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Herpetofauna of Termit Massif and neighbour areas in Tenere Desert, southeastern Niger, West Africa

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Abstract. A recent field trip to Niger allowed herpetological exploration of the Termit Massif (southeastern Tenere Desert), an area rarely visited by herpetologists. A total of 13 species were collected or observed, some typical of Saharan habitats and others related to more mesic Sahelian habitats. The later species are mostly restricted to temporary humid river beds locally called '*kori'*. Our field data were completed by observations made during several years in the frame of the 'Project Sahelo-Saharan Antelopes' (Sahara Conservation Fund) in the same area and neighbouring Tin Toumma and another mammal oriented field trip, confirming species occurrence and providing data for four additional species, thus totalling 17 species for the area. Note however that more species should be present and potential species are discussed. We here report the occurrence of *Acanthodactylus senegalensis* from the country by vouchers, thus confirming its considerable eastern extension only recently reported. Some ecomorphological external characters allowing easy distinction between *Acanthodactylus longipes* and *A. senegalensis* are provided. The most surprising feature of Termit Massif's herpetofauna is the lack of numerous genera and species occurring Northwest of Termit at Aïr Massif and sometimes even in the southern part of the country (e.g. *Uromastyx* and *Ptyodactylus*). Such differences between Aïr and Termit herpetofaunas are explained by more arid conditions at the later place, the Aïr Mountains being an efficient barrier to clouds, thus offering more mesic habitats to its herpetofauna.

Keywords. Herpetofauna, desert, Sahara, biodiversity, Niger, Termit Massif, Aïr.

The Termit Massif is a mountain range of about 100 km North-South length and a maximum East-West width of about 50 km with elevations below 700 meters. This mountain range is located in the Tenere Desert, approximately 15.6° to 16.5°N and 11.2° to 11.6°E, at the junction of Saharan and Saharo-Sahelian climatic borders. Its annual rainfall is generally not over 100 mm. By car, the Termit is located at about 1400 km East/Northeast of Niamey (Figure 1A). Together with Tin Toumma [bordered north by Tenere Desert, east by Chad, south by the latitude 14°40'N and west by Termit Massif], and part of the Great Bilma Erg (18°41'12"N, 12°55'12"E), Termit Massif is included in a National Nature Reserve (primarily aimed at the protection of several endangered mammal species) created on 6 March 2012 and totalling almost 100,000 km² (www.ass-niger.org/-termit-tintoumma).

The Termit area comprised an exceptional faunal diversity in relation to the extreme climatic conditions encountered. Several highly threatened antelope species are still present like Dorcas gazella (*Gazella dorcas*), Dama gazella (*Nanger dama*), Addax (*Addax nasomaculatus*), Barbary sheep (*Ammotragus lervia*), but also carnivores like North-West African cheetah (*Acynonix jubatus*), Striped hyena (*Hyaena hyaena*), Golden jackal (*Canis aureus*), Fennec fox (*Vulpes zerda*), Sand cat (*Felis margarita*) and a unique metapopulation of Sulcate tortoise (*Centrochelys sulcata*) (see http://www.catsg.org/cheetah/05_library/5_3_publications/C/Claro_2003_Survey_of_fauna_in_Niger.pdf).

That area was recently prospected for its herpetofaunal biodiversity during April-May 2012 by Gonçalves *et al.* (2013). They reported nine species from Termit. Three of us (II, LC, MA) had been able to visit that area

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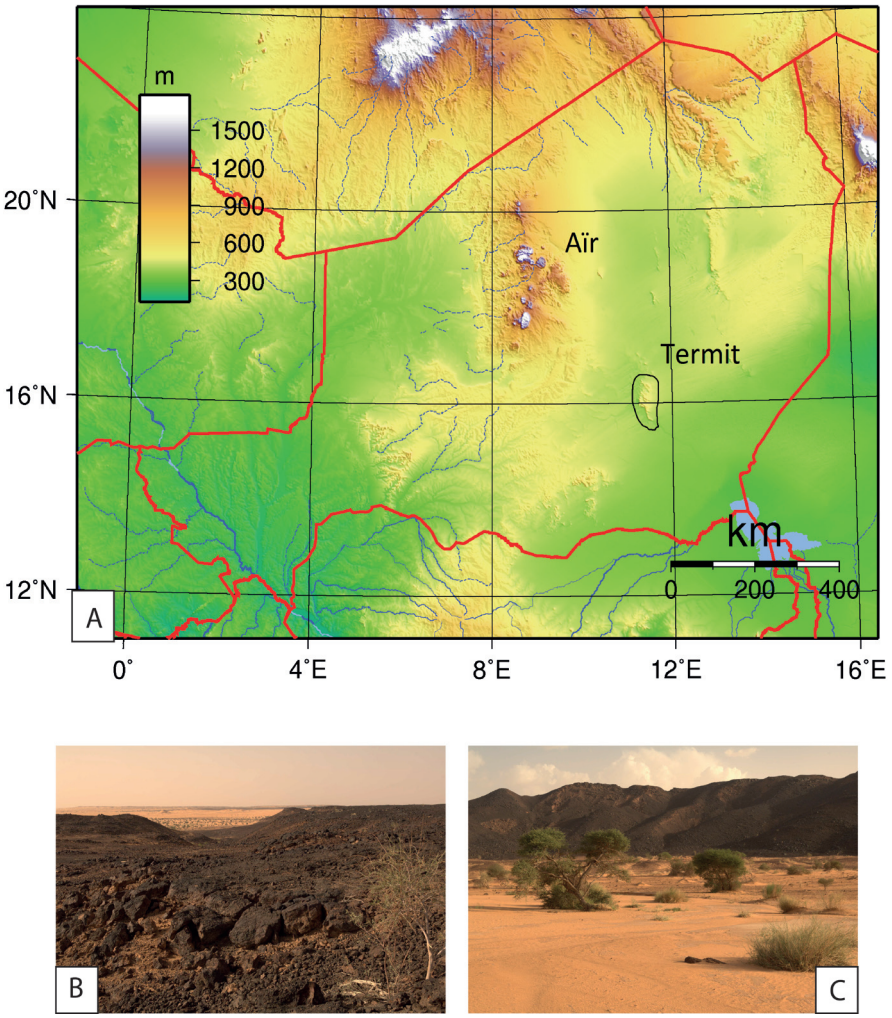

Figure 1. A) Map of Niger (West Africa) showing the location (circled with black) of Termit Massif in the South-East of the country and Aïr Massif, a mountain range located North-West of Termit; B) A large part of the Termit area is covered with black sandstones and has scarce vegetation. Picture: Maurice Ascani; C) Large sandy areas are common in Termit Massif and are occupied by typical psammophilous reptile species. Picture: Maurice Ascani.

previously for 18 days in 2005 and here we report the results of that survey which includes nine additional species and confirm most of the 2012 records. Our results are complemented by data obtained during several years of mammal surveys undertaken by another two of us (JN, TR) in the same area ('Project Sahelo-Saharan Antelopes', Sahara Conservation Fund). Our present review also comprises specimens observed in the Tin Toumma area which is an erg located east of Termit and covering a large area with about 100km long. Observations from that area are based on numerous field trips made by two of us (JN, TR).

Herpetological surveys from 12 to 29 August of 2005 allowed us to travel about 600 km by car within the mountain range from 12 to 29 August (Figures 1B, 1C). Reptiles were sampled by day and by night, using foot and car with spotlights. All specimens were preserved in 10% formalin after tissues were taken and placed in absolute ethanol. Most collected specimens were placed in the Paris Natural History Museum collections

(MNHN) and a few were left at Niamey (L. Chirio pers. coll.). Other reptile data provided during mammal surveys are not supported by voucher specimens. Pictures were however always taken and they allowed unambiguous identification of all observations.

