34	-0.49 / 0.01	20 ± 8.5	-12.2 / -2.5	56.9 ± 8.4	-12.8 / -2.9	76.9 ± 30.8	-17.2 / 1.8
		N=20	ns		p=0.005		p=0.003		ns	
	Macrotermes	**Control-plot**	0.34 ± 0.14	Δ -8.67	10.3 ± 3.7	Δ -247.4	51.3 ± 11.9	Δ -48.7	57.2 ± 16.1	Δ -69.9
		Sheetings in Cp	9.01 ± 2.62	-10.63 / -6.7	257.7 ± 81.1	-305.1 / -189.6	100 ± 0	-57.2 / -40.2	127.1 ± 27.9	-84.7 / -55.1
		N=10[5]	p<0.00001		p<0.00001		p<0.00001		p<0.00001	
		Control-plot	0.32 ± 0.08	Δ -0.22	13.8 ± 6.9	Δ -16.6	54.8 ± 15.5	Δ -1.1	45.9 ± 12.2	Δ -23.5
		Sheetings in H	0.54 ± 0.17	-0.4 / -0.03	30.4 ± 3.6	-23.8 / -9.5	55.9 ± 12.2	-12 / 9.9	69.4 ± 10.7	-35.3 / -11.7
		N=8	p=0.03		p<0.001		ns		p=0.002	
		Control-plot	0.3 ± 0.02	Δ -0.4	18 ± 6	Δ -4.6	54.5 ± 13.7	Δ -3.5	64.9 ± 19.4	Δ -15.1
		Sheetings in W	0.7 ± 0.38	-3.65 / 2.85	22.6 ± 2	-76.3 / 67.1	58 ± 13	-14.4 / 7.5	80 ± 19.9	-27.1 / -3.2
		N=8	ns		ns		ns		p=0.02	
	Topsoil	**Control-plot**	0.31 ± 0.1	Δ -0.63	9.7 ± 4.4	Δ -9.8	49.2 ± 13	Δ -14.5	66.7 ± 21.3	Δ -12
		Compost-plot	0.94 ± 0.45	-0.83 / -0.42	19.5 ± 7.3	-13.4 / -6.3	63.7 ± 14.6	-19.5 / -9.6	78.7 ± 25.2	-20.4 / -3.6
		N=20[9]	p<0.00001		p=0.00002		p<0.00001		p=0.007	
		Control-plot	0.33 ± 0.12	Δ 0	12 ± 6.3	Δ -2.4	48.8 ± 13.3	Δ 1.6	61.4 ± 21.5	Δ -6.2
		Hay-plot	0.33 ± 0.19	-0.09 / 0.09	14.4 ± 4.7	-4.8 / 0	47.2 ± 14.8	-2.2 / 5.4	67.6 ± 18.6	-12.1 / -0.3
		N=25[10]	ns		ns		ns		p=0.04	

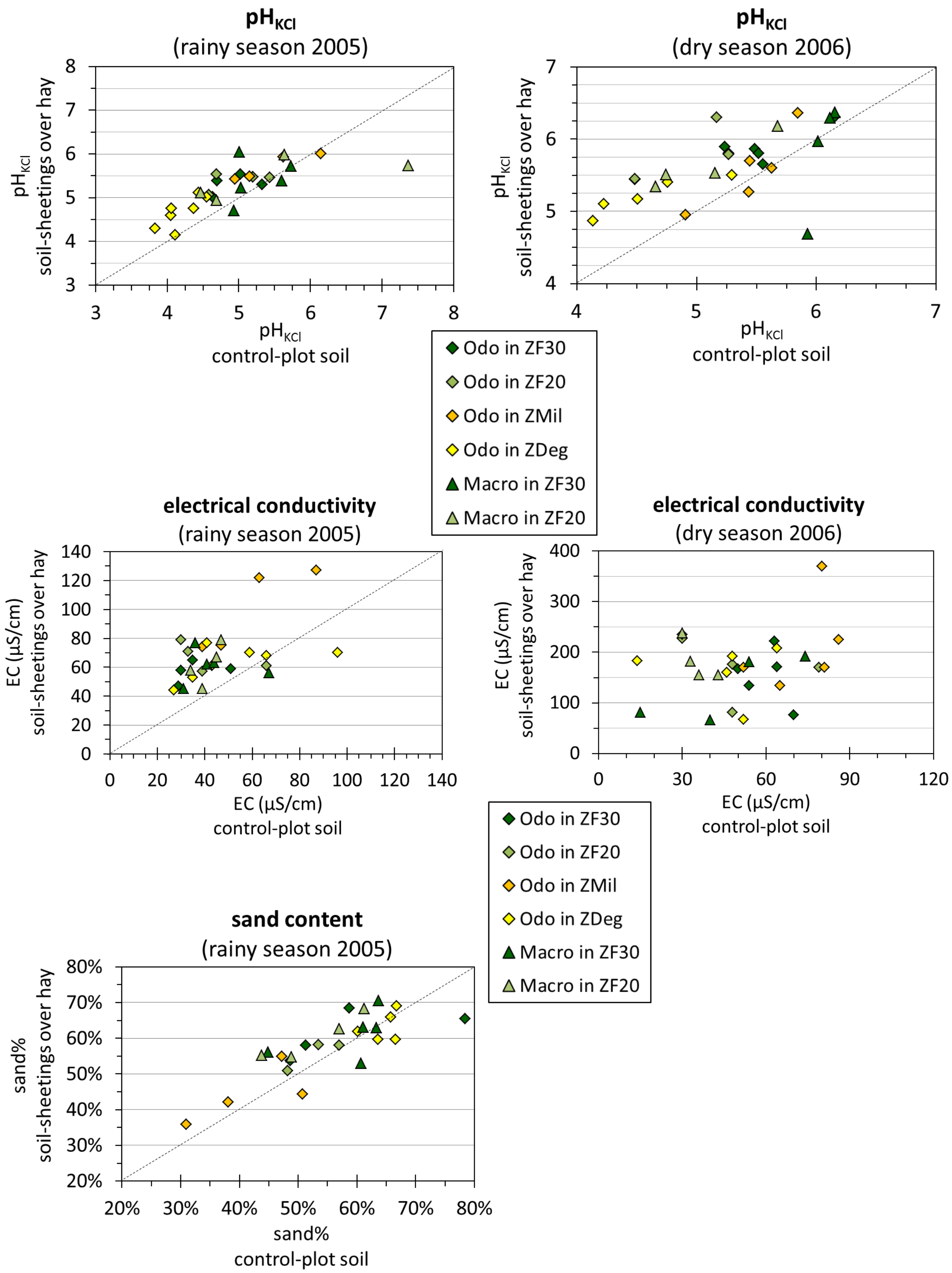
[3] BS, CEC: *N*=19; [4] BS, CEC: *N*=20; [5] P_CAL: *N*=9

