Data on the distribution of the terrestrial herpetofauna of Morocco: records from 2001–2006

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MOROCCO is situated in the Northeast point of Africa, with an area of just over 400,000 km² (excluding Western Sahara). Together with Algeria and Tunisia it forms the Maghreb, a well defined geographic region within North Africa. Morocco has a great diversity of habitats, ranging from Mediterranean to Sahara, which are essentially separated by the Atlas Mountains range that traverses the country from Northeast to Southwest. Morocco has the highest diversity of herpetofauna of North Africa and of the Western Mediterranean region. Bons & Geniez (1996) accepted 104 species, with 23 endemic to Morocco, and several new taxa have been formally recognised since (e.g. Wade, 2001). Additionally analyses of genetic variation suggest several widespread forms may actually be species complexes.

Here we report on the findings of six years of field work carried out in Morocco, from 2001 to 2006, totalling approximately 70 person/weeks of observations. Field trips were in most cases carried out during spring, and a total of 427 observations of amphibian and reptile species were recorded. When a species was observed, the coordinates of the location were it was found were marked with a GPS. A total of 159 localities were sampled (Map 1, Appendix 1), resulting in the observation of nine species of amphibians and 57 species of reptiles, representing more than two thirds of the known species. Specimens are classified at the species level, but subspecific comments are supplied when relevant. Since the taxonomy of several Moroccan taxa is still unresolved, we implement some of the more stable nomenclatural changes since Bons & Geniez (1996), but also discuss recently suggested alternatives.

AMPHIBIA

URODELA, Family Salamandridae

Pleurodeles waltl Michahelles, 1830; localities 5 and 36.

Locality 36, El Jadida (square S11 in Bons & Geniez, 1996): between the northern (main) distribution area and the southern localities were the species was observed, namely Safi [Q15] and Essaouira island [N19], for which Bons & Geniez (1996) suggested the need for confirmation. Adults were found under stones during wet weather (locality 36, reported in detail in Carretero et al. (2004)), juveniles in large, shallow temporary ponds (locality 5).

ANURA

Family Discoglossidae

Alytes obstetricans (Laurenti, 1768); only found in locality 19d. Currently referred to Alytes maurus (Fromhage et al., 2004, Gonçalves et al., 2007). Adult specimens were found under stones on a well-grazed, steeply sloping hillside.
Discoglossus pictus Otth, 1837; localities 2a, 18, 19d, 32, 35, 47a and 61. Currently referred to Discoglossus scovazzi (Fromhage et al., 2004, Zangari et al., 2006). Locality 47a: Gourrama. Previously unreported from east of the Atlas Mountains, this extends the distribution into the drier region to the east (Fig. 1A). Found in a variety of ponds, roadside ditches and marshy mountain meadows.

**Family Bufonidae**

*Bufo bufo* (L., 1758); localities 31b, 61, 61b, 62a and 73. *Bufo mauritanicus* Schlegel 1841, localities 1, 3, 18, 19a, 19d, 24, 29, 31b, 34a, 38, 45a, 46, 50, 57, 61, 69 and 73. *Bufo viridis* Laurenti, 1768; localities 24, 28b, 36, 45a, 58 and 68. *Bufo viridis* appears to be a species complex (Stöck et al., 2006). Some of these new localities fill gaps in the known range of this widespread species.

Bufo brongersmai Hoogmoed, 1972; only found in localities 58 and 74a. These connect the locations of Souss basin and south of High Atlas with the isolated observations in the Marrakech plain (Fig. 1B). Mature adult *Bufo* sp. were generally found under stones. Huge numbers of recent metamorphosed *B. mauritanicus* were observed in various regions of the Rif mountains.

**Family Hylidae**

*Hyla meridionalis* Boettger, 1874; localities 19d, 61, 61b and 62. Typically found in reeds near more permanent streams and rivers. Unusual silver coloured individuals were seen at Jebel Sirwah (locality 61).

**Family Ranidae**

*Rana saharica* Boulenger, 1913; localities 3, 17, 19, 19a, 28b, 31b, 32, 43, 45a, 46, 47a, 61 and 73. Proposed as a possible species complex by Bons and Geniez (1996), but analysis of mtDNA shows minimal variation across Morocco (Harris et al., 2003a). Common in a variety of water bodies throughout its range.
REPTILIA

CHELONIA

Family Testudinidae: *Testudo graeca* L., 1758; localities 7, 8c, 13a, 19d, 23, 24b, 32, 38, 40, 56, 59 and 65.

Locality 56: There are few citations of *T. graeca* from the East of the Atlas Mountains. Extensive anthropogenic effects make it difficult to rule out artificial introductions, although this new locality is a long way from any large human settlements (Fig. 1C).

Family Bataguridae: *Mauremys leprosa* (Schweigger, 1812); localities 1a, 8b, 8d, 35, 59 and 87. Although most specimens were found near large mountain streams and rivers, many were clearly of a temporal nature that were likely to be dry for much of the year.

SAURIA

Family Agamidae

*Agama bibroni* Dumeril & Dumeril, 1851; localities 2a, 2b, 3, 5, 8c, 10, 13a, 18, 19d, 20, 30, 31, 32, 37, 44, 47, 47a, 54b, 59, 63b, 74, 75b, 79, 86c and 88b. One of the most commonly seen species in Morocco, found in a wide variety of habitats but typically associated with rocks.

*Trapelus mutabilis* (Merrem, 1820); localities 45d, 50a, 54a and 59a.