Together all our data on Termit Massif and the neighbouring area enabled us to report one tortoise species, one agamid, one chameleon, four geckos (3 gekkonids and 1 phyllodactylid), three lacertids and one varanid, totalling 11 lizard species, but also six snake species belonging to boids (1), psammophids (2), and viperids (3).

CHELONIA BRONGNIART, 1800

Centrochelys sulcata (Miller, 1779)

This species is threatened all over its range (Vetter, 2005). It is however still relatively common in the Termit Massif where it sometimes occurs in elevation (around 500 m) but also not far from dry river beds (locally called '*kori*'). We have observed adults, juveniles and tracks during our trip but we prefer not indicating geographic coordinates of observations to avoid illegal collects. Two recent studies concerned this species and its conservation in the Termit area (Viard, 2007; Boulweydou, 2008). Its populations remain however threatened and should be subject to particular attention from the Niger authorities. Note also that some other relatively dense populations of this species occur in a protected area of southern Niger (Chirio, 2009). The high demand for that species in the country (mainly in Niamey for the gardens of European foreigners living and working there and in numerous gardens of local peoples) but also in the international pet trade market (smuggling mostly), make such populations particularly vulnerable (Figure 2A). Happily the species is not eaten locally by the Toubous, the main inhabitants temporarily occupying this mountain range with their camels (transhumance during the pastures). Note also that the Termit zone lies outside the main routes used by tourists due to its being difficult of access.

Lacertilia Owen, 1842

Agamidae Spix, 1825

Agama boueti Chabanaud, 1917

Examined material [4 specimens]: MNHN 2005.0323, track between Kellé and Termit Kaoboul, 15°18.22'N 10°48.51'E; MNHN 2005.0322, 2005.0324-25, Termit Massif, 15°53.52'N 11°27.41'E.

This species seems to be relatively common in the Termit area. Dilia of Achetinamou is a location where it was observed (Figure 2B).

This agamid can be relatively common but is only found in the most mesic areas. Coloration sexual dimorphism is clearly evident during reproductive period (Figures 2C-2F). Our four specimens comprised three males and only one female. That female (MNHN 2005.0325) was gravid and held three large yellow ovocytes in its right oviduct and two in the left. Table I indicate morphometric characters for our four specimens. Dorsal scales are keeled and mucronate and a small nuchal crest is present (see Figure 2D).

Note that our records from Termit are the easternmost records for the species (Trape *et al.*, 2012).

Table I. Sex and morphometric characteristics of the four specimens of *A. boueti* collected at Termit Massif. SVL: snout-vent length (mm); TL: tail length (mm) (+ when tail not entire); MSC: midbody scale rows; T4L: fourth toe lamellae on both sides; SL: supralabials on both sides; IL: infralabials on both sides.

MNHN	2005.0322	2005.0323	2005.0324	2005.0325
Sex	male	male	male	female
SVL	88	90	110	91
TL	131+	175	114+	78+
MSC	60	58	57	63
Right/left T4L	21/20	16/18	18/-	19/18
Right/left SL	12/12	11/13	11/11	14/13
Right/left IL	13/12	12/13	11/12	13/11
Interorbital scales	13	13	14	11

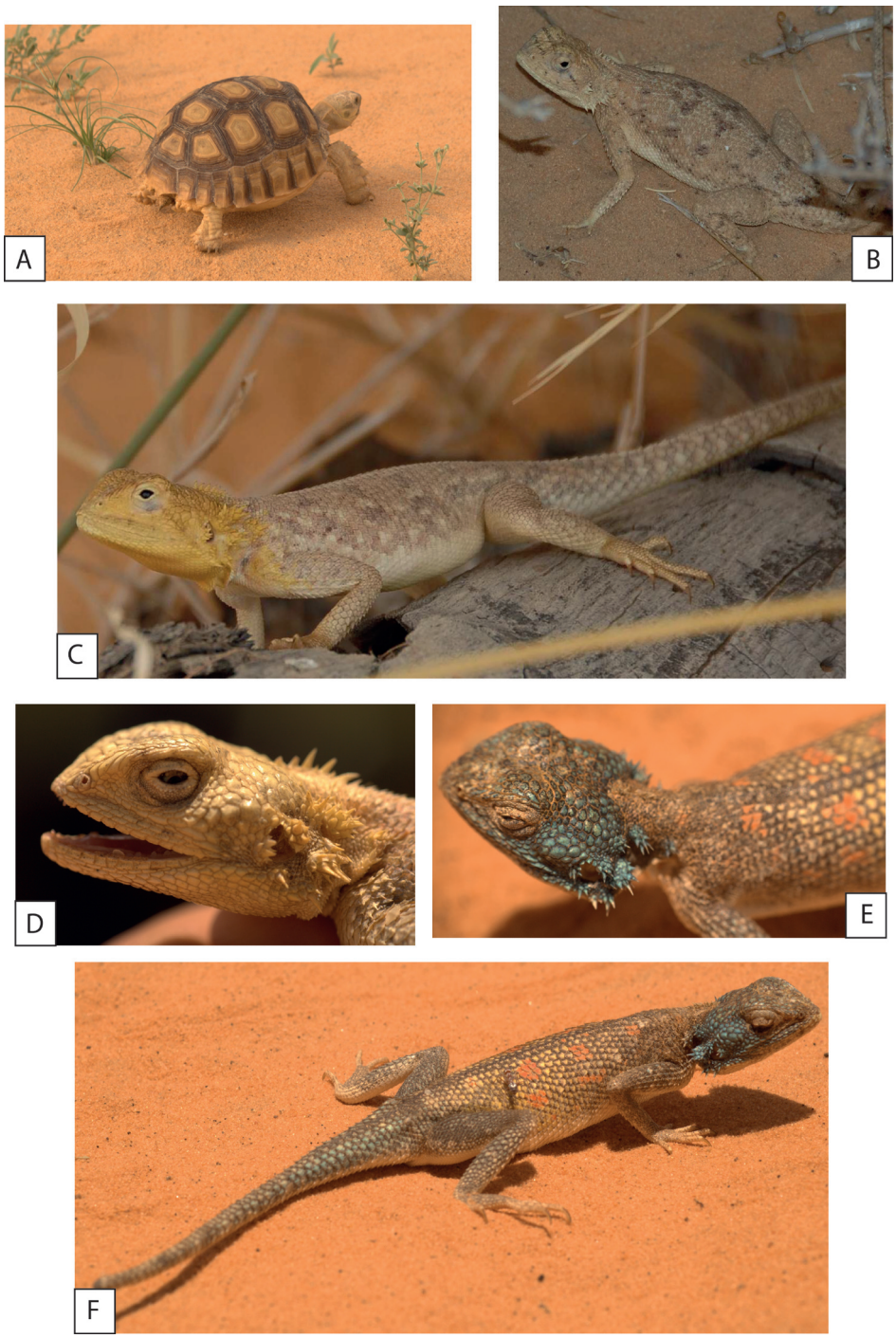

Figure 2. A) African spurred tortoise (*C. sulcata*) has relatively dense and healthy populations in the Termit area and juveniles (this picture) are readily observed. Picture: Maurice Ascani; B) *Agama boueti*. Dilia of Achetinamou, Niger (15.40°N 10.96°E). 29 May 2009. Picture: John Newby/SCF; C) *Agama boueti*. Termit Massif, Niger (15.84°N 11.45°E). June 2009. Pictures: John Newby/SCF; D) *Agama boueti*. Termit Massif, Niger. During the reproductive period, sexual dimorphism in coloration is very evident (male (Fig. 2D) and gravid female (Fig. 2E-F)). Pictures: Maurice Ascani; E-F) Typical gravid female coloration of *Agama boueti* on Termit, Niger (MNHN 2005.0325). Picture: Maurice Ascani.

