

Contributions to the natural
history and distribution of
Dasypeltis sahelensis TRAPE &
MANÉ, 2006, in Morocco

The Atlantic coast of North Africa is inhabited by three species of snake with mostly Sub-Saharan ranges: *Bitis arietans* MERREM, 1820, *Boaedon fuliginosus* (BOIE, 1827), and *Dasypeltis sahelensis* TRAPE & MANÉ, 2006 (GENIEZ et al. 2004; TRAPE & MANÉ 2006). They represent northern relict populations that became isolated from their southern range areas after changes in late Pleistocene climate conditions (ESCORIZA 2010; BRITO et al. 2013). The genera *Dasypeltis* (Africa and Arabian Peninsula) and *Elachistodon* (Asia), are the only snakes specialized in predation of bird eggs. Moreover, *Dasypeltis* mimics sympatric viperids by color, morphology and defensive behavior (GANS 1959, 1961), being *D. sahelensis* an imitator of the White-bellied

Table 1: Spatial and temporal schedule of the authors' sampling campaigns from 2009 to 2016.

Trip Dates	Sampling Effort (person days)							Specimens found
	Coast (less than 50 km inland)			Inland				
	Souss & Massa Valleys	Sidi Ifni - Guelmin	Guelmin - Laayoune	Agdz	Assa	Tata	Smara	
March 2009	—	2	—	—	—	1	—	—
August 2009	1	3	3	—	—	1	—	—
March 2010	—	2	2	—	—	1	—	2
August 2010	—	2	—	—	—	—	—	—
October 2010	—	—	—	2	—	—	—	—
June 2011	1	2	1	2	—	—	—	—
August 2011	—	—	1	—	1	—	—	—
April 2012	—	—	—	1	—	—	—	—
April 2012	—	2	2	—	1	—	—	4
May 2012	1	2	1	—	1	1	—	—
May 2012	1	3	2	1	1	1	—	—
August 2012	1	3	3	—	1	1	1	—
August 2013	1	4	3	—	1	1	1	1
October 2013	1	4	3	—	1	—	1	—
May-June 2014	1	5	5	1	2	1	1	1
July-August 2015	3	7	7	—	2	1	1	1
December 2015	—	—	2	—	—	—	1	—
March 2016	2	1	2	—	1	—	—	—
Total 2009-2016	13	42	37	7	12	9	6	9

Carpet Viper *Echis leucogaster* ROMAN, 1972 (BONS & GENIEZ 1996; TRAPE & MANÉ 2006). Furthermore, both species have serrated keeled scales that produce a defensive sound, a stridulation, when rubbed against their body flanks.

Dasypeltis was discovered in Morocco in 1970 (STEMMLER 1971). The authors are aware of 18 sightings of *Dasypeltis* in Morocco reported in the literature (GRUBER & HELLMANN 1984; BONS & GENIEZ 1996; GENIEZ & GUILLOD 2003; GENIEZ et al. 2004; ESCORIZA 2009; BARNESTEIN et al. 2010; ESCORIZA 2010; BARNESTEIN et al. 2012; CROCHET et al. 2015). Therefore, it is considered as a rare species for the country (BONS & GENIEZ 1996) and its proposed national conservation status is “Vulnerable” (VU B1ab(iii) – PLEGUEZUELOS et al. 2010). The Moroccan populations were formerly considered as *Dasypeltis scabra* (LINNAEUS, 1758), but recent taxonomic work showed that they belong to *D. sahelensis*, a species mostly distributed in the western Sahel (TRAPE & MANÉ 2006; TRAPE et al. 2012). Little information is available. The activity of the Sahel Egg Eater, especially nocturnal, is associated with the availability of its

trophic resource, during the breeding season of birds present in its habitat. Thus, its annual activity cycle was declared to last up to four months or even a single month during spring or end of winter (BONS & GENIEZ 1996; ESCORIZA 2012; CROCHET et al. 2015). Captive individuals of *D. scabra* survived up to 11 months without ingesting any food (SCHLEICH et al. 1996). Dispersing hatchlings of *D. sahelensis* were observed at the end of October (ESCORIZA 2012).

To contribute to the almost unknown natural history of the Sahel Egg Eater, the authors compiled information on its activity and distribution by reviewing the literature on the species in Morocco, visiting underground water cisterns and driving a vehicle along roads in the first hours of night. All the *D. sahelensis* individuals found were soon after released to adjacent habitats.

