Basic and Applied Herpetology 28 (2014): 99-111

Atlas of the distribution of reptiles in the Parc National du Banc d'Arguin, Mauritania

Andack Saad Sow[1], Fernando Martínez-Freiría[2], Pierre-André Crochet[3], Philippe Geniez[4], Ivan Ineich[5], Hamidou Dieng[6], Soumia Fahd[1], José Carlos Brito[2,*]

[1] Département de Biologie, Faculté des Sciences de Tétouan, Université Abdelmalek Essaâdi, Tétouan, Morocco.
[2] CIBIO/InBio, Centro de Investigação em Biodiversidade e Recursos Genéticos da Universidade do Porto, Vairão, Portugal.
[3] CNRS-UMR 5175, Centre d'Ecologie Fonctionnelle et Evolutive, Montpellier, France.
[4] EPHE-UMR 5175, Centre d'Ecologie Fonctionnelle et Evolutive, Montpellier, France.
[5] Muséum national d'Histoire naturelle, Département Systématique et Evolution (Reptiles), UMR CNRS 7205 (OSEB), Paris, France.
[6] Faculté des Sciences et Techniques, Université des Sciences, de Technologie et de Médecine de Nouakchott, Nouakchott. R.I. Mauritanie.

* Correspondence: Campus Agrário de Vairão, R. Padre Armando Quintas, 4485-661 Vairão, Portugal. Phone: +351 252660416, Fax: +351 252661780, E-mail: jcbrito@cibio.up.pt

Received: 17 December 2012; received in revised form: 19 April 2013; accepted: 19 April 2013.

This study provides the first atlas of the distribution of reptiles in the Parc National du Banc d'Arguin, Mauritania. The area is a UNESCO World Heritage Site and a Nature Reserve. Unpublished fieldwork observations collected between 2008 and 2011 were combined with published records and museum data in a Geographical Information System to produce maps with the distribution of individual species and species richness. The taxonomic list of reptiles includes 21 species grouped in eight families. Three species (*Stenodactylus mauritanicus*, *Mesalina pasteuri* and *Psammophis sibilans*) were detected for the first time in the area. Reptiles form distinct groups according to their distribution patterns and preliminary habitat selection trends: 1) species selecting bare areas present throughout the park; 2) species selecting rocky habitats present mostly in the northern areas; and 3) species selecting sandy habitats present mostly in the southern areas. A total of eight areas were identified as of high species richness (N > 8 species), usually presenting species typical of rocky or dune habitats and also species present in open bare areas.

Key words: Africa; biodiversity; GIS; protected area; Sahara desert.

Atlas de distribución de los reptiles del Parque Nacional Banc d'Arguin, Mauritania. El presente estudio constituye el primer atlas de distribución de reptiles en el Parque Nacional Banc d'Arguin, Mauritania. El área es una Reserva Natural y está declarada Patrimonio de la Humidad por la UNESCO. Combinamos en un Sistema de Información Geográfica observaciones no publicadas obtenidas durante campañas de campo entre 2008 y 2011 con registros publicados y datos procedentes de museos para elaborar mapas de distribución de cada especie así como de la riqueza de especies. La lista taxonómica de reptiles incluye 21 especies agrupadas en ocho familias. Tres especies (*Stenodactylus mauritanicus*, *Mesalina pasteuri* y *Psammophis sibilans*) se detectaron por primera vez en el área. Los reptiles forman grupos distintos de acuerdo a sus patrones de distribución y a las tendencias preliminares de selección del hábitat: 1) especies que seleccionan áreas yermas distribuidas a lo largo del Parque, 2) especies que seleccionan hábitats rocosos presentes mayoritariamente en la zona norte, y 3) especies que seleccionan áreas arenosas presentes mayoritariamente en la zona sur. Se identificaron un total de ocho áreas de elevada riqueza específica (N > 8 especies) que habitualmente presentan especies típicas de hábitats rocosos y dunares, pero también especies presentes en áreas abiertas y sin vegetación.

Key words: África; área protegida; biodiversidad; desierto del Sáhara; SIG.

DOI: http://dx.doi.org/10.11160/bah.12011/

Global biodiversity is being lost at an accelerated rate (BUTCHART *et al.*, 2010), as a consequence of human induced factors such as habitat loss and fragmentation, biological invasions and climate change (BROOKS *et al.*, 2002; GARCIA *et al.*, 2012). Knowledge on the distribution patterns of species and the identification of areas holding high richness are necessary steps for developing coherent conservation policies (MYERS *et al.*, 2000; HOBOHM, 2003; HOLE *et al.*, 2011). Biogeographic transition zones constitute attractive areas for long-term conservation of biodiversity. As they assemble communities of species at the border of their requirements, they allow conserving evolutionary processes (SPECTOR, 2002; CARVALHO *et al.*, 2011) and meeting goals of representativeness and complementarity in protected-areas systems (ARAÚJO, 2002; KATI *et al.*, 2004).

Mauritania is located along the transition zone between the Palearctic and Afro-Tropical biogeographical regions and combines species of Saharan-Sindian and Sahelian affinities (DEKEYSER & VILLIERS, 1956; LE BERRE, 1989). Within Mauritania, the coastal Parc National du Banc d'Arguin (PNBA) was declared as a UNESCO World Heritage Site and as a Nature Reserve to mainly protect natural resources, having exceptionally high importance as breeding, staging and wintering area for birds (MAHÉ, 1985). However, a varied community of reptiles should be present in the PNBA due to its character of transition zone and its proximity to the Ocean (MONOD, 1988).

Knowledge on reptile species of PNBA is limited but it has been progressively increasing. Until the late 1980s, eight species of reptiles were known (LE BERRE, 1989), and that number was increased to 19 species with the inventories made during the project "Environment et littoral mauritanien" (INEICH, 1997). Posterior works have allowed detailing distributional patterns for particular species (PADIAL *et al.*, 2002; BRITO, 2003; CROCHET *et al.*, 2003). Specifically, morphological analyses of the *Acanthodactylus scutellatus* group defined preliminary ranges of individual species and identified specimens with intermediate morphological traits between *A. dumerili* and *A. senegalensis*, suggesting the occurrence of interspecific gene flow.