Table A8-8: Comparisons of control-plot topsoil with sheetings constructed by *Odontotermes* or *Macrotermes* on compost (Cp), hay (H) or wood (W), and with topsoil of Cp- or H-plots after 4 weeks foraging activity (dry season 06). Given are means (*M*) ± standard deviations (*SD*), the mean difference (Δ), 95% confidence interval of Δ and the *p*-value (paired-samples *t* test; ns for $p > 0.05$). All Zaï sites combined.

		Soil parameter	**Na^{+} (mmol$_c$ kg^{-1})**		**K^{+} (mmol$_c$ kg^{-1})**		**Mg^{2+} (mmol$_c$ kg^{-1})**		**Ca^{2+} (mmol$_c$ kg^{-1})**	
		Paired-samples	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**	***M ± SD***	**Δ 95% CI**
Dry season 2006	***Odontotermes***	**Control-plot**	0.3 ± 0.23	Δ -1.4	2.5 ± 1.5	Δ -50.6	7.5 ± 3.3	Δ -21.5	22.8 ± 11.8	Δ -16.3
		Sheetings in Cp	1.7 ± 0.74	-1.75 / -1.05	53.1 ± 36.5	-68.1 / -33.2	29 ± 7.5	-25 / -18	39.1 ± 11.8	-22.1 / -10.5
		N=19	*p*<0.00001		*p*<0.00001		*p*<0.00001		*p*=0.00001	
		Control-plot	0.32 ± 0.26	Δ -0.81	2.7 ± 1.6	Δ -4.9	7.4 ± 3.2	Δ -3.1	21 ± 9.7	Δ -4
		Sheetings in H	1.13 ± 0.54	-1.09 / -0.54	7.5 ± 1.8	-5.7 / -4	10.5 ± 4.7	-4.7 / -1.6	24.9 ± 12.1	-6.9 / -1.1
		N=20	*p*<0.00001		*p*<0.00001		*p*=0.0003		*p*=0.01	
		Control-plot	0.25 ± 0.18	Δ -0.66	2.6 ± 1.1	Δ -2.8	7.9 ± 3.3	Δ -2.6	23.2 ± 11.6	Δ -4.7
		Sheetings in W	0.9 ± 0.47	-0.89 / -0.42	5.4 ± 2.7	-4 / -1.6	10.5 ± 4.6	-3.9 / -1.4	27.9 ± 15.1	-10 / 0.6
		N=20	*p*=0.00001		*p*=0.0001		*p*=0.0003		ns	
	Macrotermes	**Control-plot**	0.34 ± 0.23	Δ -1.37	2.3 ± 0.9	Δ -52.5	7.4 ± 2.7	Δ -24.6	18.7 ± 7.2	Δ -19.8
		Sheetings in Cp	1.72 ± 0.42	-1.67 / -1.08	54.9 ± 17.4	-64.9 / -40.2	32 ± 8.9	-30.1 / -19.1	38.5 ± 9.7	-24.1 / -15.5
		N=10	*p*<0.00001		*p*<0.00001		*p*<0.00001		*p*<0.00001	
		Control-plot	0.34 ± 0.23	Δ -0.11	1.9 ± 0.8	Δ -4.7	6.4 ± 2.5	Δ -4.4	16.2 ± 8	Δ -5.5
		Sheetings in H	0.41 ± 0.17	-0.42 / 0.21	6.6 ± 2.2	-6.8 / -2.5	10.7 ± 4	-6.8 / -1.9	21.7 ± 8	-11.2 / 0.2
		N=8	ns		*p*=0.001		*p*=0.004		ns	
		Control-plot	0.3 ± 0.16	Δ -0.46	2.7 ± 2.3	Δ -3.9	8.4 ± 3.4	Δ -2.4	23.6 ± 9.6	Δ -4.2
		Sheetings in W	0.76 ± 0.23	-0.72 / -0.2	6.7 ± 2.7	-8.5 / 0.7	10.8 ± 2.9	-3.7 / -1.1	27.7 ± 9.8	-11.8 / 3.5
		N=8	*N=8*		*p*=0.006		ns		*p*=0.005	
	Topsoil	**Control-plot**	0.3 ± 0.22	Δ -0.35	2.5 ± 1.3	Δ -4.5	7.7 ± 3.1	Δ -3.5	22.4 ± 10.7	Δ -8
		Compost-plot	0.65 ± 0.52	-0.57 / -0.12	7 ± 2.8	-5.7 / -3.4	11.3 ± 3.9	-4.8 / -2.3	30.4 ± 11	-12 / -3.9
		N=25	*p*=0.004		*p*<0.00001		*p*<0.00001		*p*=0.0005	
		Control-plot	0.34 ± 0.25	Δ -0.42	2.4 ± 1.5	Δ -0.6	7.2 ± 3.1	Δ -0.8	20 ± 9.6	Δ -0.4
		Hay-plot	0.76 ± 0.93	-0.81 / -0.03	3 ± 1	-1.2 / 0	7.9 ± 3.4	-1.6 / 0.1	20.3 ± 9.9	-3 / 2.3
		N=26	*p*=0.04		ns		ns		ns	