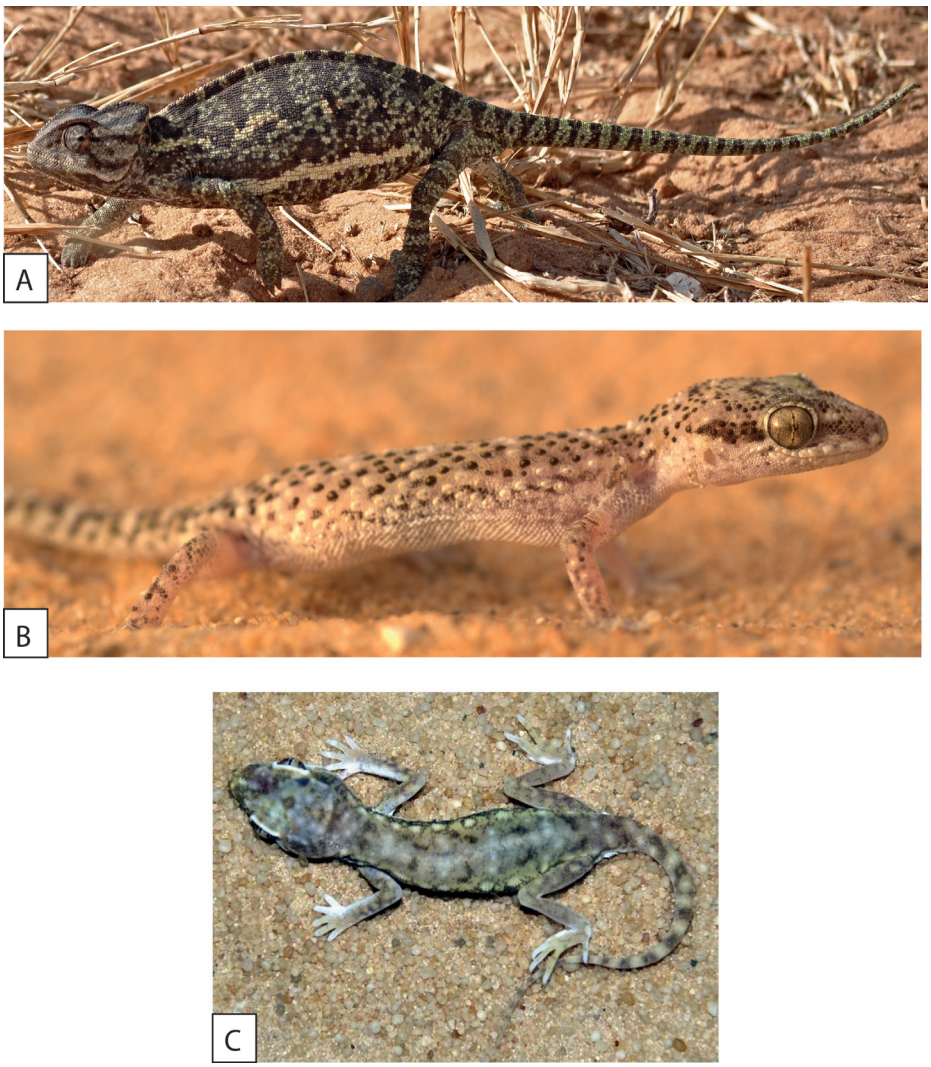

Figure 3. A) *Chamaeleo africanus*. Termit Massif area, Niger (14.41°N 10.22°E). 19 November 2010. Picture: Thomas Rabeil/SCF; B) *Hemidactylus angulatus*. Termit Massif, Niger. MNHN 2005.0326. Picture: Maurice Ascani; C) *Stenodactylus petrii*. Termit Massif area, Niger (16.23°N 11.71°E). 7 December 2008. Picture: John Newby/SCF.

Chamaeleonidae Gray, 1825

***Chamaeleo africanus* (Laurenti, 1768)**

This species was not observed in Termit Massif but one specimen was seen in a more favourable habitat outside Termit but not too far (Figure 3A). Trees are necessary in the habitat of that arboreal chameleon, a vegetation type present but not common in our study area were the species' occurrence has to be assessed.

Gekkonidae Gray, 1825

***Hemidactylus angulatus* Hallowell, 1852**

Examined material [1 specimen]: MNHN 2005.0326, Termit Kaoboul.

This gecko was collected on the walls of the former anti-locust control field station of Termit Kaoboul. We never found it anywhere else in the field and thus can not exclude the fact that this species was introduced by man and restricted only to this area which is the most commonly visited place in the range and the place where

many vehicles arrive. This anthropophilous species is however sometimes present far away from habitations at other places.

Our specimen, a female, has a snout-vent length of 55 mm and a regenerated tail of 31 mm. It has two cloacal spurs clearly visible on both sides of its cloaca. It has 16 mid-dorsal enlarged granule rows and enlarged granules are present on the head top. We counted 25 interorbital granules. The first pair of postmentals is enlarged and in large contact and the second pair widely separated is much smaller. Right/left supralabials 12/13, infralabials 7/7. Lamellae on fourth toe 8/8. Coloration pattern is as expected for the species with intermixed dark brown and white enlarged and strongly keeled back granules. A dark brown band runs from in front of the eye to behind the eye and just behind tympanum (see Figure 3B).

***Stenodactylus petrii* Anderson, 1896**

Examined material [1 specimen]: MNHN 2005.0327, Termit Massif, 16°10'N 11°28'E.

This species seems relatively uncommon and despite several intensive nocturnal researches, we captured only one specimen on Termit Massif, on the soil in a relatively wet *kori* bed after recent rain. Our specimen is a subadult of 31 mm SVL with a tail of 30 mm. It has 20 scales between the eyes and shows cloacal tubercles in several rows clearly protruding at the base of the tail. A second specimen was later observed (Figure 3C). Those records are among the most southern records known for the species (Trape *et al.*, 2012).

***Tropiocolotes tripolitanus* Peters, 1880**

Examined material [2 specimens]: MNHN 2005.0329-30, Termit Kaoboul.

Like *Hemidactylus angulatus* and *Tarentola hoggarensis*, two specimens of this gecko were collected at the base of the walls of the buildings at Termit Kaoboul (former anti-locust field station). Despite intensive researches in favourable habitats at many other places, we never collected that species anywhere else in the Termit Massif.

Our specimens do not fit the characters used by Baha el Din (2001, 2006) in his keys. Our largest specimen (MNHN 2005.0329) has a SVL of 21 mm for a tail length of 29 mm. It has 16 dark bands on the tail, like the smaller specimen (MNHN 2005.0330: SVL 17 mm, tail length 21 mm). MNHN 2005.0329 has 15 lamellae under 4th toe but they are unicarinate not tricarinate. It also has 51 midbody scale rows, mediodorsal scales larger than medioventral scales, and 14 interorbital scales including supraoculars; the interorbitals are not really imbricate but rather juxtaposed. It shows also two pairs of postmentals (pm), the second larger than adjacent scales. On its right, the first pm is in contact by just a point with the second infralabial and not in contact on its left. Coloration of those specimens is rather particular: several white coloured scales (like snow flakes) are scattered among the brown greyish light coloured body. There is a dark brown band clearly marked in front of the eye and behind the eye until above shoulder. These two specimens are similar in scalation and coloration to another specimen that one of us (II) recently collected in the area of Lake Chad (Chad) and we suspect the *Tropiocolotes* east of Mali to belong to a distinct taxon (see also Papenfuss, 1969). Those of Mali that we examined are in complete accordance with *T. t. tripolitanus* but not with our samples from Niger and Chad. Gonçalves *et al.* (2013) reported *Tropiocolotes steudneri* (Peters, 1869) from Diora Aouoranga, Termit Massif but we confirm that our specimens from Termit and Chad do not belong to *T. steudneri*. This is the first record for the area, expanding the known distribution more than 250 km to the East, since in Niger it was only known from Aïr Mountains (Trape *et al*., 2012).