The major aims of this work are to provide an updated taxonomic list of the reptiles present in the PNBA, to map their distributions, and to identify areas of species richness.

MATERIALS AND METHODS

Study area

The PNBA covers an area of about 120 000 km^2 (latitudes 19°21' to 21°51' N and longitudes 16°00' to 16°45' W) and is located along the coastal Atlantic region of Mauritania, West Africa (Fig. 1). The PNBA comprises both terrestrial (48% of its area) and marine portions (52%) and there are eight islands and islets, the largest of which is Tidra, with a maximum length and width of 30 km and 10 km, respectively. The continental part includes also the small Cap Blanc Satellite Reserve, especially dedicated to the protection of monk seal (*Monachus monachus*) colonies. The PNBA is located in the Sahara terrestrial ecosystem, at the southern limit of the Palearctic realm. The area is mostly flat (maximum altitude 61 m) and there are two main rock outcrops located in the northern (Kerekchet et Teintâne) and

central (Dlô Amotai) areas. The climate is arid and hot, with annual precipitation and annual average temperature ranging between 17 and 50 mm and 21.8 and 25.2ºC, respectively (HIJMANS *et al.*, 2005). The most representative land-cover categories are bare areas (40.1%), consolidated bare areas (hardpans, gravels, bare rock, stones, boulders; 37.9%) and non-consolidated bare areas (sandy desert; 21.5%) (BICHERON *et al.*, 2008). The northern region is mostly dominated by consolidated bare areas associated with the alluvial floodplain of oued Chibkha, which is mostly dry and covered with sparsely distributed *Acacia* trees that often follow the former river. The southern region is dominated by non-consolidated bare areas associated to the huge sand seas of erg Azefal and Agneitir. Relict mangrove stands are found in coastal areas around Mamghar and in islands that testify past humidity conditions in the region (GASSE, 2000).

Field work and data analysis

Field work was performed during a total of 31 days between 2008 and 2011. A total of 3200 km were covered by vehicle within the PNBA and two visits were made to Tidra Island (Fig. 1). Visual encounter surveys were performed by four persons in 2008/2009 and seven persons in 2010/2011. Sampling sites were selected in order to cover the environmental variability of the PNBA as well as particular topographic features, such as the Cap Blanc. Sampling sites were surveyed by foot for no longer than 1 hour (sampling effort ranging from 0.07 person/hour/day in 2008/2009 to 0.14 in 2010/2011) and night sampling was performed opportunistically around camping sites. Ad hoc observations (road-kills and live specimens) collected by the authors and National Park staff were also recorded. Captured specimens were photographed, a tissue sample was collected, and the geographic coordinates of the locality recorded with a Global Positioning System (GPS).

A georeferenced database of fieldwork observations was created and complemented with published data (MOCQUARD, 1895; PELLEGRIN, 1910; ANGEL, 1938; VILLIERS, 1954; VALVERDE, 1957; SALVADOR, 1982; LE BERRE, 1989; INEICH, 1997; PADIAL *et al.*,

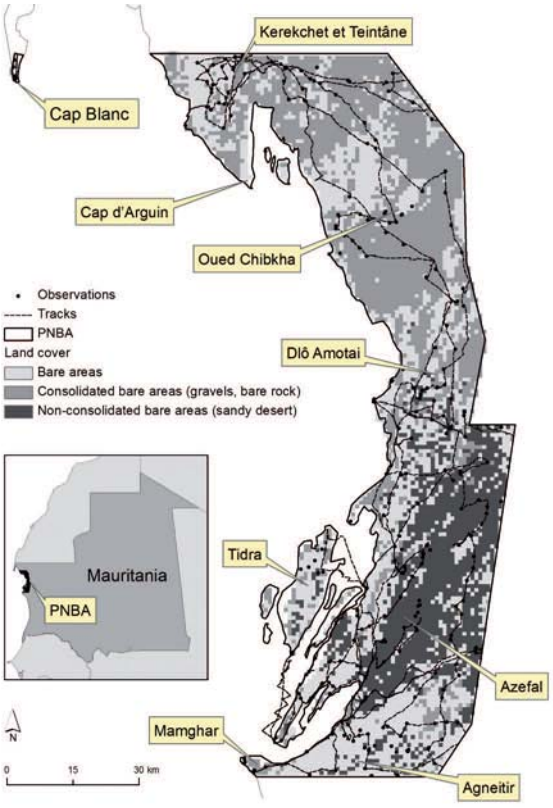

Figure 1: Limits of the Parc National du Banc d'Arguin, distribution of all reptile observations, tracks of sampling routes between 2008-2011, main land-cover types (BICHERON *et al.*, 2008) and localities mentioned in text.

2002; BRITO, 2003; CROCHET *et al.*, 2003; GENIEZ *et al.*, 2004; PLEGUEZUELOS *et al.*, 2004; PADIAL, 2006). Geographic coordinates of bibliographic references were collected from topographical maps of Mauritania (Institut Géographique National; 1:200,000). Specimens from PNBA available at the collection of the Muséum national d'Histoire naturelle de Paris (INEICH, 1997) were also included in the database.

The distribution of individual species and species richness were projected on the coordinate system WGS 1984 UTM Zone 28N, using the Geographical Information System ArcGIS 10.0 (ESRI, Redlands, California, USA). Species maps represent fieldwork and published observations over 2 x 2 km UTM grid cells (1685 cells in total) while the species richness map represents number of species observed over 10 x 10 km UTM grid cells (92 cells in total). Observations of each species detected in more than 10 localities were intersected with land-cover categories (BICHERON *et al.*, 2008) to quantify preliminary patterns of habitat selection.