From 2009 to 2016, the authors made 18 trips investing a sampling effort of 126 person days, split in 92 person days in the coastal areas (less than 50 km inland) from Agadir to Laayoune and 34 person days in the inner areas, from Agdz to Smara. Further details on time allocation can be found in Table 1. With all this sampling

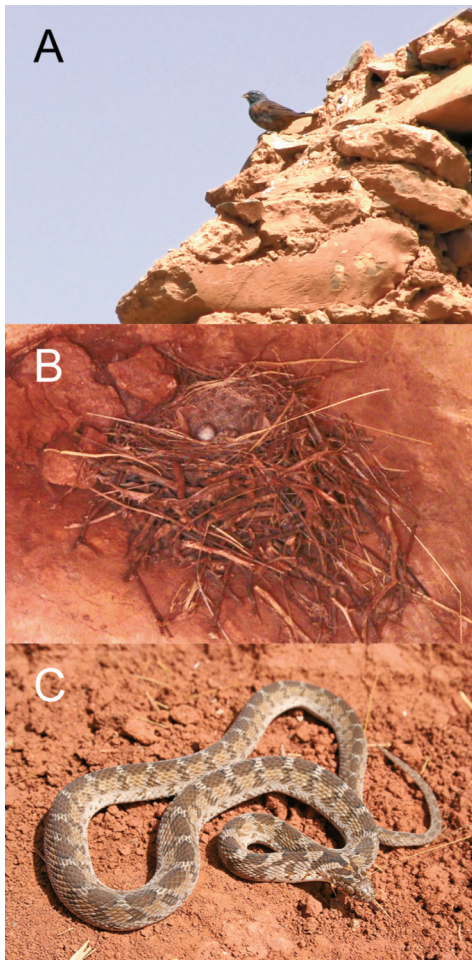


Fig. 1: A - One of the two house buntings (*Emberiza sahari*) found nesting inside an abandoned water cistern in Lakhssas, in August 2, 2015;

B - their nest with two eggs;

C - the specimen of *Dasypeltis sahelensis* TRAPE & MANÉ, 2006, found inside the same cistern. Photographs: Raúl León.

a road near Sidi Ifni in 2013, the other trapped inside an old, abandoned underground water cistern in the area of Lakhssas in 2015. While approaching that cistern, a pair of house buntings (*Emberiza sahari*) were observed fleeing (Fig. 1A). Inside, there was a bird nest with two eggs, on a ledge at the inner wall, very close to the water entrance hole (Fig. 1B). The house buntings were restless and came back to the nest repeatedly. The snake probably fell down to the bottom after detecting the eggs inside. The ophidian was found under debris and, different from other reptiles rescued from cisterns, in good physical condition (Fig. 1C). Obviously, the egg eater had been trapped only a short time ago showing that in August, the snake's trophic resource can still be available in this area, extending the activity period of *Dasypeltis* into summer.

Earlier observations of this snake in Morocco were centered at two cores: the locality of Ait Baha, southeast of Agadir, and the area of Sidi Ifni (BONS & GENIEZ 1996). All those records occurred in steppes with Atlantic influence and vegetation of *Argania spinosa* and *Euphorbia officinarum*. Most of the reported observations occurred also in that vegetation type, with eleven specimens in the region between Sidi Ifni and Guelmin (Fig. 2). Other specimens were found in the "classic" locality of Ait Baha, in the vicinities of Aarb Sahel (C. LANGNER, pers. comm.), 12 km north of Sidi Ifni (F. HULBERT, pers. comm.), Lakhssas, and south of Bou Jerif (S. BOGAERTS, pers. comm.; G. VERSPUI, pers. comm.). The new data suggest a more continuous distribution of *D. sahelensis* in the coastal region between the Souss and Draa Valleys, ascending the Atlantic slopes of the Anti-Atlas Mountains, up to the 950 m reached in Lakhssas (locality 16 in Fig. 2). There are not recent records of *Dasypeltis* south of the mouth of the river Draa in Tan-Tan, where the climate and vegetation of argans and cactiform *Euphorbia* cease (MÉDAIL & QUÉZEL 1999). Besides our sampling effort in that area, given the existence of an old record south of Laayoune (BONS & GENIEZ 1996), the authors suspect that *Dasypeltis* are less abundant south of the river Draa.

effort, the authors found nine specimens and report other nine observations from colleagues (Table 2). Most individuals were observed between March and May, but also in June and August.

