

Mammals and birds from Oued Draa and Oued Chebeika, Morocco. A field survey report

Xabier SALGADO-IRAZABAL⁽¹⁾, Pedro ALONSO-ALONSO⁽¹⁾, Ilaria MELCORE⁽²⁾ & Zbyszek BORATYŃSKI⁽¹⁾

⁽¹⁾ CIBIO-InBIO Associate Laboratory, Research Centre in Biodiversity and Genetic Resources, University of Porto, Vairão – 4485-661 Vairão (Portugal)
xsalgadobio@gmail.com, pedro.alonso.bio@gmail.com, boratyns@gmail.com

⁽²⁾ Department of Life Sciences and Systems Biology, University of Turin, Via Accademia Albertina 13 – 10123 Torino (Italy)
ilaria.melcore@gmail.com

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Introduction

The Lower Draa and the Lower Chebeika valleys are two biologically important areas located south of the Anti-Atlas mountains, along environmental gradients between distinct biogeographical regions. On one hand, there is a climatic shift along a north-south axis, from the humid Mediterranean ecoregion of northwestern Africa to the arid Saharan ecoregion in the south (Dinerstein *et al.* 2017), and on the other hand, there is a gradient along a west-east axis between humid coastal and dry inland areas (Mokhtari *et al.* 2013). This generates a diversity of habitats, from dry acacia woodlands and seasonal grasslands to bare rocky plateaus (hamada) and sandy areas. Therefore, the north-western part of the Sahara desert has been proposed as a vertebrate diversity hotspot with an emphasis on a critical need for conservation (Brito *et al.* 2016, Vale *et al.* 2016). Moreover, previous local surveys corroborate a rich concentration of avian and mammalian species (Moores & Brown 2014, Guerreiro *et al.* 2016, Bergier *et al.* 2017). The aim of this work was to collect new data on the diversity of mammals and birds in this area, and to test whether this region is a good candidate for further investigations on arid-adapted fauna.

Methods

A field expedition to assess vertebrate diversity was conducted along the lower Draa and Chebeika valleys between the 31st of December 2019 and the 13th of January 2020. The surveys were undertaken by observations (birds and mammals), camera traps (two Apeman Trail H70s) and live trapping (small mammals) using heavy-duty large kangaroo rat Sherman traps and hand nets. Sherman traps and camera traps were placed in each sampling location at dusk and were collected the next morning. Live traps were baited with a mixture of canned sardines and peanut butter, and camera traps with canned sardines and dry cat food. Body dimensions and weights were recorded for small mammals. All trapped individuals were photographed and tissues (small ear biopsies) were sampled for barcoding. All observations were georeferenced with a GPS (Aventura 2, TwoNav). The species identification was made with field-guides available for the region, both for birds and mammals (Svenson *et al.* 2009, Aulagnier *et al.* 2009, Kingdon 2015), and was supported by available reference datasets for rodents.

Results

46 observations of mammals (Figure 1) were recorded for 10 species: 14 *Jaculus hirtipes* (previously recorded as *J. jaculus* in the area, see e.g. Guerreiro *et al.* 2016 ; for current taxonomy see Shenbrot *et al.* 2016;

Moutinho et al. 2020), 3 *Gerbillus tarabuli*, 2 *G. gerbillus*, 1 *G. amoenus*, 1 *G. henleyi*, 2 *Atlantoxerus getulus*, 6 *Lepus cf. capensis*, 1 *Vulpes vulpes*, 1 *Felis libyca* and 2 *Elephantulus rozeti* (Table 1; Figure 2).