Lacertidae Oppel, 1811

***Acanthodactylus longipes* Boulenger, 1918**

Examined material [10 specimens]: MNHN 2005.0331-36, around Termit Kaoboul buildings; MNHN 2005.0337-39, around Termit Kaoboul, 15°38.83'N 11°35.03'E); MNHN 2005.0347, Tenere Desert around Termit Massif, 15°48.06'N 11°41.04'E.

A. longipes and *A. senegalensis* belong to the *scutellatus* group and both species are present in the Termit area. They possess four rows of scales around toes and fingers, subocular plate not bordering the lip, fourth toe strongly pectinated, ventral scales in more or less oblique series, acuminate snout, and pale, often weakly contrasted coloration, among other distinctive characters. All species of that group are exclusively found in sandy habitats, from moving dunes in the erg areas to sand banks on hard or rocky substratum, with clearly marked habitat preferences between species. Both Termit species are sympatric but not syntopic; we never collected both species in the same place. *A. longipes* is a Saharan endemic typical of desertic herbaceous formations related to eolian sands (Figure 4A). It is frequent in the Termit Massif and the surrounding Tenere Desert. Its populations are generally relatively dense but restricted. Their activity

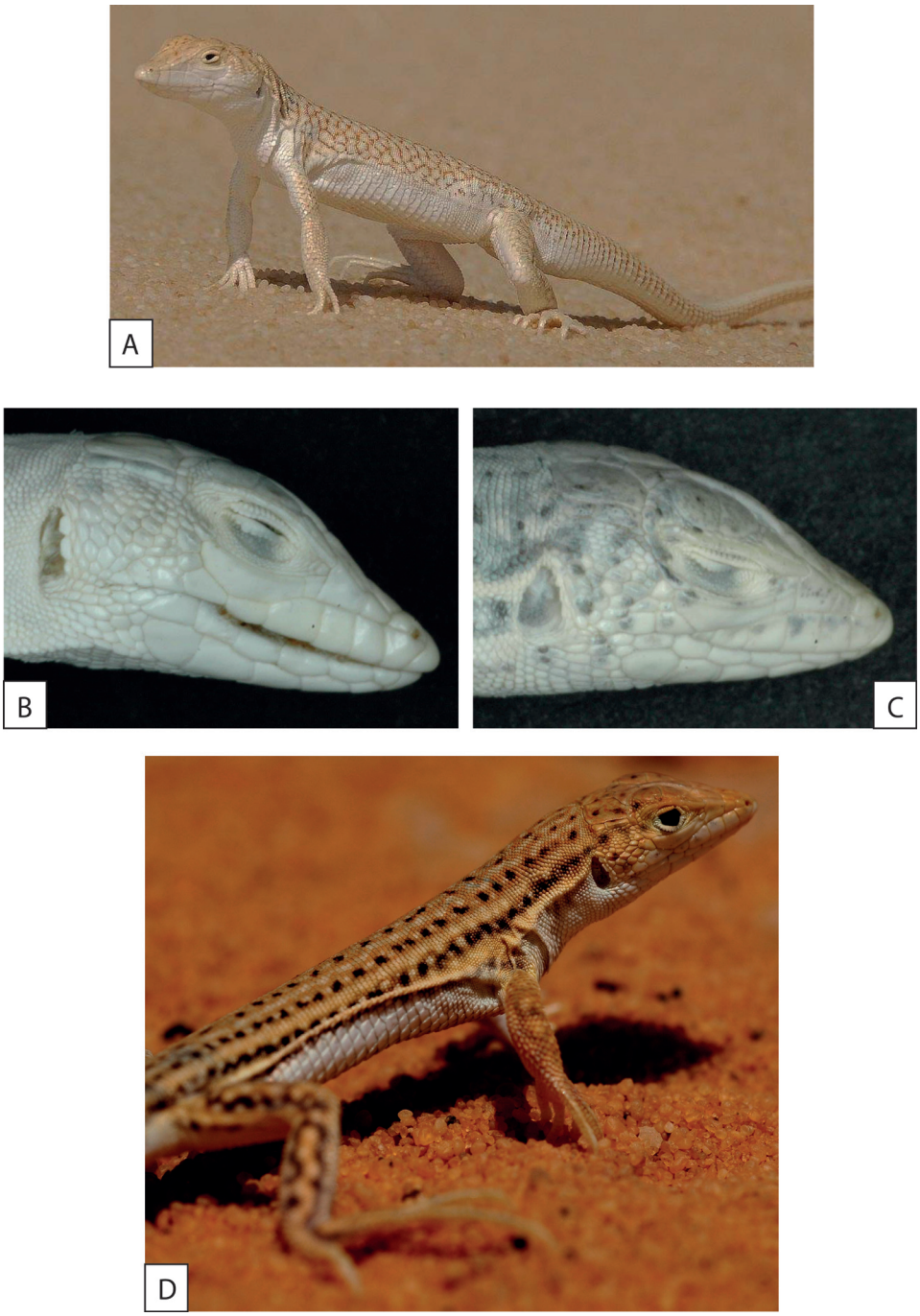

Figure 4. A) *Acanthodactylus longipes*. Termit Massif area, Niger (16.58°N 12.08°E). 22 November 2007. This picture nicely illustrates several of the most characteristic features of the species. Picture: John Newby/SCF; B) MNHN 2005.0332 (*A. longipes*) and ; C) MNHN 2005.0342 (*A. senegalensis*) showing more developed upper and lower eyelid scales, oval shaped and protected tympanum and elongate snout in the former, probably preventing sand from entering in ear and eye; that species is clearly more adapted to sandy habitats than the later; D) *Acanthodactylus senegalensis* from Termit Massif area, Niger. Picture: Maurice Ascani.

seemed to be strictly diurnal and dependant on factors like sunshine and winds intensity.

***Acanthodactylus senegalensis* Chabanaud, 1918**

Examined material [7 specimens]: MNHN 2005.0340-43, Termit Massif, oued Oualata, 15°48.58'N 11°20.00'E; MNHN 2005.0344, Termit Massif, dried river bed, 15°47.17'N 11°24.99'E; MNHN 2005.0345, Termit Massif, 16°22.88'N 11°26.87'E; MNHN 2005.0346, Termit Massif, 15°53.52'N 11°27.41'E.

This species was only recently reported from the country (Brito *et al.*, 2008). Before that report, the easternmost station was located at Goundam and M'Bouma, more than 1400 km West in Mali (Crochet *et al.*, 2003). We collected several specimens and tissue samples from Termit Massif. The species is associated with alluvial sand formations in dried river beds, with developed vegetation during the rainy season; its habitat is clearly different from the one occupied by *A. longipes* and is more related to the presence of vegetation and more mesic conditions (even during a short time of the year). The marked habitat differences between *A. longipes* and *A. senegalensis* can be correlated to several ecomorphological characters: ear opening shape and ornamentation (large [water-drop-shaped] with anterior flattened scales by *A. senegalensis* and narrow with spiny developed ear-plates partially covering ear opening by *A. longipes*), conformation of upper and lower eyelid borders (weakly enlarged with small flattened scales by *A. senegalensis* and strongly enlarged and with large flattened scales by *A. longipes*) (Figures 4B-4C), and also the development of lateral sickle-like scales on toe and fingers (weakly developed by *A. senegalensis* and strongly developed by *A. longipes*). Such important morphological differences clearly reflect the more eolian habits of *A. longipes* contrary to *A. senegalensis* which is rather related to vegetation and less associated with sand. Note also that *A. senegalensis* occupied habitats often shared with *Centrochelys sulcata* which is never the case for *A. longipes*. *A. senegalensis* is searching for humid river beds like those that we observed at the station located 15.99789°N 11.311656°E, in a valley at the heart of Termit (obs. T. Rabeil, 16 June 2008).