CONTROL-TOPSOIL PLOTTED AGAINST SIGNIFICANTLY MODIFIED SHEETING-SOIL CONSTRUCTED IN HAY




pH$_{KCl}$
(rainy season 2005)
pH$_{KCl}$ soil-sheetings over hay
8
7
6
5
4
3
3 4 5 6 7 8
pH$_{KCl}$
control-plot soil
pH$_{KCl}$
(dry season 2006)
pH$_{KCl}$ soil-sheetings over hay
7
6
5
4
4 5 6 7
pH$_{KCl}$
control-plot soil
Odo in ZF30
Odo in ZF20
Odo in ZMil
Odo in ZDeg
Macro in ZF30
Macro in ZF20
electrical conductivity
(rainy season 2005)
EC (µS/cm) soil-sheetings over hay
140
120
100
80
60
40
20
0
0 20 40 60 80 100 120 140
EC (µS/cm)
control-plot soil
electrical conductivity
(dry season 2006)
EC (µS/cm) soil-sheetings over hay
400
300
200
100
0
0 30 60 90 120
EC (µS/cm)
control-plot soil
Odo in ZF30
Odo in ZF20
Odo in ZMil
Odo in ZDeg
Macro in ZF30
Macro in ZF20
sand content
(rainy season 2005)
sand% soil-sheetings over hay
80%
70%
60%
50%
40%
30%
20%
20% 30% 40% 50% 60% 70% 80%
sand%
control-plot soil

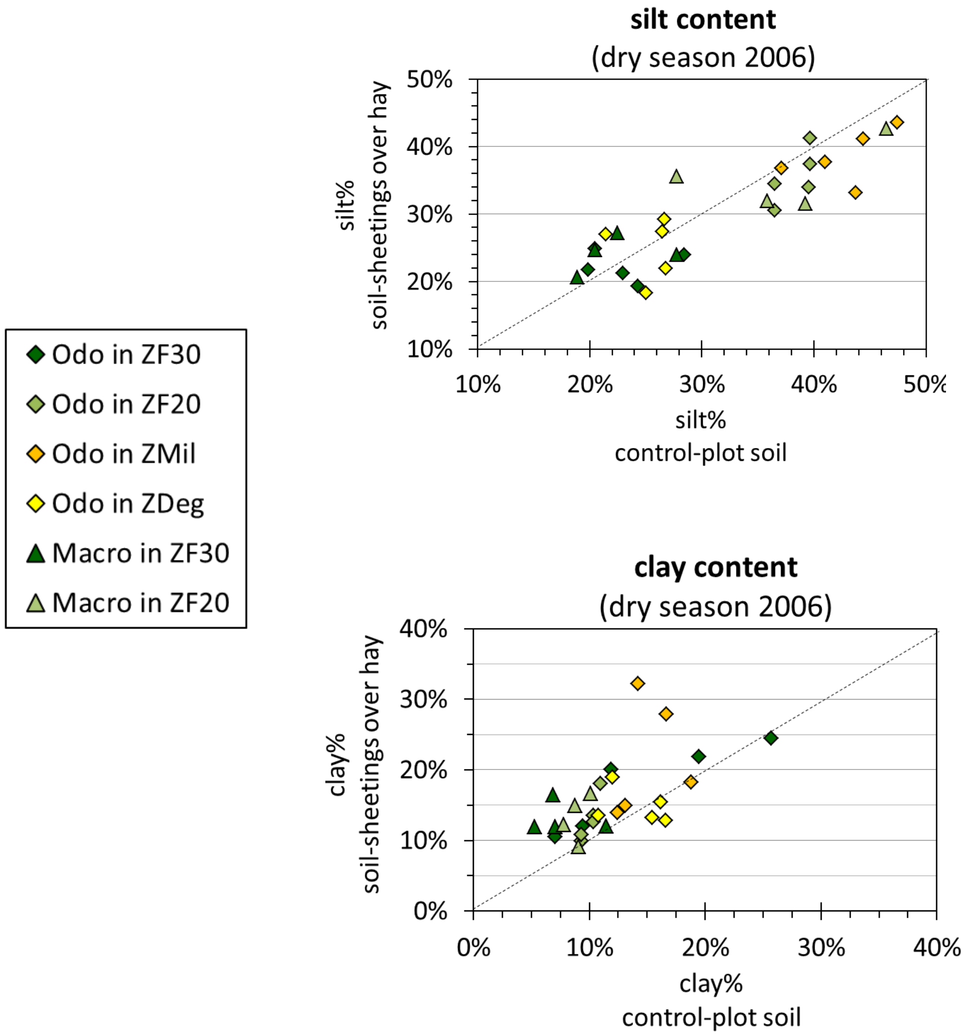
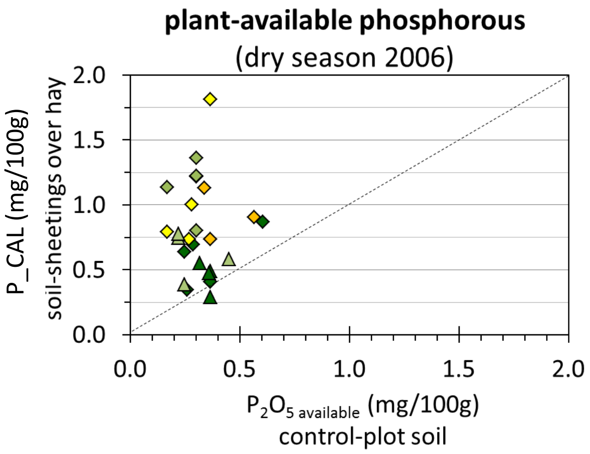


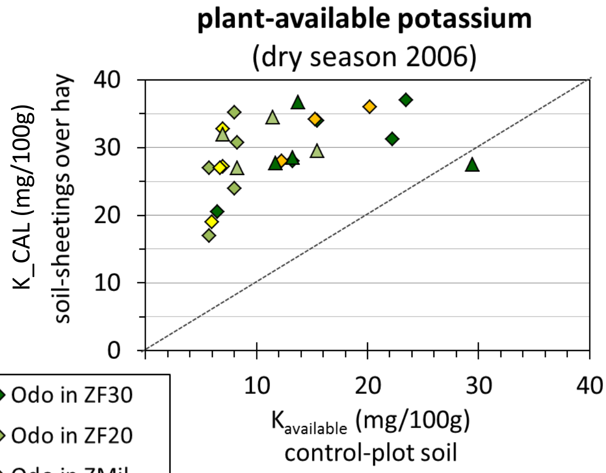
Fig. A8-25: Shown are all physico-chemical parameters which were significantly modified in soil-sheetings constructed by *Odontotermes* or by *Macrotermes* species. Control-plot samples (0-10 cm) are plotted against sheeting-soil samples (0-10 cm) collected in hay-plots of the rainy season run (left) and the dry season run (right).