334 observations of birds (Figure 1) were recorded for 36 species: 40 *Tadorna ferruginea*, 3 *Alectoris barbara*, X *Columba livia*, X *Streptopelia decaocto*, 5 *Pterocles orientalis*, 3 *Clamator glandarius*, 4 *Burhinus oedicnemus*, 1 *Ciconia ciconia*, 4 *Buteo rufinus*, 1 *Bubo ascalaphus*, 1 *Falco biarmicus*, 4 *Lanius excubitor*, 5 *Corvus ruficollis*, 4 *Alaemon alaudipes*, 12 *Ammomanes cinctura*, 11 *A. deserti*, 28 *Galerida macrorhyncha*, 4 *G. theklae*, 7 *Hirundo rustica*, 6 *Ptyonoprogne sp.*, 4 *Pycnonotus barbatus*, 3 *Phylloscopus collybita*, 1 *Scotocerca inquieta*, 4 *Sylvia conspicillata*, 6 *S. deserticola*, 1 *S. melanocephala*, 24 *Turdoides fulva*, 2 *Phoenicurus moussieri*, 21 *Oenanthe deserti*, 75 *O. leucopyga*, 6 *O. leucura*, 2 *O. moesta*, 30 *Passer hispaniolensis*, 6 *Motacilla alba* and 8 *Emberiza sahari* (where 'X' refers to > 10 individuals for species where individuals were numerous and impossible to count, e.g. common in urban areas; Table 2; Figure 3).

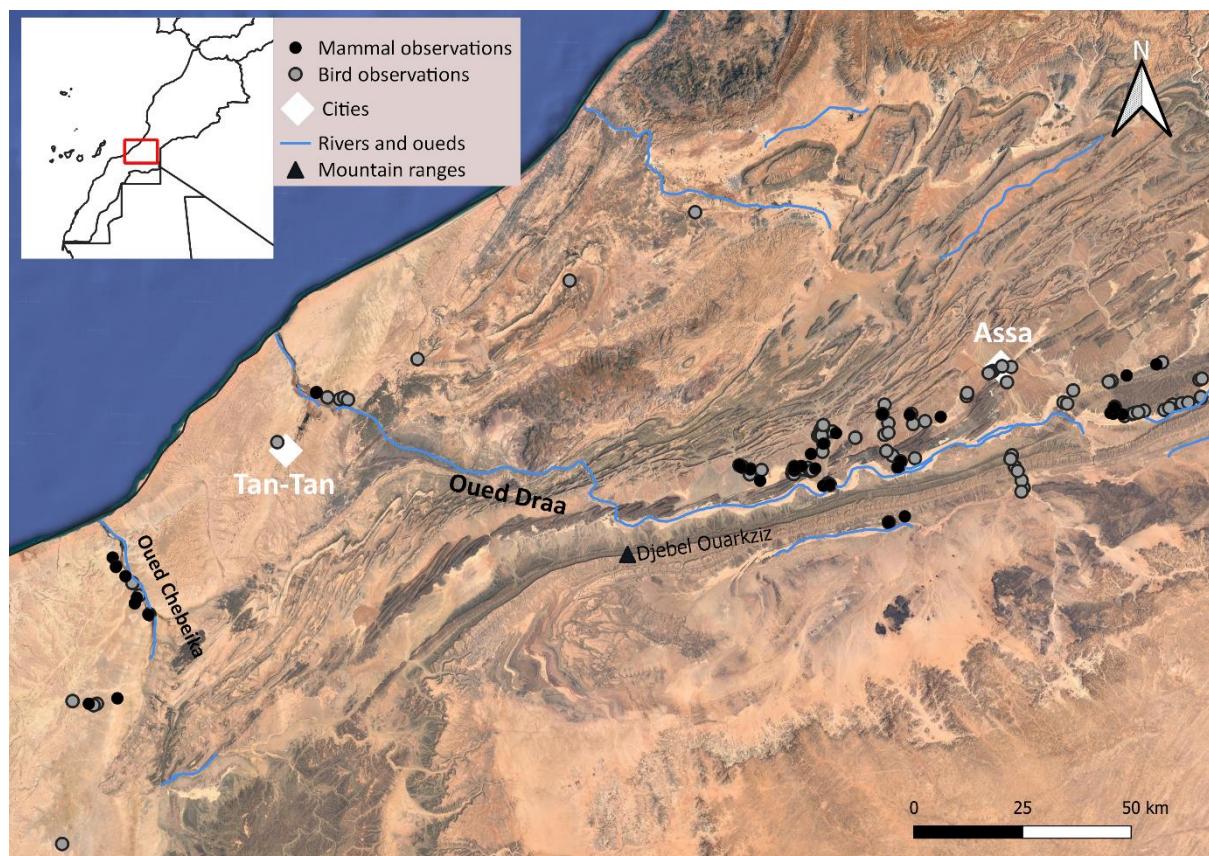


Figure 1. Study area with mammals (black dots) and birds (gray dots) observed during the field expedition. White diamonds represent the main cities (Main map source: Google Maps, TerraMetrics 2020)