Several scalation and morphometric characters reported by Crochet *et al.* (2003) allow distinction of both species (table II). They can however easily be distinguished by their coloration alone in formalin or alcohol preservative: dorsal black marks dispatched but abundant, sometimes representing seven symmetrical distinct dorsal incomplete lines by *A. senegalensis* (Figures 4D, 5A) and none or few diffuse weak black-marks by *A. longipes* (Figure 4A). Note also that *A. senegalensis* seems to show a directional asymmetry for its supraocular I fragmentation pattern (fragmented on both sides in 4 specimens and only on the right in 2 specimens, N = 6).

Our specimens of *A. senegalensis* confirmed the extension of the known distribution for the species of about 1400 km East of the previous known limit located in Mali (see Figure 17 *in* Crochet *et al.*, 2003); they represent the easternmost and southernmost records for the species (Trape *et al.*, 2012). Their specific identification has been confirmed by DNA sequencing (P. Geniez pers. com.).

***Latastia longicaudata* (Reuss, 1834)**

Examined material: only a broken tail was available and collected. An additional specimen was observed in 2007 (Figure 5B).

This species is difficult to catch and even to observe. It is however easy to identify by many characteristic features (flank colouration, snout-vent length, tail length). Its occurrence in Termit Massif is definitively confirmed: we collected the tail (tissue) of a specimen observed for a long time but not collected and have seen a second one in a different locality. No entire specimen was collected from Termit Massif but the species' occurrence there can now be confirmed without any doubt. A picture taken later in 2007 (Figure 5B) confirmed identification. Like the viperid snake *Echis leucogaster*, this lizard is a Sahelian species here at the northern limit of its distribution.

Phyllodactylidae Gamble, Bauer, Greenbaum & Jackman, 2008

***Tarentola hoggarensis* Werner, 1937**

Examined material [1 specimen]: MNHN 2005.0328, walls of a building at Termit Kaoboul.

This gecko was collected on the walls of the buildings at Termit Kaoboul. It could have been, like *H. angulatus*, accidentally introduced by man. We however collected a second specimen in a dried river bed far away from human locations (16°23'N 11°28'E), which certainly indicated the indigenous nature of that species in the area. The examined specimen, a female, has a snout-vent length of 67 mm and a tail length of 48 mm. It has 17 rows of enlarged granules at midbody, 14 interorbital scales and 15 lamellae under left fourth toe.

Table II. Morphometric characters of the *Acanthodactylus* specimens collected at Termit Massif. MNHN: collection number; SPE: species, *A. longipes* = LON or *A. senegalensis* = SEN; SVL: snout-vent length (mm); TL: tail length (mm) (indicated with a "+" when tail was not entire); VENT: number of longitudinal rows of ventral plates; DORS: number of dorsal scales at midbody; KEE: keel development on dorsal scales (codification according to Crochet *et al.*, 2003); GRAN: rows of supraciliaries granules at the level of third supraocular (see Crochet *et al.*, 2003); FRSO: plate fragmentation at the level of supraocular I; FEPO: number of femoral pores (highest value right or left).

MNHN	SPE	SVL	TL	VENT	DORS	KEE	GRAN	FRSO	FEPO
2005.0331	LON	41	18+	17	72	2	2.5	NO	20
2005.0332	LON	48	16+	17	64	2	2	NO	21
2005.0333	LON	44	14+	17	65	3	2	NO	21
2005.0334	LON	48	18+	16	77	2	2.5	NO	20
2005.0335	LON	46	21+	16	68	3	3	NO	19
2005.0336	LON	42	13+	15	77	2	3	NO	/
2005.0337	LON	48	76	16	62	2	2	NO	19
2005.0338	LON	43	81	16	68	2	2	NO	17
2005.0339	LON	48	94	18	76	2	3	NO	19
2005.0347	LON	47	39+	17	71	3	3	NO	17
2005.0340	SEN	41	76	15	50	4	2	R/L	16
2005.0341	SEN	45	9+	15	41	4	1	R	16
2005.0342	SEN	40	12+	15	46	5	1	R/L	16
2005.0343	SEN	36	63	15	43	3	1	R/L	15
2005.0344	SEN	41	26+	13	45	5	1.5	R	13
2005.0345	SEN	46.5	86	16	51	4	2	R/L	18
2005.0346	SEN	/	53	13	49	4	/	/	15

This specimen fits with *T. hoggarensis* (saharo-sahelian form), a form previously considered as a subspecies of *T. ephippiata* but that was given specific status by Trape *et al.* (2012) (see also Jogger, 1984).

Varanidae Gray, 1827

Varanus griseus (Daudin, 1803)

Examined material: only a dead specimen was collected and left in Niamey (L. Chirio pers. coll.).

This varanid is relatively common in Termit Massif (Figures 5C-5E) and it is easy to see at least one specimen during a one day car travel in the area. We did not see any big sized individual but about ten subadult or adult specimens during our 2005 trip. Our records are the southeastern most observations for the species (Trape *et al.*, 2012).

Serpentes Linnaeus, 1758

Boidae Gray, 1825

Eryx muelleri (Boulenger, 1892)

An earlier field trip devoted to mammals (Claro *et al.*, 2002; see also http://www.catsg.org/cheetah/05_library/5_3_publications/C/Claro_2003_Survey_of_fauna_in_Niger.pdf) noted the occurrence of the sand boa on the trail Tasker-Termit, not far from our study area. We did not find this species during our prospections in the Termit Massif.

Psammophiidae Boie, 1827

We did not collect or observe any non viperid snake during our 2005 field trip. This should certainly be a sampling artifact and probably has to be related to the dates of our visit since several species were later observed during field trips related to mammal observations (see below). Note also that several colubrids or psammophids typical for arid areas should be present in the Termit Massif even if not yet