RESULTS

The published and fieldwork data comprised 461 records (389 unpublished observations and 72 published observations) from 21 reptile species, grouped in eight families

Table 1: Taxonomic list of reptiles present in the Parc National du Banc d'Arguin. N: number of observations, UTM: number of 2 x 2 km UTM squares in which species was detected, % area: percentage of area occupied, Bare / CBA / NCBA: percentage of observations in bare, consolidated bare and non-consolidated bare areas, respectively.

Family	Species	N	UTM	% area	Bare	CBA	NCBA
Phyllodactylidae	*Tarentola annularis* (Geoffroy Saint-Hilaire, 1809)	96	95	5.6	35.4	45.8	18.8
	Tarentola chazaliae (Mocquard, 1895)	4	1	0.1	-	-	-
	Tarentola ephippiata O'Shaughnessy, 1875	34	33	2.0	52.9	23.5	23.5
Gekkonidae	*Stenodactylus mauritanicus* Guichenot, 1850	1	1	0.1	-	-	-
	Stenodactylus petrii Anderson, 1896	2	2	0.1	-	-	-
	Stenodactylus sthenodactylus (Lichtenstein, 1823)	9	9	0.5	-	-	-
	Tropiocolotes tripolitanus Peters, 1880	10	9	0.5	50.0	0.0	50.0
Agamidae	*Trapelus boehmei* Wagner, Melville & Schmitz, 2011	12	12	0.7	41.7	8.3	50.0
Lacertidae	*Acanthodactylus aureus* Günther, 1903	13	11	0.7	92.3	7.7	0.0
	Acanthodactylus boskianus (Daudin, 1802)	1	1	0.1	-	-	-
	A. dumerili / *senegalensis* (Daudin, 1802) / Chabanaud, 1918	97	92	5.5	56.7	35.1	8.2
	Acanthodactylus longipes Boulenger, 1921	75	70	4.2	36.0	14.7	49.3
	Mesalina pasteuri (Bons, 1960)	9	9	0.5	-	-	-
Scincidae	*Chalcides sphenopsiformis* (Duméril, 1856)	22	22	1.3	27.3	18.2	54.5
	Scincus albifasciatus Boulenger, 1890	4	4	0.2	-	-	-
Varanidae	*Varanus griseus* (Daudin, 1803)	21	21	1.2	23.8	23.8	52.4
Colubridae	*Lytorhynchus diadema* (Duméril, Bibron & Duméril, 1854)	11	11	0.7	36.4	9.1	54.5
	Psammophis schokari (Forsskål, 1775)	3	3	0.2	-	-	-
	Psammophis sibilans (Linnaeus, 1758)	4	4	0.2	-	-	-
Viperidae	*Cerastes cerastes* (Linnaeus, 1758)	10	10	0.6	30.0	60.0	10.0
	Cerastes vipera (Linnaeus, 1758)	13	13	0.8	30.8	7.7	61.5

(Table 1); detailed distributions are presented in Figs. 2-4. In relation to the published data, three new species for the PNBA were detected: 1) The gecko *Stenodactylus mauritanicus* Guichenot, 1850, recently resurrected from the synonymy of *S. sthenodactylus* by METALLINOU *et al.* (2012), located only at the Cap Blanc peninsula (Fig. 2); 2) the lacertid *Mesalina pasteuri*, located throughout the PNBA (Figs. 3 and 5b); and 3) the snake *Psammophis sibilans*, located exclusively in Tidra island (Figs. 4 and 5d). On the contrary, the lizard *Acanthodactylus boskianus*, known from a single observation at Mamghar from 1994 (MNHN 1996.2924), was not observed during recent fieldwork.

Three preliminary patterns of habitat selection were observed among the reptiles of the PNBA (Table 1): 1) species mostly related to bare areas, such as *Tarentola ephippiata*, *Tropiocolotes tripolitanus*, *Acanthodactylus aureus* and *A. dumerili* / *senegalensis*; 2) species mostly related to consolidated bare areas, particularly the rocky outcrops of Kerekchet et Teintâne and Dlô Amotai, such as *Tarentola annularis* and *Cerastes cerastes*; 3) species mostly related to non-consolidated bare areas, particularly the Azefal and Agneitir dune massifs, such as *T. tripolitanus*, *Trapelus boehmei*, *Acanthodactylus longipes*, *Chalcides sphenopsiformis*, *Varanus griseus*, *Lytorhynchus diadema* and *Cerastes vipera*. *Tarentola ephippiata* was very often found in *Acacia* trees and tree holes, sometimes in syntopy with *T. annularis*.

The distribution of observed species richness exhibits spatial asymmetries, and five areas with more than eight species can be observed: Agneitir and Azefal dunes, oued Chibkha river valley, and the Dlô Amotai and Kerekchet et Teintâne rock outcrops (Fig. 6). These areas tend to present species typical of rocky or dune habitats, species present in open bare areas, and also species exhibiting arboreal behaviour, such as the geckos *T. annularis* and *T. ephippiata*. For example, the Dlô Amotai escarpment gathers typical species of rocky habitats, such as *T. annularis*, *S. sthenodactylus* and *C. cerastes*, and also in surrounding areas, species associated to bare areas, such as *T. ephippiata*, *T. boehmei* and *A. dumerili*, and species associated to sandy areas, such as *A. longipes*, *C. sphenopsiformis* and *V. griseus*.

DISCUSSION

A total of 15 reptile species have been previously reported as being present in the Cap Blanc peninsula (GENIEZ *et al.*, 2004), from which only two (*Tarentola chazaliae* and *A. aureus*) were observed at the Cap Blanc Satellite Reserve. Such discrepancy is probably related to the small size (9.2 km^2) and location (extreme southern tip) of the continental portion of the Reserve in relation to the Cap Blanc peninsula. Several widely ranged species in Mauritania that are present in neighbouring areas of the PNBA, including *Uromastyx dispar*, *Agama boueti* and *Echis leucogaster*, were also undetected. While general lack of herbaceous vegetation and significant rock outcrops may be related to the absence of the latter two species (authors' unpublished data), respectively, *U. dispar* may be present as there are observations very close to the central-eastern border of the PNBA (authors' unpublished data). Further sampling is needed to determine the potential presence of *U. dispar* as well as the status of *A. boskianus* in the PNBA.