Discussion

We have shown that through an expedition of moderate duration, a relatively high diversity of mammals (10) and birds (37) were recorded in the lower Draa and Chebeika valleys. Despite a larger sampling effort (the expedition lasted 12 days and covered a larger study area), we captured fewer rodents (23) than Guerreiro et al. (2016; they captured 47 individuals in 7 days). This smaller number can be explained by two main factors. On one hand, the 10th of January there was a full moon and the activity of rodents could have diminished because of their propensity to avoid moonlight, as previously recorded for arid adapted rodents (Daly et al. 1992), and for the species in this area (Barros et al. 2018). On the other hand, a low primary productivity caused by drought prior to the field survey could have had a negative effect on the reproduction and the

activity of many mammals (Barros *et al.* 2018, Pavey *et al.* 2008). Nevertheless, it is worth emphasizing that from the 14 captured *J. hirtipes* (5 females and 9 males), 2 females were lactating and one was pregnant, which corroborates the importance of winter breeding in this species (Moutinho *et al.* 2015). Despite the low number of recorded mammal individuals (33), a moderate number of rodent (6) and mammalian (10) species was recorded during the trip compared with previous expeditions (Guerreiro *et al.* 2017: 8 and 10 species, respectively).

The majority of the bird species recorded during this expedition are common in the region and most of them (24) are year-round residents. Six are winter visitors or migrants, while the other 5 can be either residents or seasonal migrants (Table 1; Bergier *et al.* 2016).

According to Bergier *et al.* (2017), the presence of *G. macrorhyncha* was not confirmed in this region ('Il n'y a aucune donnée confirmée au Sahara Atlantique mais des observations possibles entre Aït Bekkou et Fask suggèrent sa présence dans le nord du Bas Draa aux confins de l'Anti-Atlas Occidental, en limite sud-ouest de son aire de répartition'). The lack of morphological and/or genetic research on the *Galerida* species in the Atlantic Sahara makes it difficult to confirm its presence and this issue has recently been a matter of discussion among ornithologists and birdwatchers that work along the Atlantic Sahara (Qninba *et al.* 2019, Hane *et al.* 2020). Our photos of a few individuals we observed during the expedition (Figure 4-7), seem to confirm the presence of this species in the Draa valley near Assa. Obviously, further research will be needed to clarify the taxonomy and distribution of the *Galerida* group in Northwest Africa.

According to our results, the area of the lower Draa and Chebeika valleys is a biologically interesting region that combines both northern elements such as *P. hispanoliensis*, *P. moussieri* or *V. vulpes* and southern arid specialists such as *A. alaudipes*, *O. leucopyga* or *J. hirtipes* (Kingdon 2015, Svensson *et al.* 2009). This mosaic of biota gives the opportunity to study ecological and evolutionary mechanisms that is driving adaptation to arid environments.

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Table 1. Species and location of mammals observed during the expedition