Two specimens of *D. sahelensis* were found as late as August, one of them dead on

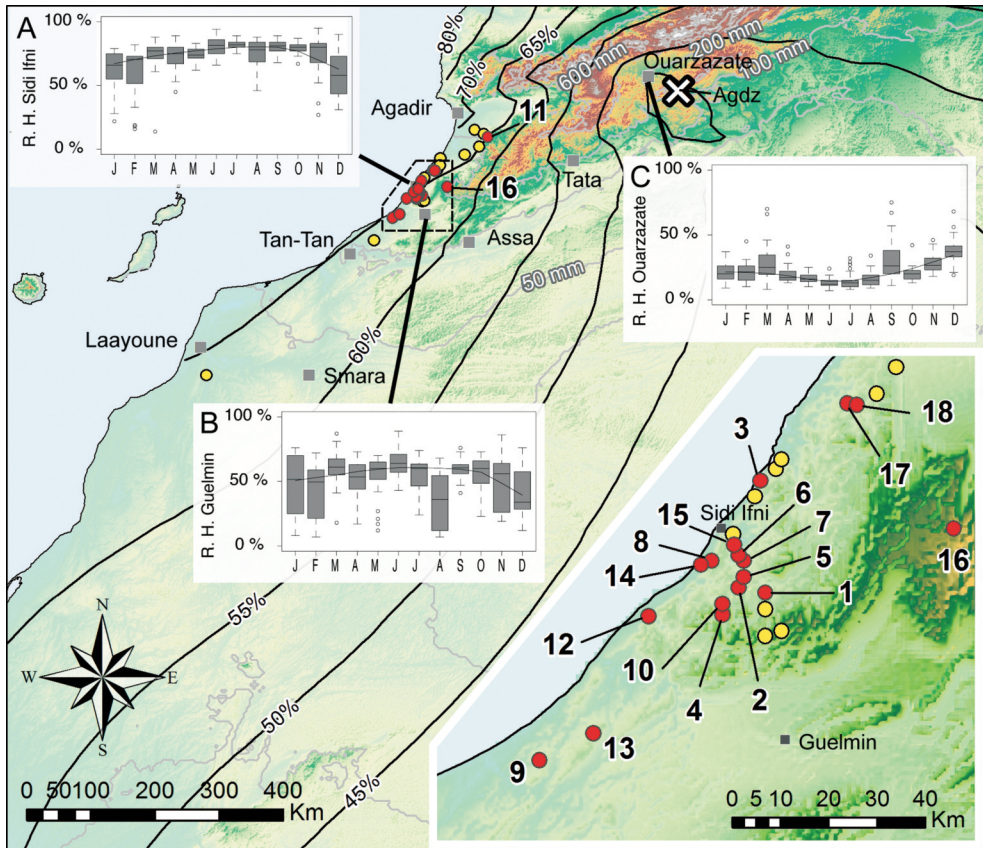


Fig. 2: Records of *Dasympeltis sahelensis* TRAPÉ & MANÉ, 2006, in Morocco. Yellow circles are previously known localities (BONS & GENIEZ 1996; GENIEZ & GUILLOD 2003; ESCORIZA 2009; BARNESTEIN et al. 2010; ESCORIZA 2010; BARNESTEIN et al. 2012; CROCHET et al. 2015); red circles are the new records presented in this work; the outline X symbol represents the record of *Echis* in Agdz (STEMMLER 1971), erroneously attributed to *Dasympeltis* by BONS & GENIEZ (1996) and subsequent publications (e.g., GENIEZ & GUILLOD 2003; ESCORIZA 2010; DE POUSS et al. 2011). Numbers of each record are in chronological order and correspond to those in Table 2. Black lines are isohumes obtained by averaging relative humidity data (NEW et al. 2002) that show the west-east gradient of humidity, while gray lines are isopluvial lines obtained from WorldClim (HUMANS et al. 2005), that show a north-south gradient of annual precipitation. Elevation is represented by different background color. The inset graphs represent the annual variation of relative humidity along the year 2013, of A - Sidi Ifni (< 1 km inland), B - Guelmin (> 35 km inland) and C - Ouarzazate (> 250 km inland) (data obtained from tutiempo.net). D - The region of Sidi Ifni and Guelmin in detail.