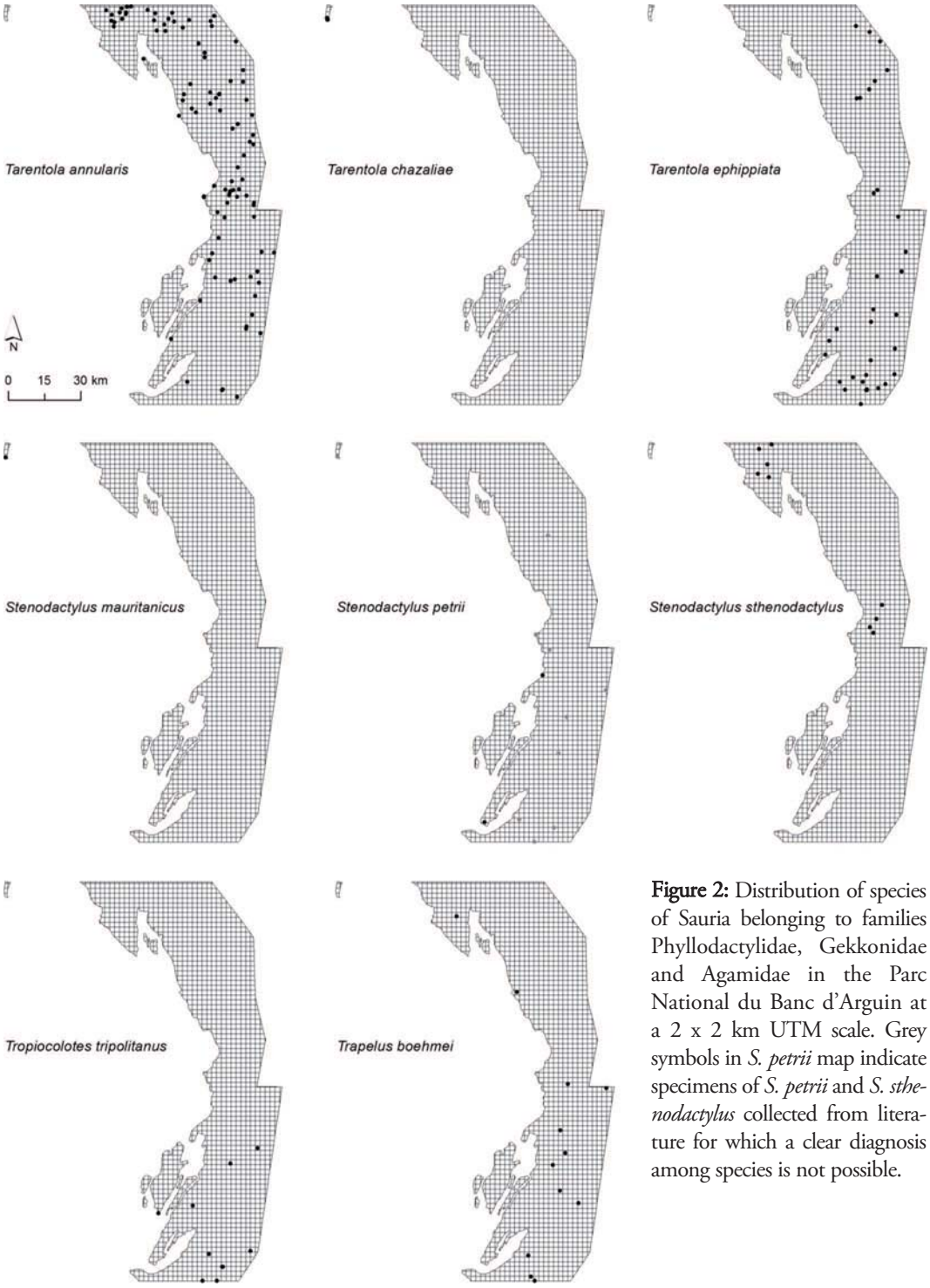

Figure 2: Distribution of species of Sauria belonging to families Phyllodactylidae, Gekkonidae and Agamidae in the Parc National du Banc d'Arguin at a 2 x 2 km UTM scale. Grey symbols in *S. petrii* map indicate specimens of *S. petrii* and *S. sthenodactylus* collected from literature for which a clear diagnosis among species is not possible.