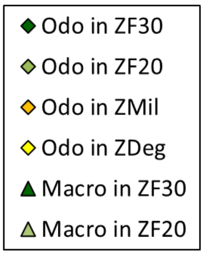
Termite genera are Odo: *Odontotermes* (square), Macro: *Macrotermes* (triangle).

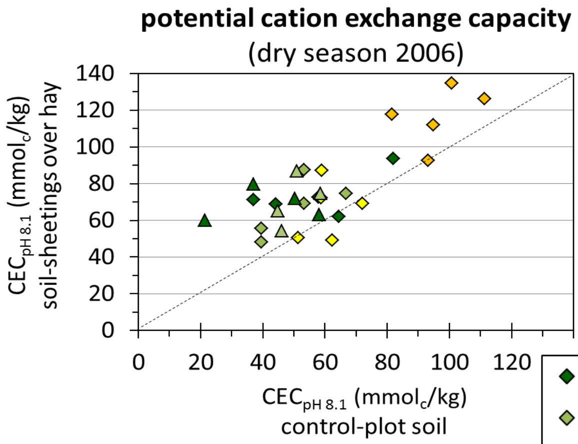
Study sites are ZDeg: barren, degraded land (yellow), ZMil: millet field (orange), ZF20: young Zaï forest (light-green), ZF30: old Zaï forest (dark-green).

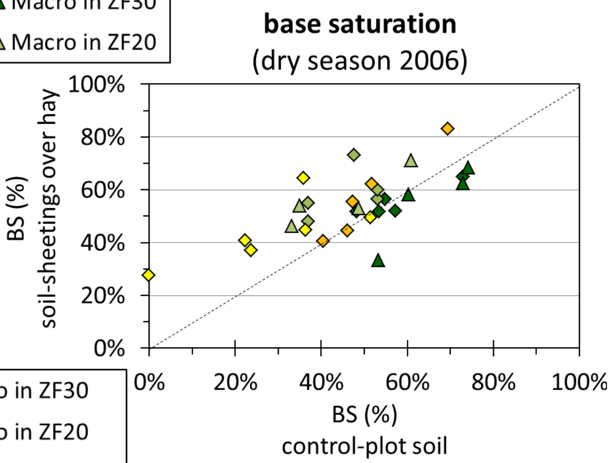
ADDITIONAL PARAMETERS ANALYZED SOLELY FOR THE DRY SEASON SAMPLES (CONSTRUCTED IN HAY)