In the region of Agdz, in 1969, Erich SOCHUREK found a piece of shed skin and identified it as that of a viper of the genus *Echis*. Othmar STEMMLER included the slough in his collection under the code HStR 001312 (STEMMLER 1971). Upon the authors' request, this specimen was, however, neither present at the Naturhistorisches Museum Basel (D. VALLAN, pers. comm.) nor

the Naturhistorisches Museum Wien (H. GRILLITSCH pers. comm.). In the first report of *Dasympeltis* occurring in Morocco, STEMMLER (1971) did not fully rule out the possibility that the above piece of shed skin, belonged to *Dasympeltis*, due to the lack of comparative material. Probably as a consequence of a mistranslation, this information was considered a reliable record of *Dasy-*

Table 2: New records of *Dasyplectis sahelensis* TRAPE & MANÉ, 2006, in Morocco. Numbers in the first column match those of the map in Figure 1. Specimen N° 3 was deposited in the Zoologisches Forschungsmuseum Alexander Koenig (ZFMK), Bonn, Germany.

N°	Area	Coordinates	Date	Observer(s)	Additional data
1	Arbaa Mesti	29°15'36"N, 10°05'24"W	1 April, 2010	B. Rebollo, F. Jimenez-Cazalla, V. Gabari & G. Martínez	Roadkill
2	Arbaa Mesti	29°16'12"N, 10°08'24"W	1 April, 2010	B. Rebollo, F. Jimenez-Cazalla, V. Gabari & G. Martínez	Fresh roadkill, 20:15 h
3	Legzira	29°28'08"N, 10°05'57"W	19 May, 2010	F. Hulbert	ZFMK 91083. Roadkill
4	Sbouya	29°13'12"N, 10°10'12"W	20 April, 2012	B. Rebollo	Active with light rain at 23:05 h
5	Arbaa Mesti	29°17'24"N, 10°07'48"W	20 April, 2012	B. Rebollo	Active with light rain at 23:40 h
6	6 km SE Sidi Ifni	29°19'48"N, 10°08'24"W	21 April, 2012	B. Rebollo	Fresh roadkill, with light rain at 00:05 h
7	7.5 km SE Sidi Ifni	29°19'12"N, 10°07'48"W	21 April, 2012	B. Rebollo	Active with light rain at 00:15 h
8	7 km S Sidi Ifni	29°19'12"N, 10°11'24"W	26 March, 2013	P. Geniez, M. Geniez	Active at 20:45 h
9	23 km SW Bou Jerif	28°57'00"N, 10°30'36"W	7 June, 2013	S. Bogaerts, F. Pasmans	In underground water cistern
10	Sbouya	29°14'24"N, 10°10'12"W	18 August, 2013	G. Martínez, B. Rebollo, M. Sassoe	Roadkill
11	Ait Baha	30°04'48"N, 09°10'12"W	15 May, 2014	R. León, B. Rebollo, O. Jiménez-Robles	Under stones in open water tank
12	22 km SW Sidi Ifni	29°00'00"N, 10°24'36"W	24 May, 2014	A. Bouazza	In underground water cistern
13	12 km SW Bou Jerif	29°00'00"N, 10°24'36"W	25 April, 2015	G. Verspui, S. van Bommel & F. Deschandel	In underground water cistern
14	2 km S Sidi Ifni	29°18'45"N, 10°12'35"W	1 May, 2015	G. Smith	Active at 22:30 h
15	Sidi Ifni	29°21'00"N, 10°08'54"W	3 May, 2015	A. Roux	Fresh roadkill at 20:30 h
16	Lakhssas	29°22'48"N, 09°44'24"W	August 2, 2015	R. León, M. Soto	Under debris in underground water cistern
17	Arbaa Sahel	29°36'46"N, 9°56'14"W	2 April, 2016	C. Langner	Fresh roadkill at 1:18 h
18	Arbaa Sahel	29°36'35"N, 9°55'11"W	2 April, 2016	C. Langner	Roadkill

peltis by BONS & GENIEZ (1996), an error that was carried forward in subsequent works (e.g., GENIEZ & GUILLOD 2003; ESCORIZA 2010; DE POUS et al. 2011). With the sampling efforts reported in Table 1, the authors did not find any specimens of *Dasyplectis* in the inland areas. Currently, several specimens of *Echis leucogaster* are known from southwest Moroccan inland areas such as Tata, Assa or Agdz, including five specimens of Ait Semgane-Tesla (MARAN & GENIEZ 1999; ESCORIZA et al. 2009; AYMERICH 2010; MARTÍNEZ & REBOLLO 2012; M. Aymerich pers. comm.) where SOCHUREK

had found the piece of shed skin. Thus, there are no evidences to consider the region of Agdz as a valid locality for the Sahel Egg Eater.