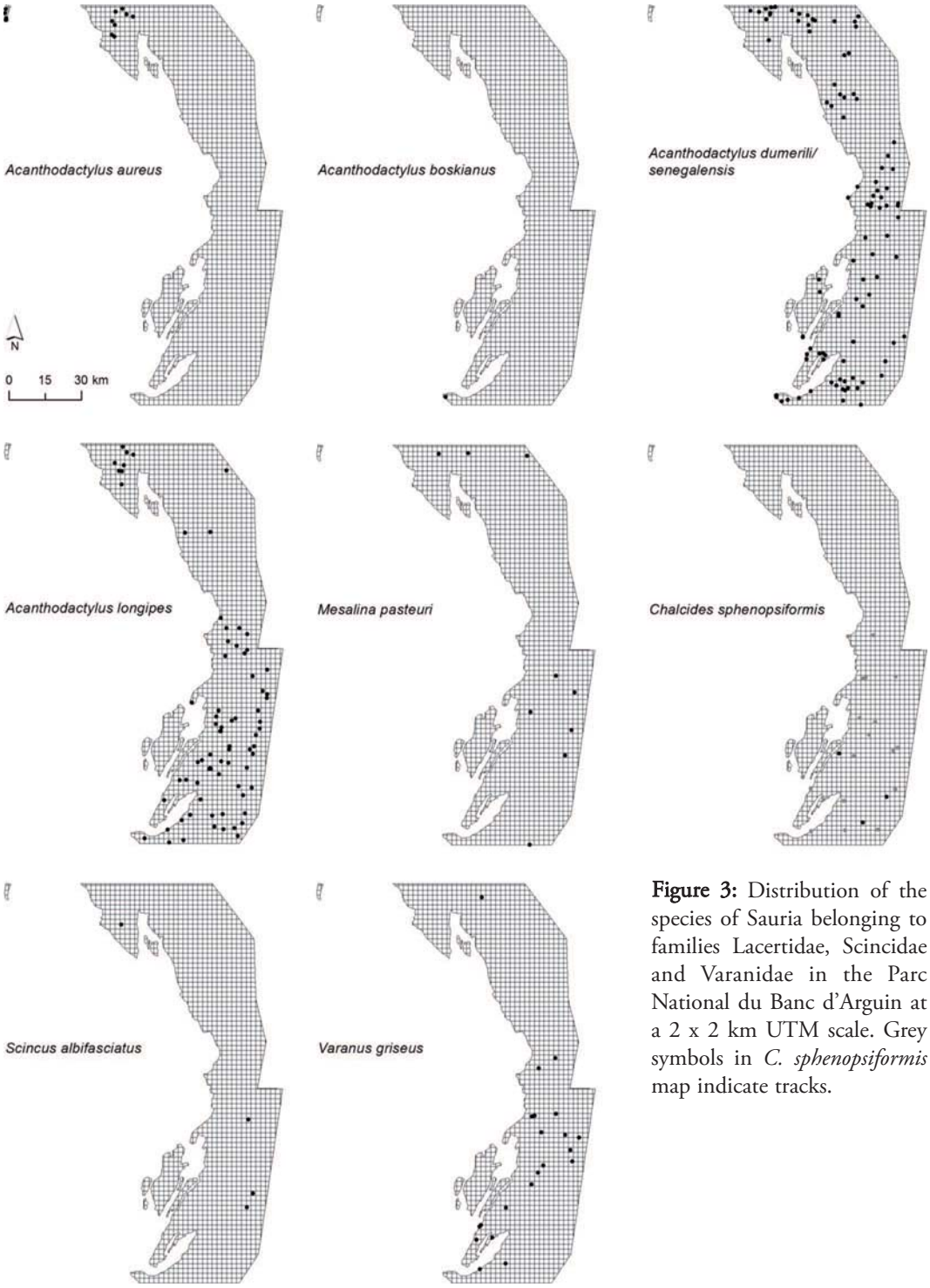

Figure 3: Distribution of the species of Sauria belonging to families Lacertidae, Scincidae and Varanidae in the Parc National du Banc d'Arguin at a 2 x 2 km UTM scale. Grey symbols in *C. sphenopsiformis* map indicate tracks.

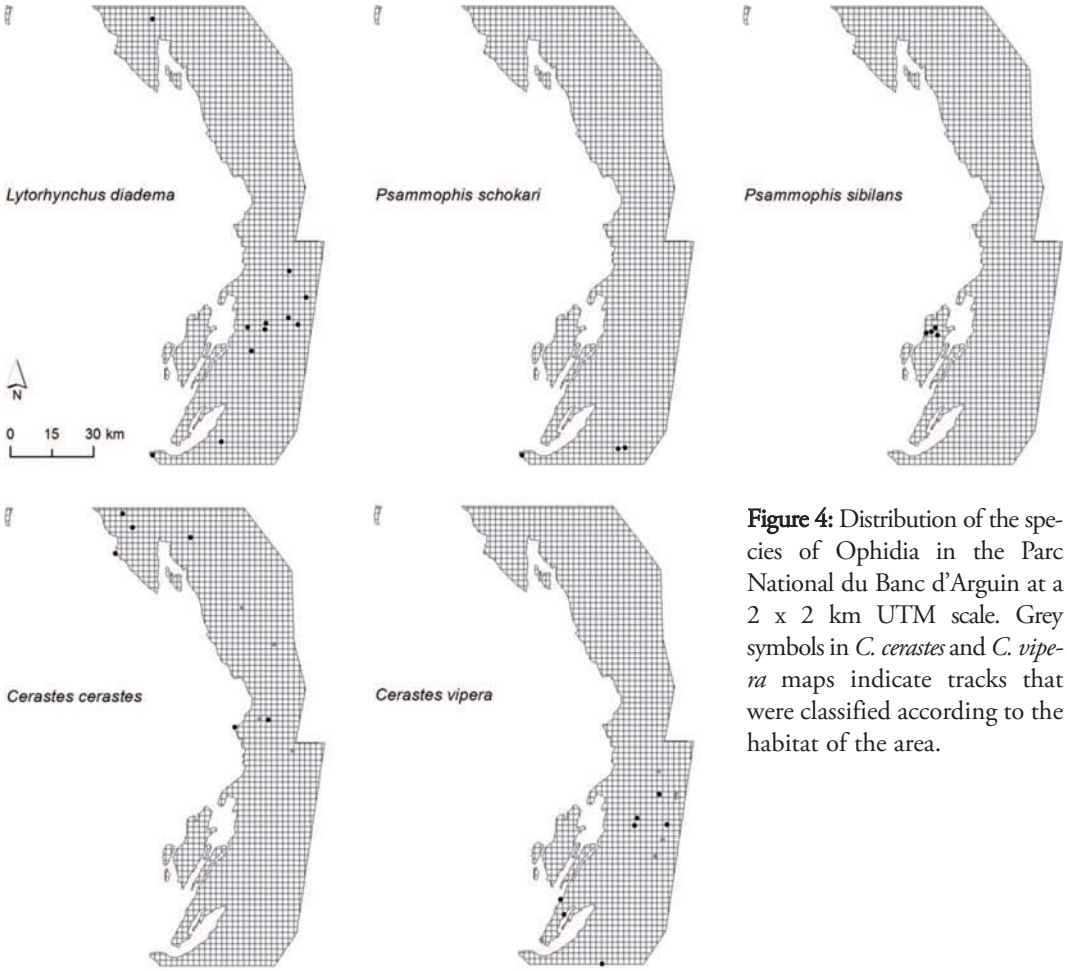

Figure 4: Distribution of the species of Ophidia in the Parc National du Banc d'Arguin at a 2 x 2 km UTM scale. Grey symbols in *C. cerastes* and *C. vipera* maps indicate tracks that were classified according to the habitat of the area.