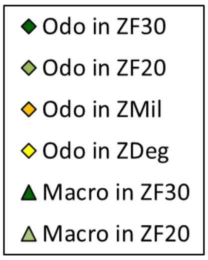


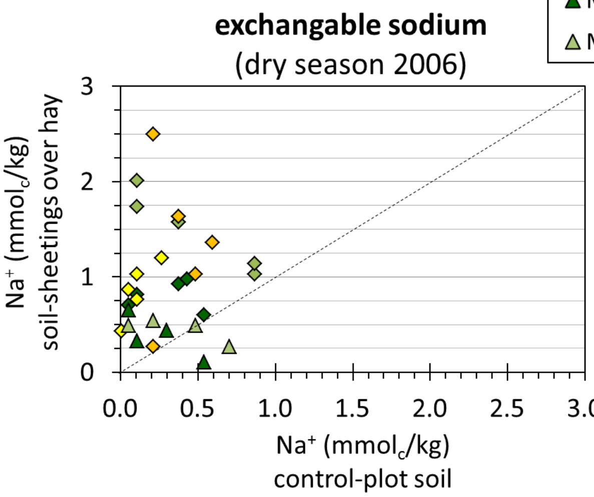


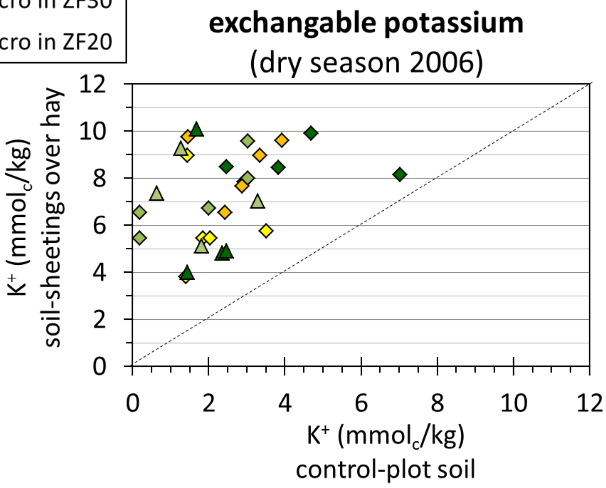












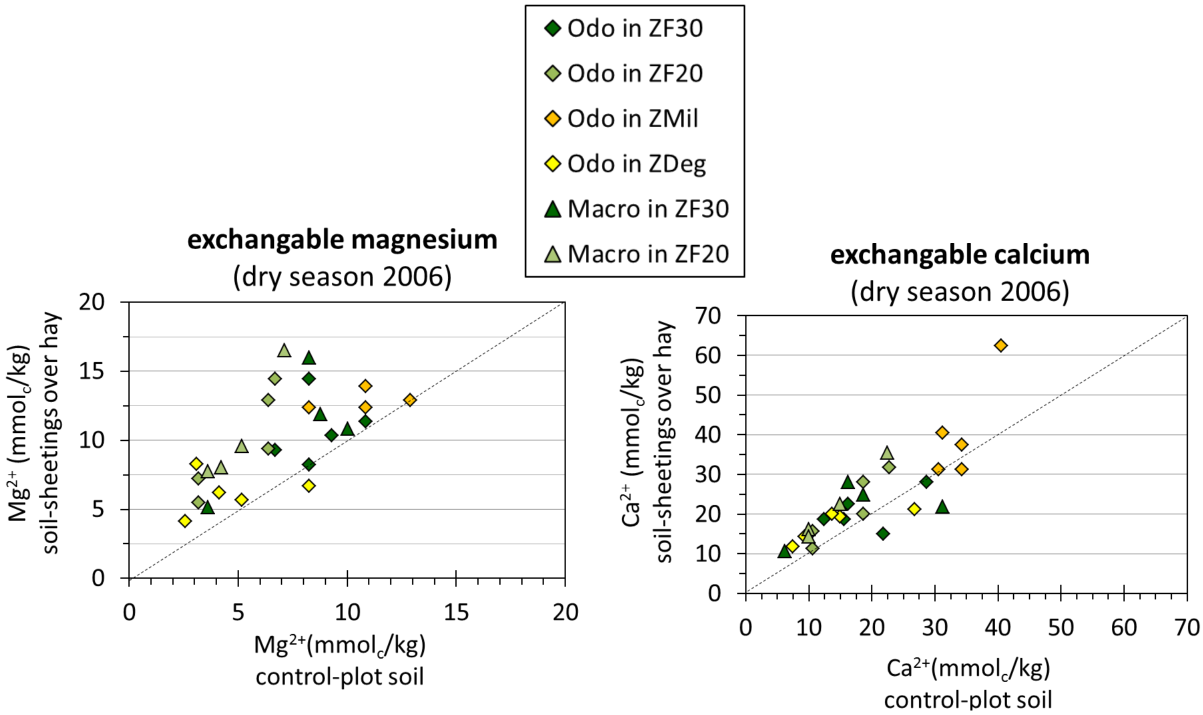
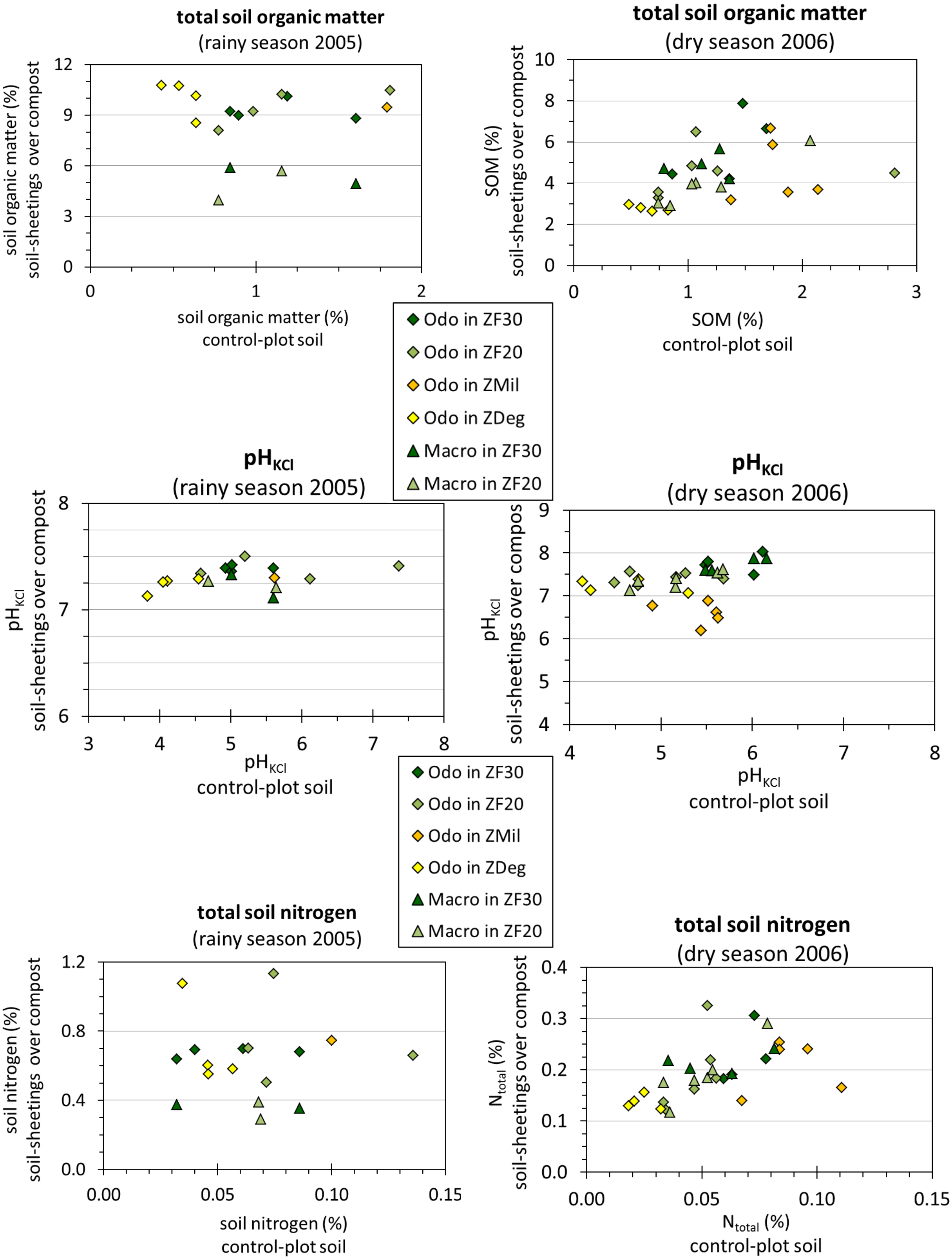