Species	Date	Lat	Long	Method
<i>Atlantoxerus getulus</i>	07.01.2020	28.512	-9.647	Observation
	07.01.2020	28.514	-9.710	Observation
<i>Gerbillus amoenus</i>	01.01.2020	28.369	-9.834	Live trap
<i>Gerbillus gerbillus</i>	12.01.2020	27.931	-11.495	Live trap
	13.01.2020	27.931	-11.495	Live trap
<i>Gerbillus henleyi</i>	02.01.2020	28.409	-10.044	Hand net
<i>Gerbillus tarabuli</i>	31.12.2019	28.406	-9.916	Hand net
	11.01.2020	28.559	-11.030	Live trap
	11.01.2020	28.559	-11.031	Live trap
<i>Jaculus hirtipes</i>	31.12.2019	28.406	-9.914	Hand net
	31.12.2019	28.367	-9.848	Hand net
	31.12.2019	28.408	-9.900	Hand net
	31.12.2019	28.398	-9.916	Hand net
	01.01.2020	28.416	-9.668	Hand net
	01.01.2020	28.406	-9.673	Hand net
	01.01.2020	28.417	-9.668	Hand net
	02.01.2020	28.409	-10.044	Hand net
	02.01.2020	28.377	-9.996	Hand net
	03.01.2020	28.515	-9.172	Hand net
	06.01.2020	28.593	-9.141	Hand net
	08.01.2020	28.405	-9.674	Hand net
	08.01.2020	28.304	-9.658	Hand net
	13.01.2020	28.137	-11.449	Hand net
<i>Lepus cf. capensis</i>	31.12.2019	28.402	-9.867	Observation
	01.01.2020	28.475	-9.819	Observation
	02.01.2020	28.401	-10.019	Observation
	03.01.2020	28.405	-10.041	Observation
	03.01.2020	28.409	-10.044	Camera trap
	10.01.2020	28.453	-9.848	Camera trap
	11.01.2020	28.557	-11.031	Camera trap
<i>Felis libyca</i>	04.01.2020	28.527	-9.169	Camera trap
<i>Vulpes vulpes</i>	13.01.2020	28.126	-11.454	Observation
<i>Elephantulus rozeti</i>	01.01.2020	28.432	-9.877	Hand net
	12.01.2020	27.919	-11.561	Live trap

Table 2. Species and location of birds observed during the expedition (species are permanent residents or: * seasonal migrants, ** either migratory or residential or ? not confirmed presence in the area ; Bergier *et al.* 2016).

Species	Nº	Date	Lat	Long	Species	Nº	Date	Lat	Long
<i>Alaemon alaudipes</i>	2	31/12/2019	28.398	-9.918	<i>Oenanthe leucopyga</i>	1	02/01/2020	28.417	-9.668
	1	01/01/2020	28.401	-9.893		1	02/01/2020	28.429	-9.687
	1	03/01/2020	28.399	-9.920		1	02/01/2020	28.472	-9.706
<i>Alectoris barbara</i>	3	11/01/2020	28.548	-11.005		1	02/01/2020	28.551	-9.514
<i>Ammomanes cinctura</i>	2	03/01/2020	28.409	-10.044		1	02/01/2020	28.598	-9.463
	4	05/01/2020	28.529	-9.169		1	03/01/2020	28.399	-9.992
	2	05/01/2020	28.521	-9.100		1	03/01/2020	28.409	-10.044