During the fieldwork, it became evident that taxonomical classification of observations from *A. dumerili* and *A. senegalensis* was nearly impossible using common morphological traits and that specimens with intermediate morphological traits were highly frequent (observed in 95 2 x 2 km UTM grid cells; 5.5% of study area) along most of the PNBA (Fig. 3). As such, both species were lumped for the purposes of the present study (*A. dumerili* / *A. senegalensis*). Molecular studies on the likely hybrid zone present at the PNBA are needed to understand how genetic diversity is spatially structured, if there is interspecific gene flow, where contact zones are located, and finally to revise the systematics of these lizards' group. Preliminary analyses of habitat selection in coastal Mauritania suggested that *A. dumerili* is found mostly in coastal whitish dunes of marine origin while *A. senegalensis* is mostly found in continental reddish dunes (INEICH, 1997; CROCHET *et al.*, 2003). Thus, ecological studies are also needed and, in combination with genetic data, should provide knowledge on habitat selection patterns by the distinct genetic demes present in the area.

Figure 5: Some reptile specimens from the Parc National du Banc d'Arguin. (a) *Trapelus boehmei*, NW of Baie d'Arguin, 25 November 2008. (b) *Mesalina pasteuri*, 3 km north of Elb en Nouçç, Azefal, 24 November 2010. (c) *Scincus albifasciatus*, Mednet ed Dâya, 23 November 2010. (d) *Psammophis sibilans*, Tidra Island, 04 November 2011.

The subspecies *Tarentola ephippiata hoggarensis* Werner, 1937 is present in the study area. Trape *et al.* (2012) suggested that Sahara populations belong to the full species *T. hoggarensis*, but detailed morphological and genetic variation analyses of the group *T. ephippiata* s. l. are still missing. Despite all individuals observed in the PNBA exhibited four clear white marks along the dorsum, it was kept the subspecific designation until phylogenetic relationships are resolved. Finally, regarding *Chalcides*, the most recent systematic arrangement proposed for the group (Carranza *et al.*, 2008) was followed.

A recent study on the systematics of genus Stenodactylus recognised coastal Atlantic and Mediterranean populations of *S. sthenodactylus* as belonging in fact to *S. mauritanicus*, the later taxon being raised at species level (Metallinou *et al.*, 2012). A specimen from the Cap Blanc peninsula was included in the analysis and grouped with *S. mauritanicus*. As such, literature references to the presence of *S. sthenodactylus* and *S. petrii* are now mostly uncertain and were depicted as grey dots in *S. petrii* observations (Fig. 2). In the present study, distribution maps (Figs. 2-4) depict observations corresponding to sequenced specimens or specimens for which detailed photographs were available, allowing clear identifications.

Six groups of species were identified according to distribution patterns: 1) species only

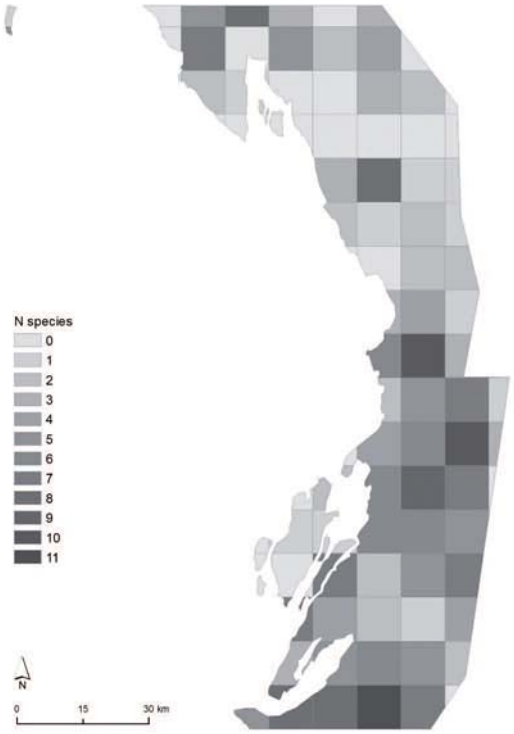

Figure 6: Reptile species richness in the Parc National du Banc d'Arguin at a 10 x 10 km UTM scale.

found in the Cap Blanc peninsula and surrounding areas: *T. chazaliae*, *S. mauritanicus* and *A. aureus*. The latter was known exclusively from the Cap Blanc peninsula (CROCHET *et al.*, 2003), while fieldwork confirmed its presence also north of the Cap d'Arguin, in the Kerekchet et Teintâne massif; 2) species only found in the northern part of the PNBA: *S. sthenodactylus* and *C. cerastes*; 3) species only found in the southern part of the PNBA: *S. petrii*, *T. tripolitanus*, *C. sphenopsiformis*, *Psammophis schokari* and *C. vipera*. These species are typical of the Sahara and have their distributions located largely north of the PNBA (TRAPE & MANÉ, 2006; TRAPE *et al.*, 2012). Such striking pattern of absence in northern PNBA areas might be related to the general bareness character of the oued Chibkha floodplain and to lower sampling effort of northern PNBA. For example, although *C. vipera* was not observed within the PNBA limits in the Cap Blanc peninsula, the species was found very close the northern limit of the Park (INEICH, 1997), which makes its presence within the Park limits highly likely; 4) species with broad range in the PNBA, such as *T. annularis*, *T. ephippiata*, *T. boehmei* (Fig. 5a), *A. dumerili* / *senegalensis*, *A. longipes*, *M. pasteuri* and *V. griseus*; 5) species with localised distribution, such as *A. boskianus*, *Scincus albifasciatus* (Fig. 5c) and *L. diadema*; and 6) species restricted to the Tidra island, such as *P. sibilans*.