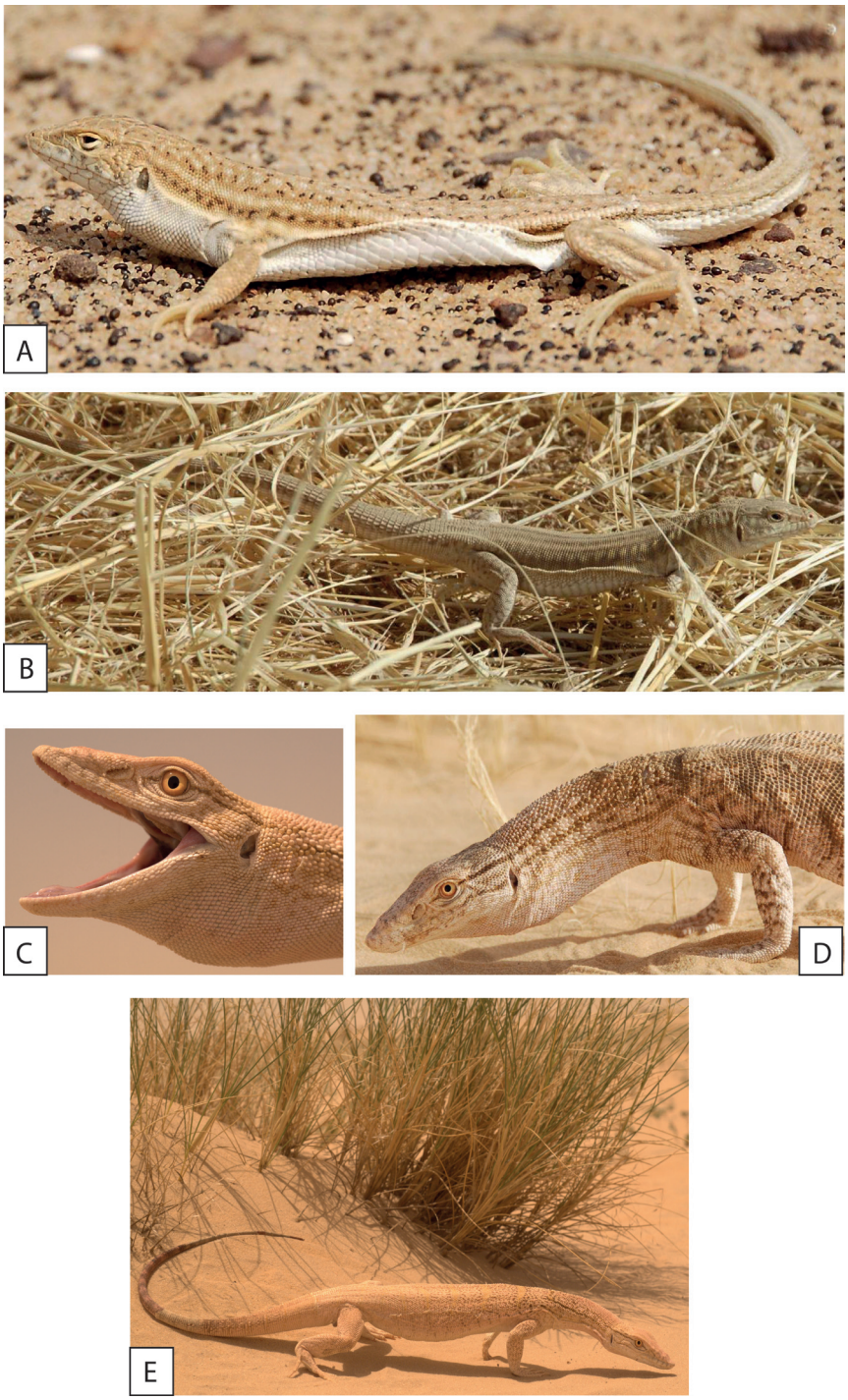

Figure 5. A) *Acanthodactylus senegalensis*. Termit Massif area, Niger (16.37°N 11.46°E). 8 December 2008. Picture: John Newby/SCF**;** B) *Latastia longicaudata*. Termit Massif, Niger (15.93°N 11.36°E). 23 November 2007. Picture: Thomas Rabeil/ SCF**;** C) *Varanus griseus*. Termit Massif area, Niger. Picture: Maurice Ascani; D) *Varanus griseus*. Termit Massif area, Niger (15.99°N 11.51°E). 5 June 2009. Picture: John Newby /SCF; E) *Varanus griseus*. Termit Massif area, Niger. Picture: Maurice Ascani.

observed, principally *Lytorhynchus diadema* (Duméril, Bibron & Duméril, 1854) [Colubridae], *Spalerosophis cliffordi* (Schlegel, 1837) [Colubridae], and *Telescopus tripolitanus* (Werner, 1909) [Colubridae] [see Trape & Mané, 2006].

Psammophis schokari Forskal, 1775 ? or *Psammophis aegyptius* Marx, 1958 ?

A psammophid belonging to one of those two species was observed several times in Termit Massif area and it seemed relatively common where habitat is suitable. Pictures were made by TR and JN but II and LC were not able to collect a specimen during their field trip. Thus without ventral scale counts specific attribution was not possible. According to the pictures we have seen it was also not possible to identify at species level since specimens on pictures had faint dorsal pattern (*P. aegyptius*) but others had strongly lined dorsal marks (*P. schokari*) (Figure 6A) – both species could occur there.

Rhagerhis moilensis (Reuss, 1834)

This species was observed several times in Termit Massif. First on 23 May 2008 by Thomas Rabeil (16.013°N 11.410°E) and later on 1st March 2009 by John Newby (16.40°N 11.96°E). A third specimen was found dead in a well on July 2010 at 15.5826°N 10.9714°E by one of us (MA), and another at 15.4490°N 11.0140°E on 28 November 2010 (TR). Identification did not cause any difficulties since the species adopted its classical behaviour in inflating its neck and miming a cobra (Figure 6B).

Viperidae Oppel, 1811

We collected four viperid (Viperinae) snakes belonging to three distinct species.

Echis leucogaster Roman, 1972

Examined material [1 specimen]: MNHN 2005.0348, Termit Massif, dry river bed, 15°58.020'N 11°26.737'E.

We collected one specimen of *Echis leucogaster*, without any doubt a Sahelian element present in Termit Massif. Our record was included in the species map of Trape and Mané (2006). The species certainly represents a relict according to the former more widespread humid conditions in the area and nowadays is only present at some restricted temporary and relatively humid river beds (see also Geniez *et al.*, 2004). Our specimen was collected at night inland of the Massif, on the rocky sides of a river bed. The species was previously recorded for the country (David & Ineich, 1999). Its morphometric characters are summarised in table III.

Cerastes cerastes (Linnaeus, 1758)

Examined material [1 specimen]: MNHN 2005.0349, Termit Massif, dry river bed, 16°10'N 11°28'E.

The occurrence of this Saharo-Sahelian species in Termit Massif is not surprising. Contrary to *C. vipera*, *C. cerastes* prefers a heavier vegetal cover and a higher relative humidity and thus habitat separation between both vipers is similar to that observed between *Acanthodactylus senegalensis* and *A. longipes*. Our collected specimen presents two well developed horns above the eyes (Figure 6C) but such a characteristic is

Table III: Sex and morphometric characters of the three viperid snakes collected at Termit Massif. SVL: snout-vent length (mm); TL: tail length (mm); V: preventrals + ventral plates; SC: subcaudal plates (entire/divided); Anal.: anal plate entire (Ent.) or divided (Div.); SL: right and left supralabials; IL: right and left infralabials; Dors: number of dorsal scale rows at midbody; Eye: number of plates and granules between the eyes, including supraoculars.

Species MNHN	Sex	SVL	TL	V	SC	Anal.	SL	IL	Dors	Eye
E. leucogaster 2005.0348	M	439	62	3+168	38 ent.	Ent.	10/10	12/12	30	9
C. cerastes 2005.0349	F	610	90	2+148	41 div.	Div.	12/12	14/15	28	12
C. vipera 2005.0350	M	235	31	3+118	27 div.	Ent.	12/13	12/13	26	10