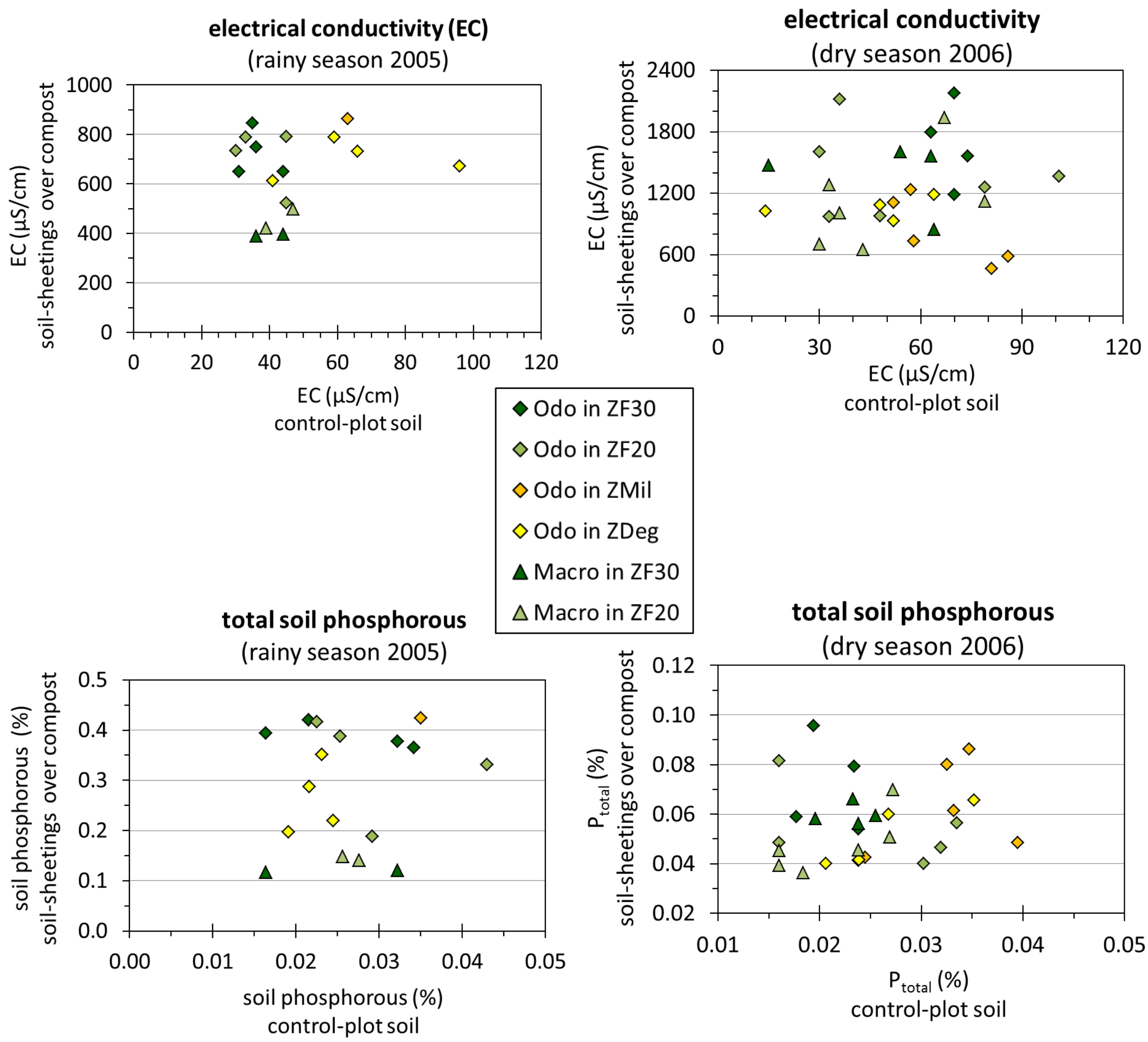
Fig. A8-26: Shown are physico-chemical parameters analyzed solely for the dry season samples which were significantly modified in sheetings constructed either by *Odontotermes* or by *Macrotermes* species. Control-plot samples (0-10 cm) are plotted against sheeting-soil samples (0-10 cm) collected in hay-plots.

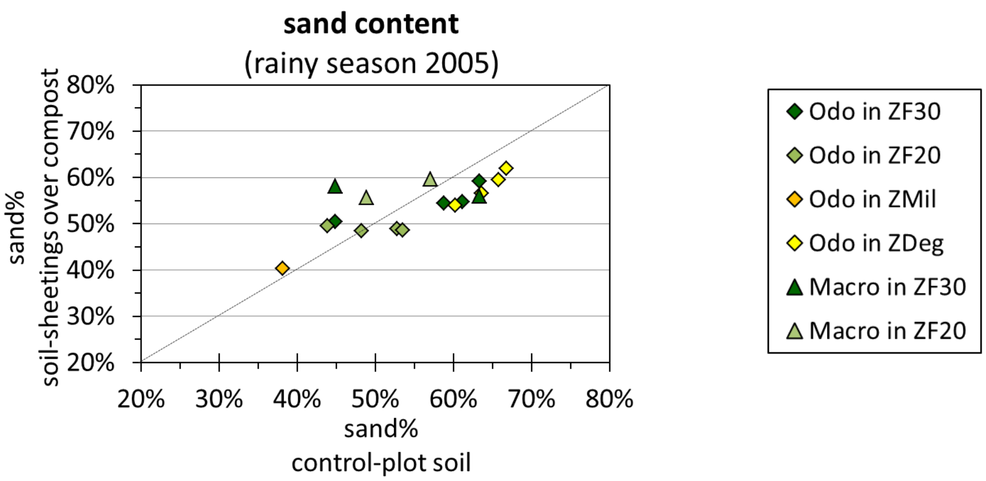
Termite genera are Odo: *Odontotermes* (square), Macro: *Macrotermes* (triangle).

Study sites are ZDeg: barren, degraded land (yellow), ZMil: millet field (orange), ZF20: young Zaï forest (light-green), ZF30: old Zaï forest (dark-green).