Four reptiles were observed at Tidra Island, *T. tripolitanus*, *A. dumerili* / *senegalensis*, *C. sphenopsiformis* and *P. sibilans*. The closest known populations of *P. sibilans* are located in the Chott Boul and Dar es Salam areas (INEICH, 1997; TRAPE & MANÉ, 2006), in the area of the mouth of Senegal River, at about 600 km to the south. Thus, molecular analyses are needed to determine the level of genetic differentiation of Tidra populations. Further field sampling is needed to determine which species are present in other small islands of the PNBA (Fig. 1).

The PNBA has been suggested as a potential area of sympatry between the vipers *C. cerastes* and *C. vipera*, where distinct micro-habitat selection probably limits contact at the local scale (BRITO *et al.*, 2011). This study did not registered syntopic specimens as *C. cerastes* is apparently restricted to the rocky outcrops of the northern PNBA, while *C. vipera* was only found on the sand dunes of the southern PNBA (Fig. 4). Further fieldwork sampling is needed to confirm if sympatry could occur in the transition zone between the Dlô Amotai rock and the Azefal dunes.

Acknowledgement

Field work developed by AS Sow was sponsored by the Mohamed bin Zayed Species Conservation Fund (project 11052709). Field work of JCB was partially supported by two grants from National Geographic Society (7629-04 and 8412-08), by Fundação para a Ciência e Tecnologia (FCT: PTDC/BIA-BEC/099934/2008), and by EU Programme COMPETE. FMF and JCB are supported by FCT (SFRH/BPD/69857/2010 and Programme Ciência 2007, respectively). Logistic support for fieldwork was given by L.O. Yarba and A. Araújo (PN Banc d'Arguin), S.M. Ould Lehlou (Direction des Aires Protégées et du Littoral), Pedro Santos Lda (Trimble GPS), and Off Road Power Shop. Z. Boratyński, J.C. Campos, D. Gonçalves, H. Rebelo, P. Sierra, N. Sillero, and P. Tarroso helped in the fieldwork. The FIBA, Fondation Internationale du Banc d'Arguin, provided financial support during the writing of the manuscript.

References

Angel, F. (1938). Liste des reptiles de Mauritanie recueillis par la mission d'études de la Biologie des Acridiens en 1936 et 1937. Description d'une sous-espèce nouvelle d'Eryx muelleri. *Bulletin du Muséum National d'Histoire Naturelle 2eme Série* 10: 485-487.

Araújo, M.B. (2002). Biodiversity hotspots and zones of ecological transition. *Conservation Biology* 16: 1662-1663.

Bicheron, P.; Defourny, P.; Brockmann, C.; Schouten, L.; Vancutsem, C.; Huc, M.; Bontemps, S.; Leroy, M.; Achard, F.; Herold, M.; Ranera, F. & Arino, O. (2008). GLOBCOVER. Products Description and Validation Report. Medias-France, Postel, Toulouse, France. Available at: http://due.esrin.esa.int/globcover/. Retrieved on: 09/21/2009.

Brito, J.C. (2003). Observations of amphibians and reptiles from North and West Africa - Morocco, Mauritania and Senegal. *Boletín de la Asociación Herpetológica Española* 14: 2-6.

Brito, J.C.; Fahd, S.; Geniez, P.; Martínez-Freiría, F.; Pleguezuelos, J.M. & Trape, J.-F. (2011). Biogeography and conservation of viperids from North-West Africa: an application of ecological niche-based models and GIS. *Journal of Arid Environments* 75: 1029-1037.

Brooks, T.M.; Mittermeier, R.A.; Mittermeier, C.G.; da Fonseca, G.A.B.; Rylands, A.B.; Konstant, W.R.; Flick, P.; Pilgrim, J.; Oldfield, S.; Magin, G. & Hilton-Taylor, C. (2002). Habitat loss and extinction in the hotspots of biodiversity. *Conservation Biology* 16: 909-923.

Butchart, S.H.M.; Walpole, M.; Collen, B.; van Strien, A.; Scharlemann, J.P.W.; Almond, R.E.A.; Baillie, J.E.M.; Bomhard, B.; Brown, C.; Bruno, J.; Carpenter, K.E.; Carr, G.M.; Chanson, J.; Chenery, A.M.; Csirke, J.; Davidson, N.C.; Dentener, F.; Foster, M.; Galli, A.; Galloway, J.N.; Genovesi, P.; Gregory, R.D.; Hockings, M.; Kapos, V.; Lamarque, J.-F.; Leverington, F.; Loh, J.; McGeoch, M.A.; McRae, L.; Minasyan, A.; Hernández Morcillo, M.; Oldfield, T.E.E.; Pauly, D.; Quader, S.; Revenga, C.; Sauer, J.R.; Skolnik, B.; Spear, D.; Stanwell-Smith, D.; Stuart, S.N.;

SYMES, A.; TIERNEY, M.; TYRRELL, T.D.; VIÉ, J.-C. & WATSON, R. (2010). Global biodiversity: indicators of recent declines. *Science* 328: 1164-1168.

CARRANZA, S.; ARNOLD, E.N.; GENIEZ, P.; ROCA, J. & MATEO, J.A. (2008): Radiation, multiple dispersal and parallelism in the skinks, *Chalcides* and *Sphenops* (Squamata: Scincidae), with comments on *Scincus* and *Scincopus* and the age of the Sahara Desert. *Molecular Phylogenetics and Evolution* 46: 1071-1094.

CARVALHO, S.B.; BRITO, J.C.; CRESPO, E.J. & POSSINGHAM, H.P. (2011). Incorporating evolutionary processes into conservation planning using species distribution data: a case study with the western Mediterranean herpetofauna. *Diversity and Distributions* 17: 408-421.