Out of the 36 current records for *Dasyplectis* in Morocco, seven specimens were observed in two single nights with light rain: three in early February 2008 with air temperatures of 10 - 20 °C (CROCHET et al. 2015) and four in April 2012, at 14 - 16 °C. These observations could indicate that activity and movements of this species in Morocco could be restricted by aridity and that the snake takes advantage of nights

with light rain or elevated humidity level for moving. Then, it is likely that environmental humidity could be a decisive factor for the activity periods of this snake.

This could also explain the fact that all the *D. sahelensis* localities north of the Sahel (excluding the invalidated record of Agdz) are limited to areas close to the Atlantic coastline (up to 46.7 km in the case of the authors' observation in Ait Baha). The climate at the Atlantic coast of southern Morocco is characterized by frequent cloudy skies and horizontal precipitation (condensation drip) coming from the sea, that turns the Saharan climate colder, wetter and reduces the temperature range (MARZOL & SÁNCHEZ-MEGÍA 2008; LEKOUCH et al. 2012). In fact, relative humidity is consistently higher in the coastal areas than inland all year round, and at the same time that humidity rises in the summer near the coast, it decreases inland (Fig. 2). This could allow *D. sahelensis* to maintain activity near the coast even during the summer.

Horizontal precipitation has a considerable importance for the vegetation in these ecosystems of southwestern Morocco (MÉDAIL & QUÉZEL 1999). The Atlantic coast of Morocco is a herpetological biodiversity hotspot (DE POUSS et al. 2011). Currently, the most frequently used environmental GIS layers for macroecological analyses (e.g., WorldClim, HUMANS et al. 2004) do not include this environmental humidity coming from the Atlantic sea as horizontal precipitation. Thus, conclusions obtained by these studies (e.g., ESCORIZA 2010; DE POUSS et al. 2011; BRITO et al. 2013) ignore this important climatic factor, probably essential for many organisms that contribute to the high biodiversity of this coastal area.

Vegetation provides more surface for horizontal precipitation condensation than the bare ground (UCLÉS et al. 2013). Destruction of native vegetation of arid ecosystems modifies the microclimate and makes irreversible its natural recovery (HILDEBRANDT & ELTAHIR 2008). Thus, conservation of native vegetation is fundamental for the condensation of humidity and the existence of endemic or relict organisms, such as *D. sahelensis*, which survive in these arid ecosystems dependent on horizontal precipitation.

To sum up, data suggest a more continuous distribution of the Sahel Egg Eater in coastal Morocco and a longer activity period, including the summer months, both facts probably favored by the high humidity all year round. While some of the old records in Morocco refer to individuals found concealed under refuges in their habitat (GRUBER & HELLMANN 1984; GENIEZ & GUILLOD 2003), it should be emphasized that all recent records originate from individuals found on roads or trapped in water storage facilities (underground cisterns, wells and tanks). These water infrastructures act as pitfalls for the vast majority of reptiles of arid regions of Morocco (LEÓN & MARTÍNEZ 2013; GARCÍA-CARDENETE et al. 2014). Sadly, this indicates that roadkill and entrapment in these infrastructures might cause important losses of individuals of this species.

AKNOWLEDGMENTS: Philippe Geniez, Michel Geniez, Sérgé Bogaerts, Frank Pasmans, Gert Jan Verspui, Felix Hulbert, Abdellah Bouazza, Garry Smith, Alexandre Roux and Christian Langner shared their observations. Juan José Ramos Melo confirmed the bird species identity. Philippe Geniez provided access to some publications. Heinz Grillitsch, Antje Girndt and Mario Schweiger assisted in understanding the German literature. Heinz Grillitsch and Denis Vallan helped in the authors' desperate search of the piece of shed skin collected by Sochurek in the museums of Vienna and Basel, respectively.

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- KEYWORDS:** Reptilia: Squamata: Serpentes: Colubridae: *Dasypteltis sahelensis*; activity pattern, horizontal precipitation, humidity, hygric physiology, Morocco
- SUBMITTED:** June 7, 2016
- AUTHORS:** Octavio JIMÉNEZ-ROBLES (Corresponding author < octavio.jimenez.robles@gmail.com >)¹, Raúl LEÓN², Manuel SOTO CÁRDENAS³, Baudilio REBOLLO⁴ & Gabriel MARTÍNEZ⁵
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Jahr/Year: 2017

Band/Volume: [30_1_2](#)

Autor(en)/Author(s): Jimenez-Robles Octavio, Leon Raul, Soto Cardenas Manuel, Rebollo Baudilio, Martinez Gabriel

Artikel/Article: [Contributions to the natural history and distribution of *Dasypeltis sahelensis* TRAPE & MANÉ, 2006, in Morocco 80-86](#)