CONTROL-TOPSOIL PLOTTED AGAINST SIGNIFICANTLY MODIFIED SHEETING-SOIL CONSTRUCTED IN COMPOST




electrical conductivity (EC)
(rainy season 2005)
EC (µS/cm)
soil-sheetings over compost
EC (µS/cm)
control-plot soil
electrical conductivity
(dry season 2006)
EC (µS/cm)
soil-sheetings over compost
EC (µS/cm)
control-plot soil
Odo in ZF30
Odo in ZF20
Odo in ZMil
Odo in ZDeg
Macro in ZF30
Macro in ZF20
total soil phosphorous
(rainy season 2005)
soil phosphorous (%)
soil-sheetings over compost
soil phosphorous (%)
control-plot soil
total soil phosphorous
(dry season 2006)
P total (%)
soil-sheetings over compost
P total (%)
control-plot soil


sand content
(rainy season 2005)
sand%
soil-sheetings over compost
sand%
control-plot soil
Odo in ZF30
Odo in ZF20
Odo in ZMil
Odo in ZDeg
Macro in ZF30
Macro in ZF20

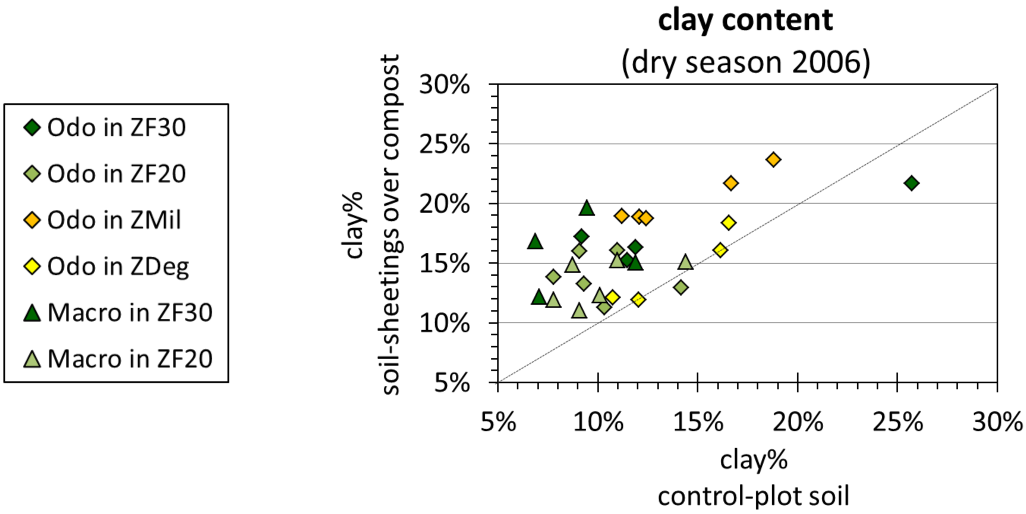


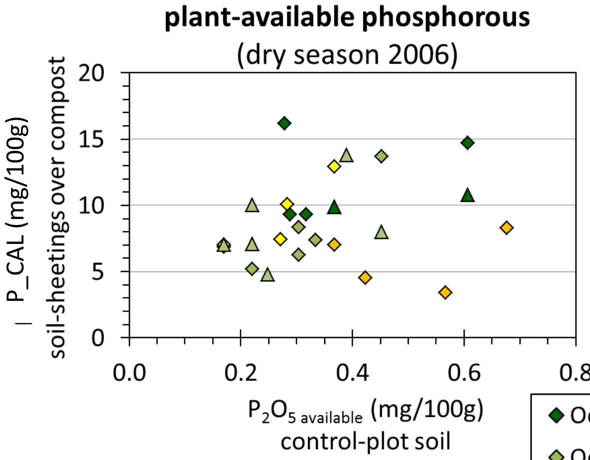
Fig. A8-27: Shown are all physico-chemical parameters which were significantly modified in soil-sheetings constructed either by *Odontotermes* or by *Macrotermes* species. Control-plot samples (0-10 cm) are plotted against sheeting-soil samples (0-10 cm) collected in compost-plots of the rainy season run (left) and the dry season run (right).

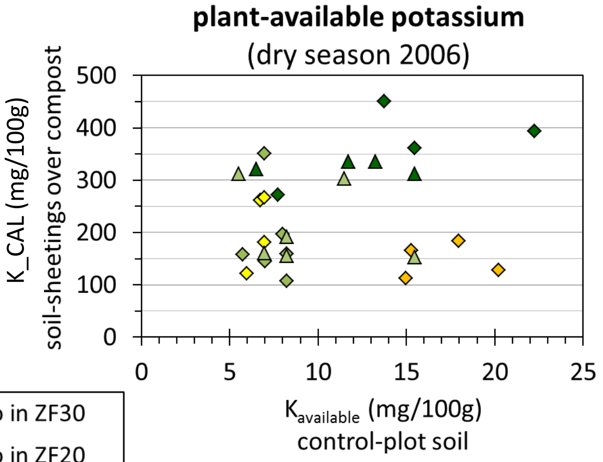
Termite genera are Odo: *Odontotermes* (square), Macro: *Macrotermes* (triangle).

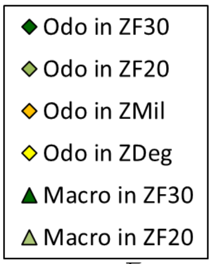
Study sites are ZDeg: barren, degraded land (yellow), ZMil: millet field (orange), ZF20: young Zaï forest (light-green), ZF30: old Zaï forest (dark-green).

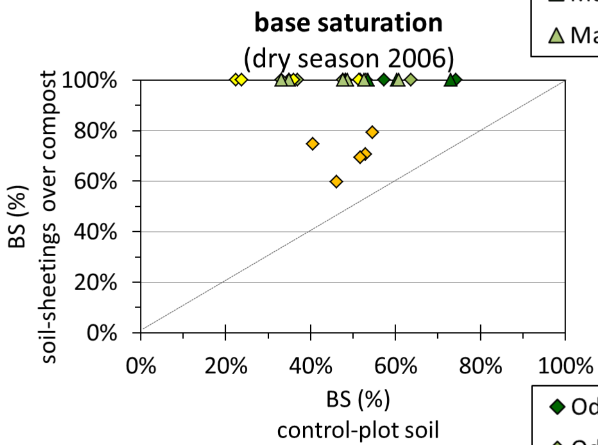
ADDITIONAL PARAMETERS ANALYZED SOLELY FOR THE DRY SEASON SAMPLES

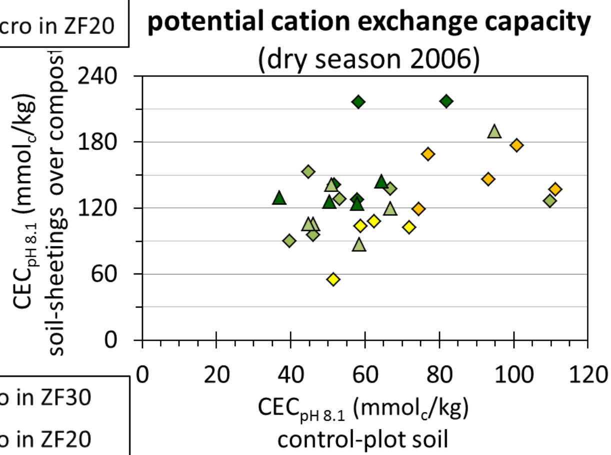
(CONSTRUCTED IN COMPOST)