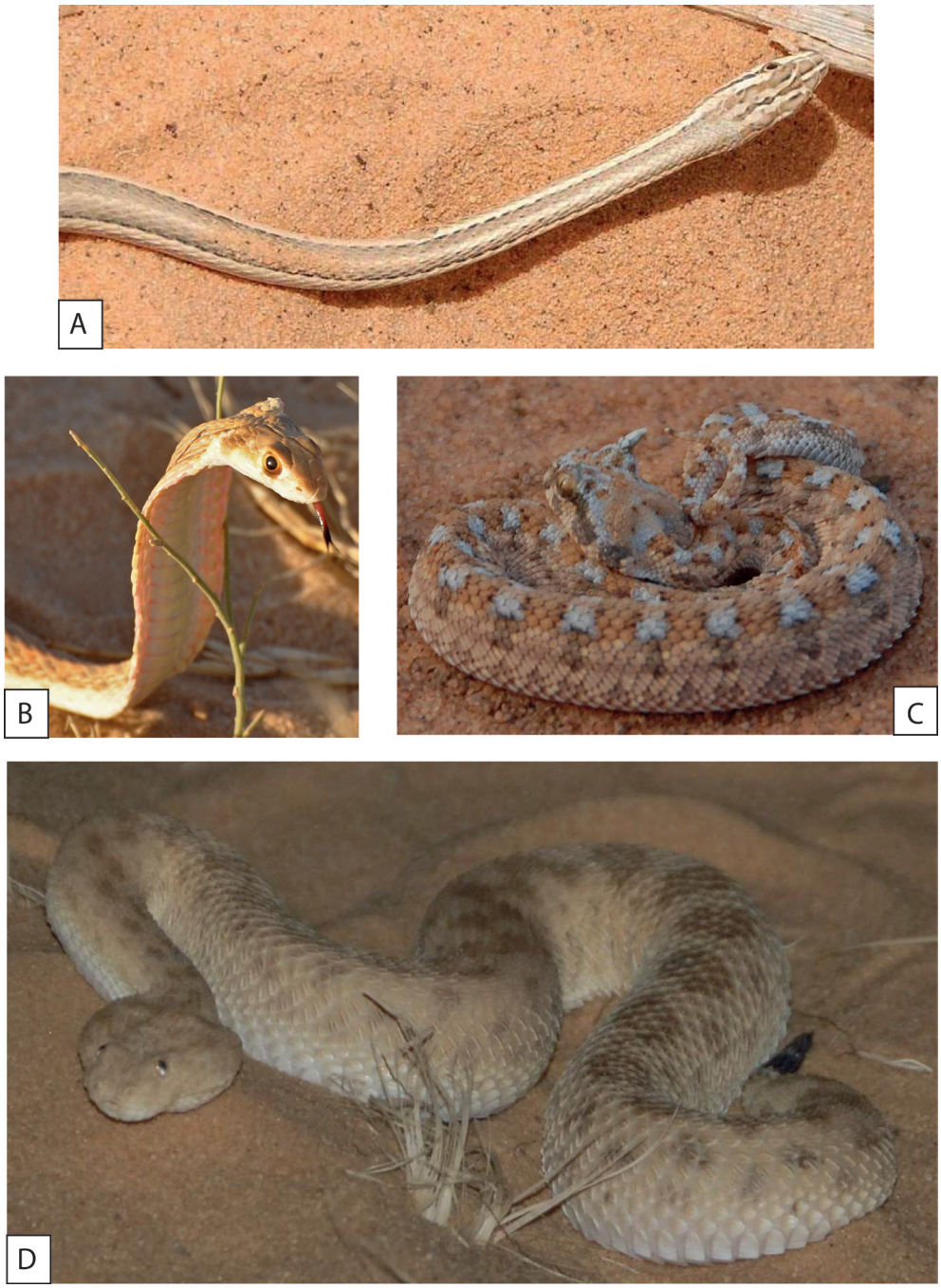

Figure 6. A) That *Psammophis* of the *P. schokari/P. aegyptius* group has the typical lined color pattern of *P. schokari* but proper identification is not possible without ventral scales count. Termit Massif, Niger (elev. 535 m, 15.90°N 11.45°E). 9 September 2009. Picture: Thomas Rabeil/SCF; B) *Rhagerhis moilensis*. Termit Massif, Niger. 15.45°N 11.02°E. 28 November 2010. Picture: Thomas Rabeil/SCF; C) *Cerastes cerastes*. Termit Massif area, Niger. Picture: Thomas Rabeil/SCF; D) *Cerastes vipera*. Termit Massif area (15.92°N 11.47°E). 19 September 2008. Picture: Thomas Rabeil/SCF.

not present in all specimens of the species, contrary to what is indicated by Trape and Mané (2006: 48). Its morphometric characters are summarised in table III. Our specimen is unusual in having its anal plate nearly totally divided.

***Cerastes vipera* (Linnaeus, 1758)**

Examined material [2 specimens but only one in MNHN collections, the other left in Niamey (L. Chirio pers. coll.)]: MNHN 2005.0350, around Termit Kaoboul buildings.

This typically Saharan species (Figure 6D) occurs in active sand dunes but also eolian flat areas typically covered with scattered herbaceous vegetation, a habitat that it shares with *Acanthodactylus longipes*. Our specimen does not represent the southernmost occurrence of the species since we have seen a picture of an adult male from Tall Desert, a locality farther south. The morphometric characters of the Termit-collected specimen are summarised in table III. Only some of the observed specimens had a dark coloured tail. MNHN 2005.0350 presents an anal plate with an additional lateral half-scale.

Our collection and observations made at Termit Massif and its surrounding area comprised 18 species [including *Chamaeleo africanus* and *Eryx muelleri* not seen in Termit Massif directly]: one tortoise, two agamids, one chameleon, four geckos, three lacertids, one varanid, one boid, two colubrids and three viperids. Our Termit survey is mostly remarkable by the lack of some species. We did not collect *Pelomedusa subrufa olivacea* Schweigger, 1812 (Pelomedusidae), *Uromastyx geyri* Müller, 1922 (Uromastycidae), *Agama tassiliensis* Geniez, Padial & Crochet, 2011 (Agamidae), *Ptyodactylus ragazzii* Anderson, 1898 (Phyllodactylidae) or *Chalcides ocellatus* (Forskal, 1775), *Scincopus fasciatus* Peters, 1864 and *Trachylepis quinquetaeniata* (Lichtenstein, 1823) (Scincidae) despite those species being well established in Aïr Massif, located only about 300 kilometers north-west of Termit (see Figure 1A) – our field trip was however short and probability to locate several of the above species is low even when they are present. The *Trapelus mutabilis* species complex seems not to go South of 17°N latitude (Trape *et al.*, 2012) and was not present in our study area. Several habitats were however suitable for all those species at Termit Massif. Such a lack is certainly not related to the meteorological conditions during our 2005 trip but has to be related to a true biological fact with an historical or climatic background. In the same way, we noted the absence of a gecko species also very common in Aïr Massif and in the whole southern part of Niger, *Ptyodactylus ragazzii*. Again this observation is in need of a hypothesis to explain that absence.

We can thus conclude that only species with clearly Saharan affinities could survive in the Termit area: it is therefore surprising to observe that the frequency of Sahelian species is relatively similar between Termit and Aïr (about half the species). Note, however that Aïr holds also two species with mediterranean affinities at their southern distribution limit, *Mauremys leprosa* (Schweigger, 1812) and *Chalcides ocellatus*, both unknown from Termit. Table IV shows the list of the species known from the Aïr area according to the works of Angel & Villiers (1950), Kriska (2001) and our own observations (Trape & Chirio, unpubl. data). It clearly appears that the number of recorded species in the Aïr area (41) is more than twice the number known from Termit Massif. Our three week field trip and the trip of Gonçalves *et al.* (2013) cannot pretend to make an exhaustive herpetological inventory of such an area and we can only suppose that additional works will enable report from Termit of several more discrete species like the skink *Scincus albifasciatus* Boulenger, 1890 [see however Gonçalves *et al.*, 2013], or snakes like *Spalerosophis cliffordi* or *Telescopus obtusus*. But a work of such a duration like the one we have done allows at least recognition of the most common species in the prospected area. Our data shows that three of the most commonly encountered species in the Aïr Massif, *Agama tassiliensis*, *Uromastyx geyri* and *Ptyodactylus ragazzii* are certainly not present at Termit Massif. Thus we can ask why such deficiencies occur and also why reptile biodiversity is so low at Termit Massif? The explanation probably lies in severe climatic conditions occurring in Termit Massif and in its topographic and geological characteristics. Aïr Massif is a huge North-South oriented mountain chain forming an important semi-arid climatic enclave inside the Niger Sahara whereas Termit Massif has only mountains of low elevation inadequate to stop clouds and produce precipitations. Moreover, the sandstone Termit does not retain enough infiltration water in contrast to the granitic or volcanic underground of Aïr. During our trip a heavy rain led to water being retained in temporary ponds but only for some hours and free standing water was rapidly absorbed by the soil and disappeared. Thus vegetal cover is less developed and permanent, even temporary water points are lacking or very rare at Termit. Several weeks after the August rains, all surface

water completely disappeared and will reappear only the following rain. The same observation can be made for most other animals like Rock hyrax common at Aïr but absent in the same kind of habitats at Termit Massif.

Some reptile species should also be cited as potential inhabitants of Termit Massif but they have not been sampled yet in the area: Phyllodactylidae: *Tarentola annularis* (Geoffroy Saint Hilaire, 1809) – Lacertidae:

Table IV. Reptile species reported from Termit and Aïr Massifs areas. Species indicated in bold were observed or collected during our study. All our collected Termit species were present at Aïr Massif, except one reported by Gonçalves *et al.* (2013), *Tropiocolotes steudneri*, a species that we have not observed at Termit. Species followed by an * were recently reported from Termit Massif by Gonçalves *et al.* (2013).