	4	06/01/2020	28.581	-9.176		1	03/01/2020	28.409	-10.044
<i>Ammomanes deserti</i>	3	03/01/2020	28.391	-10.020		1	03/01/2020	28.406	-9.916
	3	07/01/2020	28.494	-9.639		7	04/01/2020	28.437	-9.850
	4	09/01/2020	28.292	-9.696		1	04/01/2020	28.485	-9.849
	1	09/01/2020	28.463	-9.851		1	04/01/2020	28.491	-9.849
<i>Bubo ascalaphus</i>	1	07/01/2020	28.533	-9.706		1	04/01/2020	28.602	-9.453
<i>Burhinus oedicnemus**</i>	3	31/12/2019	28.404	-9.884		2	04/01/2020	28.535	-9.280
	1	08/01/2020	28.423	-9.635		1	05/01/2020	28.529	-9.169
<i>Buteo rufinus</i>	1	08/01/2020	28.430	-9.688		1	05/01/2020	28.510	-9.146
	1	10/01/2020	28.787	-10.440		1	05/01/2020	28.514	-9.128
	1	10/01/2020	28.626	-10.795		1	05/01/2020	28.518	-9.114
	1	11/01/2020	28.456	-11.122		1	05/01/2020	28.521	-9.100
<i>Ciconia ciconia*</i>	1	05/01/2020	28.549	-8.967		2	05/01/2020	28.522	-9.053
<i>Clamator glandarius*</i>	2	04/01/2020	28.491	-9.849		2	05/01/2020	28.527	-9.041
	1	09/01/2020	28.472	-9.855		1	05/01/2020	28.533	-9.034
<i>Columba livia</i>	X	02/01/2020	28.612	-9.431		3	05/01/2020	28.536	-9.012
	7	05/01/2020	28.529	-9.169		1	05/01/2020	28.538	-8.997
<i>Corvus ruficollis</i>	2	05/01/2020	28.547	-8.968		2	05/01/2020	28.547	-8.968
	2	08/01/2020	28.405	-9.674		1	05/01/2020	28.549	-8.967
	1	08/01/2020	28.363	-9.381		1	05/01/2020	28.584	-8.971
						1	05/01/2020	28.586	-8.965
<i>Emberiza sahari</i>	2	31/12/2019	28.392	-9.918		2	06/01/2020	28.620	-9.058
	2	01/01/2020	28.471	-9.860		1	06/01/2020	28.580	-9.183
	2	02/01/2020	28.612	-9.431		1	06/01/2020	28.610	-9.410
	1	04/01/2020	28.491	-9.849		1	06/01/2020	28.476	-9.697
	1	06/01/2020	28.491	-9.849		1	07/01/2020	28.514	-9.643
<i>Falco biarmicus</i>	1	10/01/2020	28.454	-9.848		1	07/01/2020	28.494	-9.639
<i>Galerida macrorhyncha ?</i>	15	05/01/2020	28.527	-9.041		1	07/01/2020	28.514	-9.710
	5	05/01/2020	28.547	-8.968		1	08/01/2020	28.417	-9.669
	8	05/01/2020	28.549	-8.967		1	08/01/2020	28.579	-9.420
<i>Galerida theklae</i>	1	02/01/2020	28.438	-9.701		1	08/01/2020	28.429	-9.409
	3	07/01/2020	28.496	-9.697		1	08/01/2020	28.406	-9.401
<i>Hirundo rustica*</i>	6	02/01/2020	28.612	-9.431		1	08/01/2020	28.378	-9.386
	1	11/01/2020	27.630	-11.623		1	09/01/2020	28.292	-9.696
<i>Lanius excubitor</i>	1	31/12/2019	28.370	-9.834		1	09/01/2020	28.355	-9.386
	1	06/01/2020	28.499	-9.611		1	09/01/2020	28.397	-9.395