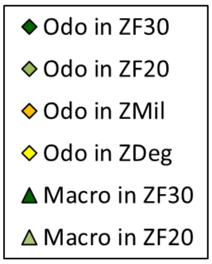


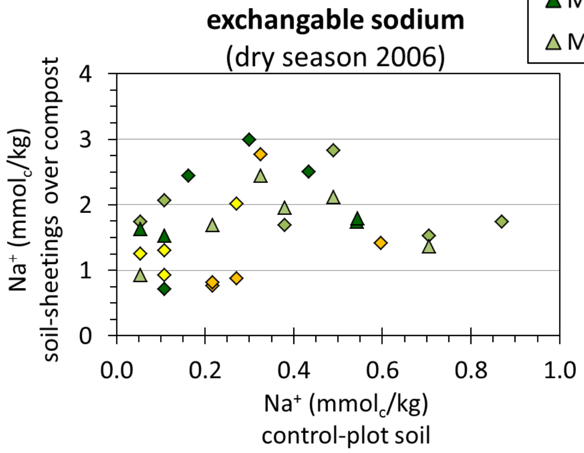


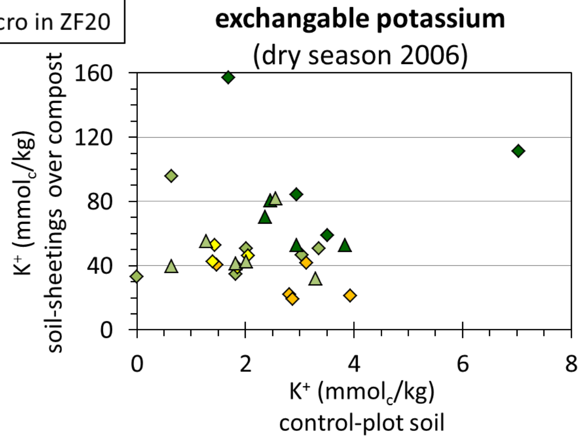












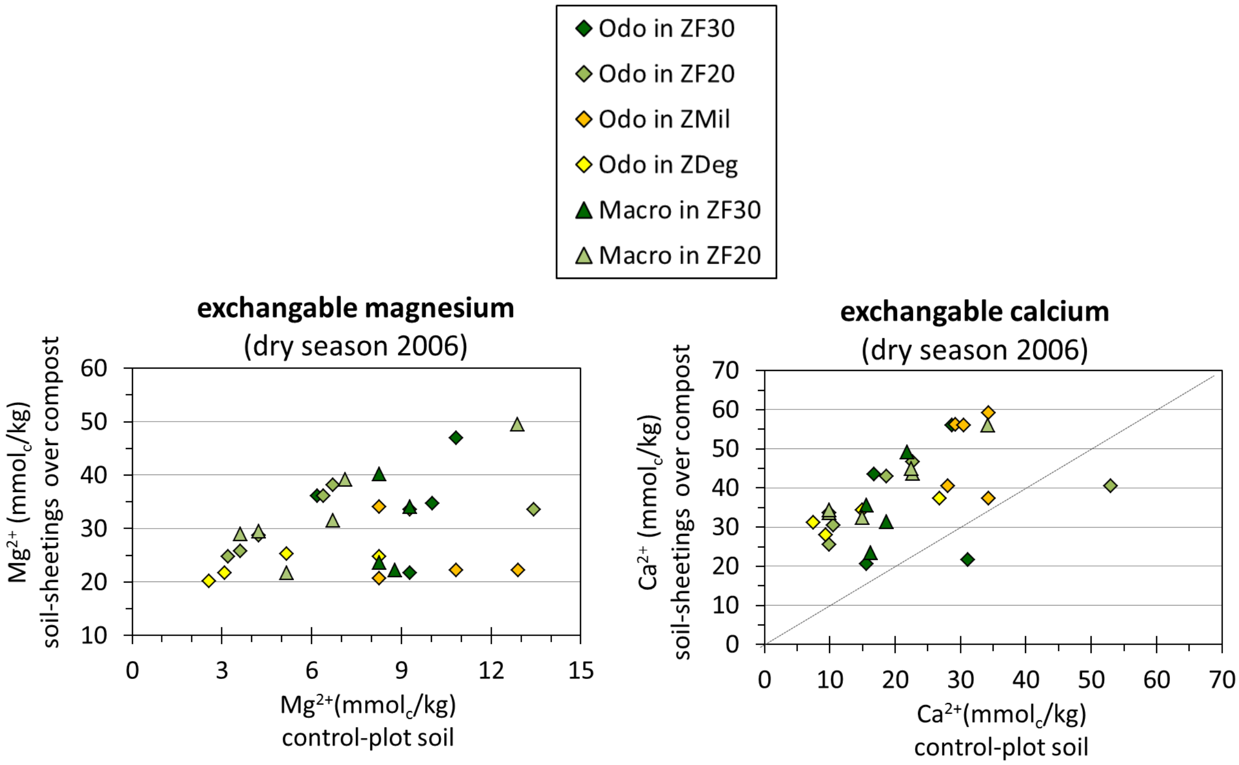


Fig. A8-28: Shown are physico-chemical parameters analyzed solely for the dry season samples which were significantly modified in sheetings constructed either by *Odontotermes* or by *Macrotermes* species. Control-plot samples (0-10 cm) are plotted against sheeting-soil samples (0-10 cm) collected in compost-plots.

Termite genera are Odo: *Odontotermes* (square), Macro: *Macrotermes* (triangle).

Study sites are ZDeg: barren, degraded land (yellow), ZMil: millet field (orange), ZF20: young Zaï forest (light-green), ZF30: old Zaï forest (dark-green).