CROCHET, P.-A.; GENIEZ, P. & INEICH, I. (2003). A multivariate analysis of the fringe-toed lizards of the *Acanthodactylus scutellatus* group (Squamata: Lacertidae): systematics and biogeographical implications. *Zoological Journal of the Linnean Society* 137: 117-155.

DEKEYSER, P.L. & VILLIERS, A. (1956). Contribution à l'étude du peuplement de la Mauritanie. Notations écologiques et biogéographiques sur la faune de l'Adrar. *Mémoires de l'Institut Français d'Afrique Noire* 44: 9-222.

GARCIA, R.A.; BURGESS, N.D.; CABEZA, M.; RAHBEK, C. & ARAÚJO, M.B. (2012). Exploring consensus in 21st century projections of climatically suitable areas for African vertebrates. *Global Change Biology* 18: 1253-1269.

GASSE, F. (2000). Hydrological changes in the African tropics since the Last Glacial Maximum. *Quaternary Science Reviews* 19: 189-211.

GENIEZ, P.; MATEO, J.A.; GENIEZ, M. & PETHER, J. (2004). *The Amphibians and Reptiles of Western Sahara: An Atlas and Field Guide*. Series: Frankfurt Contributions to Natural History, vol. 19. Edition Chimaira, Frankfurt am Main, Germany.

HIJMANS, R.J.; CAMERON, S.E.; PARRA, J.L.; JONES, P.G. & JARVIS, A. (2005). Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology* 25: 1965-1978.

HOBOHM, C. (2003). Characterization and ranking of biodiversity hotspots: centres of species richness and endemism. *Biodiversity and Conservation* 12: 279-287.

HOLE, D.G.; HUNTLEY, B.; ARINAITWE, J.; BUTCHART, S.H.M.; COLLINGHAM, Y.C.; FISHPOOL, L.D.C.; PAIN, D.J. & WILLIS, S.G. (2011). Toward a management framework for networks of protected areas in the face of climate change. *Conservation Biology* 25: 305-315.

INEICH, I. (1997). Les amphibiens et reptiles du littoral mauritanien, *In* P. Colas (ed.) *Environnement et Littoral Mauritanien. Actes du Colloque, 12-13 Juin 1995, Nouakchott, Mauritanie*. CIRAD, Montpellier, France, pp. 93-99.

KATI, V.; DEVILLERS, P.; DUFRÊNE, M.; LEGAKIS, A.; VOKOU, D. & LEBRUN, P. (2004). Hotspots, complementarity or representativeness? designing optimal small-scale reserves for biodiversity conservation. *Biological Conservation* 120: 471-480.

LE BERRE, M. (1989). *Faune du Sahara. 1. Poissons, Amphibiens, Reptiles*. Lechevalier - R. Chabaud, Paris.

MAHÉ, E. (1985). *Contribution à l'Étude*

Scientifique de la Région du Banc d'Arguin (Littoral Mauritanien 21"20'/19"20' ln). Peuplements Avifaunistiques. Ph.D. dissertation. Université des Sciences et Techniques du Languedoc, Montpellier, France.

Metallinou, M.; Arnold, E.N.; Crochet, P.-A.; Geniez, P.; Brito, J.C.; Lymberakis, P.; Baha El Din, S.; Sindaco, R.; Robinson, M. & Carranza, S. (2012). Conquering the Sahara and Arabian deserts: systematics and biogeography of *Stenodactylus* geckos (Reptilia: Gekkonidae). *BMC Evolutionary Biology* 12: 258.

Mocquard, M.F. (1895). Note sur quelques reptiles du cap Blanc. *Bulletin du Muséum National d'Histoire Naturelle* 1: 310-312.

Monod, T. (1988). *Notes sur la Flore et la Végétation du Parc National du Banc d'Arguin*. Series: Etudes Sahariennes et Ouest-Africaines, vols. 1-3. Association des Naturalistes Sahariens et Ouest-Africains, Nouakchott, Mauritania.

Myers, N.; Mittermeier, R.A.; Mittermeier, C.G.; da Fonseca, G.A.B. & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature* 403: 853-858.

Padial, J.M. (2006). Commented distributional list of the reptiles of Mauritania (West Africa). *Graellsia* 62: 159-178.

Padial, J.M.; Castroviejo-Fischer, S.; Quintana, A.Z.; Ávilla, E.; Pérez-Marín, J. & Castroviejo, J. (2002). Notas de distribución de reptiles para el NE de África. *Boletín de la Asociación Herpetológica Española* 13: 2-5.

Pellegrin, J. (1910). Mission en Mauritanie occidentale III: partie zoologique. Reptiles. *Actes de la Société Linnéenne de Bordeaux* 64: 21-25.

Pleguezuelos, J.M.; Fariña,B.; Mateo,J.A. & Geniez, P. (2004). Nuevos datos sobre los anfibios y reptiles de Mauritania y el Sáhara Occidental. *Boletín de la Asociación Herpetológica Española* 15: 76-80.

Salvador, A. (1982). A revision of the lizards of the genus *Acanthodactylus* (Sauria: Lacertidae). *Bonner Zoologische Monographien* 16: 1-167.

Spector, S. (2002). Biogeographic crossroads as priority areas for biodiversity conservation. *Conservation Biology* 16: 1480-1487.

Trape, J.F. & Mané, Y. (2006). *Guide des Serpents d'Afrique Occidentale: Savane et Désert*. IRD Éditions, Montpellier, France.

Trape, J.-F.; Trape, S. & Chirio, L. (2012). *Lézards, Crocodiles et Tortues d'Afrique Occidentale et du Sahara*. IRD Éditions, Montpellier, France.

Valverde, J.A. (1957). *Aves del Sáhara Español*. Estudio Ecológico del Desierto. Instituto de Estudios Africanos CSIC, Madrid.

Villiers, A. (1954). La collection de serpents de l'I.F.A.N. (acquisitions 1953). *Bulletin de l'Institut Fondamental d'Afrique Noire* 16: 1234-1247.