	1	06/01/2020	28.466	-9.773		1	09/01/2020	28.422	-9.412
	1	08/01/2020	28.429	-9.409		1	09/01/2020	28.600	-9.458
<i>Motacilla alba*</i>	1	01/01/2020	28.484	-9.848		1	09/01/2020	28.557	-9.513
	1	02/01/2020	28.612	-9.431		1	09/01/2020	28.491	-9.849
	1	06/01/2020	28.491	-9.849		1	09/01/2020	28.472	-9.855
	2	09/01/2020	28.485	-9.849		1	09/01/2020	28.470	-9.852
	1	12/01/2020	28.103	-11.420	<i>Oenanthe leucura</i>	2	01/01/2020	28.369	-9.833
<i>Oenanthe deserti</i>	1	31/12/2019	28.392	-9.918		1	04/01/2020	28.372	-9.838
	1	31/12/2019	28.370	-9.834		1	11/01/2020	28.548	-10.966
	2	01/01/2020	28.369	-9.833		1	11/01/2020	28.544	-10.957
	1	01/01/2020	28.394	-9.920		1	12/01/2020	27.925	-11.599
	1	02/01/2020	28.417	-9.668	<i>Oenanthe moesta</i>	2	12/01/2020	28.168	-11.460
	1	02/01/2020	28.406	-9.673	<i>Passer hispaniolensis**</i>	30	05/01/2020	28.527	-9.041
	1	03/01/2020	28.400	-10.018	<i>Phoenicurus moussieri</i>	1	02/01/2020	28.438	-9.701
	1	03/01/2020	28.406	-10.037		1	09/01/2020	28.485	-9.849
	1	03/01/2020	28.391	-10.020	<i>Phylloscopus collybita*</i>	3	09/01/2020	28.485	-9.849
	1	04/01/2020	28.538	-9.288	<i>Pterocles orientalis</i>	5	04/01/2020	28.372	-9.838
	1	05/01/2020	28.529	-9.169	<i>Ptyonoprogne sp.**</i>	3	02/01/2020	28.438	-9.701
	1	05/01/2020	28.549	-8.967		3	02/01/2020	28.598	-9.463
	1	06/01/2020	28.562	-9.266	<i>Pycnonotus barbatus</i>	3	09/01/2020	28.491	-9.849
	1	06/01/2020	28.478	-9.827		1	09/01/2020	28.470	-9.852
	1	10/01/2020	28.466	-9.774	<i>Scotocerca inquieta</i>	1	12/01/2020	27.925	-11.599
	1	11/01/2020	28.544	-10.976	<i>Streptopelia decaocto</i>	X	02/01/2020	28.612	-9.431
	1	11/01/2020	27.919	-11.542		2	04/01/2020	28.491	-9.849
	1	12/01/2020	27.925	-11.599	<i>Sylvia conspicillata**</i>	1	02/01/2020	28.417	-9.668
	1	12/01/2020	27.916	-11.550		1	09/01/2020	28.292	-9.696
	1	12/01/2020	28.142	-11.444		2	12/01/2020	28.168	-11.460
<i>Oenanthe leucopyga</i>	3	31/12/2019	28.483	-9.854	<i>Sylvia deserticola*</i>	1	03/01/2020	28.409	-10.044
	1	31/12/2019	28.393	-9.921		1	03/01/2020	28.391	-10.020
	1	31/12/2019	28.397	-9.878		1	04/01/2020	28.370	-9.834
	1	31/12/2019	28.398	-9.874		1	08/01/2020	28.405	-9.674
	1	31/12/2019	28.370	-9.834	<i>Sylvia melanocephala**</i>	1	03/01/2020	28.409	-10.044
	1	01/01/2020	28.470	-9.860	<i>Tadorna ferruginea</i>	40	10/01/2020	28.926	-10.147
	1	01/01/2020	28.472	-9.855	<i>Turdoides fulva</i>	7	05/01/2020	28.515	-9.124
	1	01/01/2020	28.369	-9.833		2	05/01/2020	28.518	-9.114
	2	01/01/2020	28.391	-9.917		10	05/01/2020	28.527	-9.041
	1	02/01/2020	28.438	-9.701		5	05/01/2020	28.549	-8.967