Species	Reference	Biogeographic affinities
Centrochelys sulcata*	**Kriska (2001)**; **Vetter (2005)**; **Trape *et al.* (2012)**	**Sahel**
Mauremys leprosa	Villiers (1950); Kriska (2001) ; Trape *et al.* (2012)	Maghreb
Pelomedusa subrufa olivacea	Kriska (2001); Trape *et al.* (2012)	Sahel
Hemidactylus angulatus	**Kriska (2001)**; **Trape *et al.* (2012)**	**Sahel**
Ptyodactylus ragazzi	Angel (1950); Kriska (2001); Trape *et al.* (2012)	Sahel
Stenodactylus sthenodactylus	Angel (1950); Trape *et al.* (2012)	Sahara
Stenodactylus petrii	**Angel (1950)**; **Kriska (2001)**; **Trape *et al.* (2012)**	**Sahara**
Tarentola hoggarensis *	**Angel (1950)**; **Joger (1984)**; **Kriska (2001)**; **Trape *et al.* (2012)**	**Sahara**
Tropiocolotes tripolitanus[1]	**Angel (1950)**; **Kriska (2001)**; **Trape *et al.* (2012)**	**Sahara**
Agama agama[2]	Angel (1950); Kriska (2001); Chirio (unpubl.)	Sahel
Agama boueti *	**Kriska (2001)**; **Trape *et al.* (2012)**	**Sahel**
Agama tassiliensis	Kriska (2001); Trape *et al.* (2012)	Sahara
Trapelus mutabilis	Kriska (2001); Trape *dx* (2012)	Sahara
Uromastyx geyri	Angel (1950); Kriska (2001); Trape *et al.* (2012)	Sahara
Chamaeleo africanus	**Angel (1950)**; **Kriska (2001)**; **Trape *et al.* (2012)**	**Sahel**
Acanthodactylus boskianus	Angel (1950); Kriska (2001); Trape *et al.* (2012)	Sahara
Acanthodactylus longipes	**Crochet *et al.* (2003)**; **Trape *et al.* (2012)**	**Sahara**
Acanthodactylus scutellatus audouini	Kriska (2001); Trape *et al.* (2012)	Sahara
Acanthodactylus senegalensis**[3]	**Trape *et al.* (2012)**	**Sahel**
Mesalina guttulata	Kriska (2001)	Sahara
Mesalina rubropunctata	Trape *et al.* (2012)	Sahara
Latastia longicaudata	**Angel (1950)**	**Sahel**
Chalcides delislei	Angel (1950); Kriska (2001); Trape *et al.* (2012)	Sahara
Chalcides ocellatus	Angel (1950); Kriska (2001); Trape *et al.* (2012)	Maghreb
Trachylepis quinquetaeniata	Trape *et al.* (2012)	Savanes

[1] Note that Gonçalves *et al.* (2013) reported *Tropiocolotes steudneri* for the first time from Termit Massif and if confirmed that will be the only species from Termit not present in the Aïr Massif area. However, we have not observed that species in the area and our specimens clearly refers to *T. tripolitanus*.

[2] *A. agama* is not a natural inhabitant of Aïr Massif but was certainly introduced recently in the city of Agadez through human transport related to the important road traffic in that city which is the main economic and commercial center for the area.

[3] Gonçalves *et al.* (2013) reported Termit populations as *Acanthodactylus* cf. *senegalensis*.

Table IV. Continued.

Scincopus fasciatus	Angel (1950); Kriska (2001); Trape *et al.* (2012)	Sahara
Scincus albifasciatus[4]	Kriska (2001); Chirio (unpubl.)	"Sahara"
Varanus griseus*	**Kriska (2001)**; **Trape *et al.* (2012)**	**Sahara**
Leptotyphlops algeriensis	Trape & Mané (2006)	Sahara
Eryx colubrinus	Villiers (1950); Kriska (2001); Trape & Mané (2006)	Sahel
Eryx muelleri	**Kriska (2001)**; **Trape & Mané (2006)**	**Sahel**
Dasypeltis sahelensis	Trape & Mané (2006)	Sahel
Rhagerhis moilensis*	**Villiers (1950)**; **Kriska (2001)**; **Trape & Mané (2006)**	**Sahara**
Psammophis aegyptius	Trape & Mané (2006)	Sahara
Psammophis schokari	Villiers (1950); Trape & Mané (2006)	Sahara
Psammophis rukwae	Villiers (1950); Trape & Mané (2006)	Sahel
Spalerosophis cliffordi	Villiers (1950); Kriska (2001); Trape & Mané (2006)	Sahara
Telescopus tripolitanus[5]	Villiers (1950); Kriska (2001); Trape & Mané (2006)	"Sahara"
Naja haje	Villiers (1950); Kriska (2001); Trape & Mané (2006)	Sahel
Naja nubiae	Trape & Mané (2006)	Sahel
Bitis arietans[6]	Villiers (1950); Kriska (2001); Trape & Mané (2006)	Savanna
Cerastes cerastes*	**Villiers (1950)**; **Kriska (2001)**; **Trape & Mané (2006)**	**Sahara**
Cerastes vipera	**Kriska (2001)**; **Trape & Mané (2006)**	**Sahara**
Echis leucogaster	**Villiers (1950)**; **Trape & Mané (2006)**	**Sahel**

[4] That skink has rather a circum-Saharan distribution pattern rather than a Saharan one (it is common around Maradi and Kouré in other parts of the country). The species was not reported by Trape *et al.* (2012) from Aïr Massif but was collected by one of us (LC) at 19°09'N and 8°57'E.

[5] The distribution pattern of that snake is most likely circum-Saharan rather than Saharan (the species was collected at Kouré in Niger, and even in the North of Central African Republic (Birao)).

[6] That viper is a panafrican savanna species extending its distribution to the South of West Africa reaching the forest border (see also Geniez *et al.*, 2004).

Acanthodactylus boskianus nigeriensis Trape, Chirio & Geniez, 2012 (its absence from the Termit area could however be related to the more mesic habitat needs of that lizard) – Scincidae: *Chalcides delislei* (Lataste, 1876). The lack of *Mauremys leprosa* (Schweigger, 1812) is certainly explained by absence of water during a large part of the year.

Particular attention should be given to the occurrence at Termit Massif of the small lacertid *Acanthodactylus senegalensis*, common in most inner valleys of the massif. That species, described from the Atlantic littoral was never reported from Aïr and we did not find it during a recent survey of the oriental border of that massif (Trape & Chirio, unpubl. data). It could be interesting to search that species in habitats similar to those occupied at Termit: a congeneric species reported from Aïr, *Acanthodactylus boskianus*, could be responsible of that absence through interspecific competition related to similar habitat choice.

Located more southerly than Aïr, Termit Massif constitutes (with Tall Desert in the Southeast of Niger and Bahr-el-Ghazal in Chad) one of the southern limits of the distribution area of several Saharan species. Despite this, the most striking characteristic of Termit Massif is its lack of several species which are common at Aïr Massif: such a low biodiversity is probably due to the extreme aridity of the massif related to a permeable subsurface which does not allow retention of water for long.

It may appear contradictory but the Termit Massif area is a last refuge for numerous threatened Saharo-Sahelian mammals such as cheetah, addax or dama gazella. Survival of those species in that Sahara area is not due to particularly favourable climatic conditions but rather to the aridity of the climate preventing permanent human habitation, thus reducing hunting pressure. Only some nomadic Toubous occasionally visit the massif with their camels, hence human pressure is much lower there than at Aïr where human settlement is relatively old and important and most such species have been extirpated or at least their populations severely reduced.

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