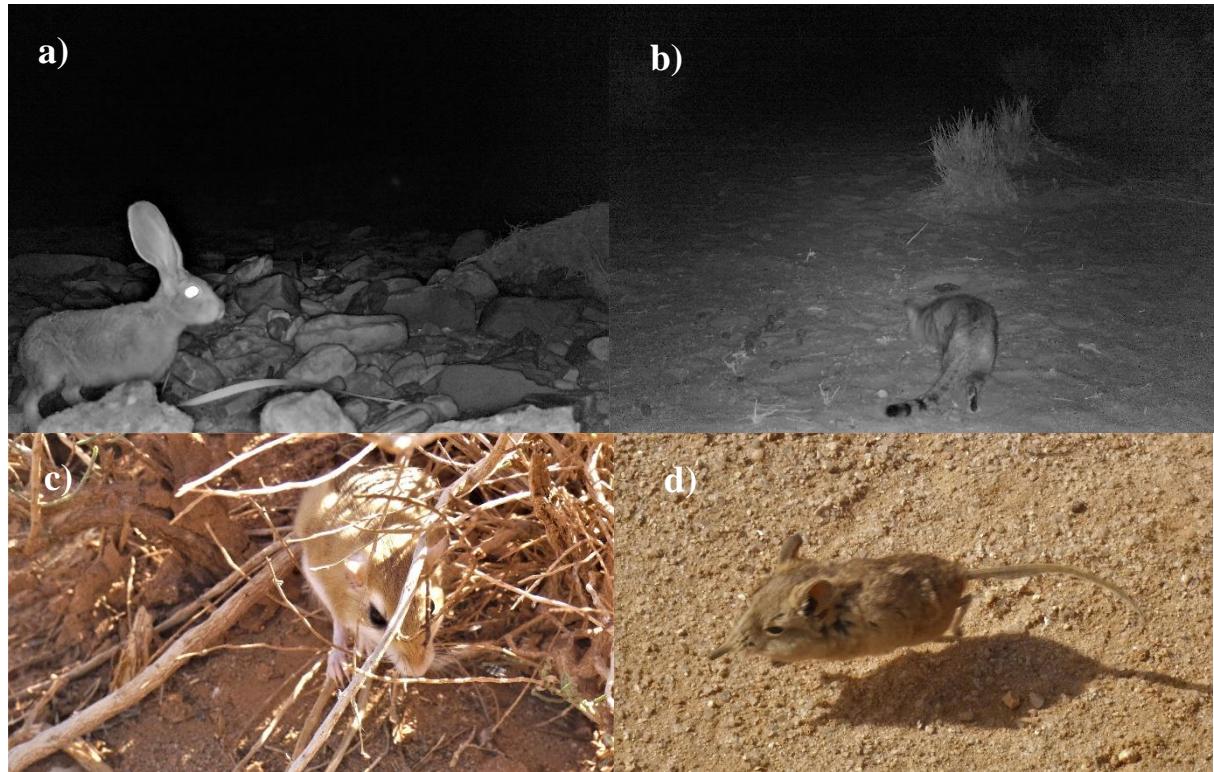


Figure 2. Selected mammalian species recorded during the expedition: a) *Lepus cf. capensis*, b) *Felis libyca*, c) *Gerbillus tarabulli*, d) *Elephantulus rozeti*. Photograph credits to XSI.

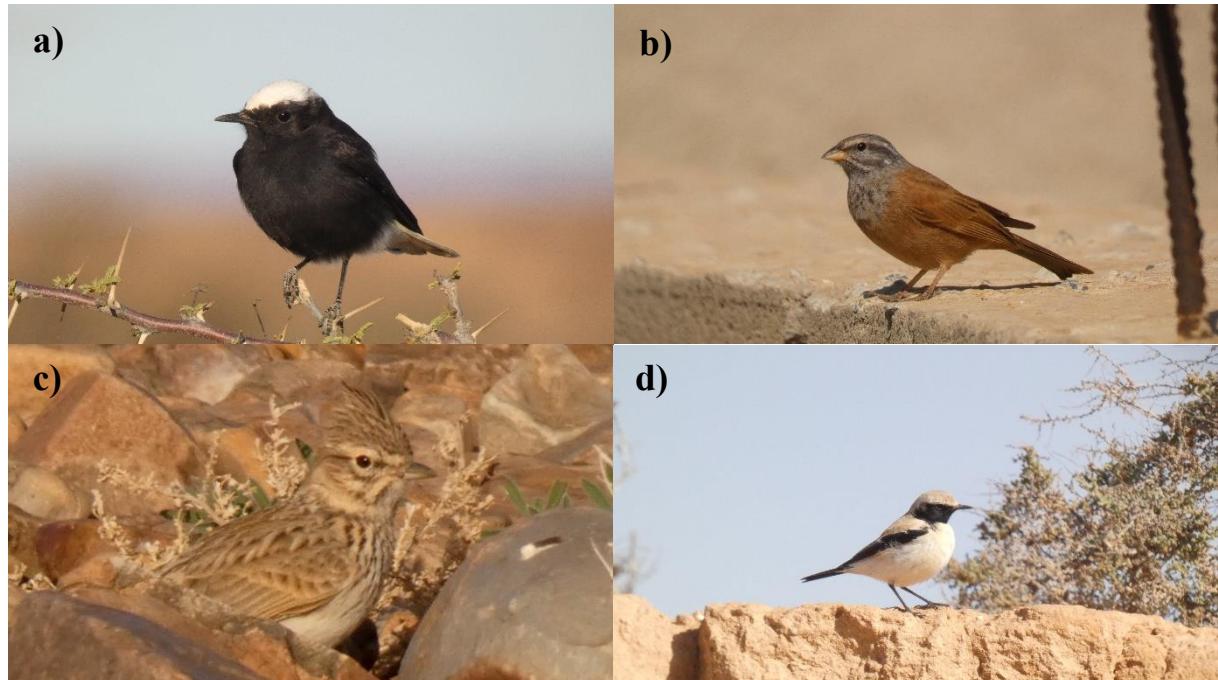


Figure 3. Selected bird species observed during the expedition: a) *Oenanthe leucopyga*, b) *Emberiza sahari*, c) *Galerida theklae*, d) *Oenanthe deserti*. Photograph credits to XSI





Figures 4-7. *G. macrorhyncha* in the Oued Draa near Assa