Figure 1. Distribution maps of some of the species observed. Black dots represent known distributions of the species (extracted from Bons & Geniez, 1996) and stars represent new records reported in this study.

*Uromastyx acanthinus* Bell, 1825; localities 20, 44, 47, 54, 54c and 85. Mitochondrial DNA analysis indicates all the Moroccan specimens form a clade within this species, although this includes a relatively high level of genetic variation (Harris et al., 2007). Although still quite common in the rocky desert areas, many specimens were roadkills, and individuals were often observed sold in markets, indicating the dual threats to this species.

Family Anguidae: *Ophisaurus koellikeri* ( Günther, 1873); only found in locality 32, under stones in a broad-leaf forest. Currently referred to *Hyalosaurus koellikeri* (Macey et al., 1999).

Family Chamaeleonidae: *Chamaeleo chamaeleon* (L., 1758); localities 20, 54a and 91. One specimen (locality 20) was found in a surprisingly open and arid area, walking along the ground.

Family Gekkonidae

*Geckonia chazaliae* Mocquard, 1895; only found in locality 91a. Currently referred to *Tarentola chazaliae* (Carranza et al., 2002).
Hemidactylus turcicus (L., 1758); only found in locality 11, within a ruined building. Analysis of mtDNA sequence variation indicates H. turcicus is probably introduced in Morocco (Carranza & Arnold 2006).

Ptyodactylus oudrii Lateste, 1880; localities 43 and 45a. Locality 43 (Tamdafelt bridge): This record extends the distribution area of the species further north into the Moulouya river valley. All specimens were found on large boulders. In locality 43 the specimen was on the underside of a rock above an irrigation channel.

Quedenfeldtia moerens (Chabanaud, 1916); localities 63, 72, 75 and 75b.

Quedenfeldtia trachyblepharus (Boettger, 1874); localities 61 and 62. Locality 61 (El Azib n-Iriri, Jbel Siroua) regarding forms: Most citations from this area are of Quedenfeldtia sp. only. This confirms the presence of Q. trachyblepharus from this area. Quedenfeldtia were active even when the sky was extremely overcast, and were usually found in very high densities when present.

Stenodactylus sthenodactylus (Liechtenstein, 1823); localities 20, 21, 22, 30, 44 and 89. Localities 22 and 30: these lie between the northern and southern areas of distribution, making it more continuous through the Moulouya river (Fig. 1D). A few specimens were found under rocks, but many more by digging out the small holes beneath thorn bushes, often also occupied by Acanthodactylus sp.

Saurodactylus mauritanicus (Dumeril & Bibron, 1836); localities 12, 13, 13a, 14 and 23.

Saurodactylus brosseti Bons & Pasteur 1957, localities 36, 58, 64, 65, 65a, 68, 71, 72, 74, 77, 78, 81, 88a.

Saurodactylus fasciaticus Werner, 1931; localities 8a, 9a and 39. Locality 39 adds another southerly locality to the few isolated points known, and increases the range of sympatry between S. fasciatus and S. brosseti. Recent analyses suggest that Saurodactylus is paraphyletic (Rato & Harris, 2008), in which case future taxonomic changes to this group are likely.

Tarentola mauritanica (L., 1758); localities 1, 2b, 3, 4, 7, 8c, 11, 17, 19, 19b, 19e, 25, 29, 31, 31b, 32, 32a, 33, 36, 39, 40, 42, 59, 61, 63b, 65, 65a, 67, 73, 75a and 76. Tarentola mauritanica appears to be a species complex, although the two accepted subspecies in Morocco do not seem to correspond to genetic lineages (Harris et al., 2004a, b). Tarentola mauritanica is extremely widespread in both natural habitats but especially in buildings.

Tarentola deserti Boulenger 1891, localities 50b and 50d. Found on clusters of large boulders. Superficially very similar to Tarentola mauritanica, but with a notably ochre-yellow iris. Tropiocolotes tripolitanus Peters, 1880; found only in locality 89, under rubbish in a small open area within the town of Gourrama.

Family Lacertidae

Acanthodactylus erythrurus (Schinz, 1833); localities 2b, 3, 19b, 24, 32, 32a, 33, 41, 41a, 61, 65, 65a and 72.

Acanthodactylus lineomaculatus Dúmeril & Bibron, 1839; localities 4, 4a, 15, 15a, 38, 70 and 71a. Evidence based on mtDNA do not support the distinction of this species from A. erythrurus (Harris et al., 2004).

Acanthodactylus maculatus (Gray, 1838); localities 14, 30a and 53a.

Acanthodactylus busacki Salvador, 1982; localities 79, 81 and 90. The morphological distinction of A. busacki has not always been accepted (see Harris & Arnold 2000). Mitochondrial DNA sequence variation indicates considerable variation within an “A. pardalis species complex”, including A. pardalis, A. maculatus, A. busacki and A. mechriguensis (Fonseca et al., 2008). However, exact delimitation of species remains equivocal. Members of this species complex are extremely difficult to separate in the field. All, like the other Moroccan Acanthodactylus sp. are typically seen running over open areas between bushes where the animals take refuge in holes around the roots.

Acanthodactylus boskianus (Daudin, 1802); localities 11, 20, 27, 28, 28a, 28b, 30, 45c, 46, 47a, 48a, 48b, 53, 55, 82, 86, 86a and 86b.

Acanthodactylus dumerili (Milne Edwards, 1829); localities 50c, 50d, 82a, 83a and 84.

Acanthodactylus longipes Boulenger, 1921; localities 52 and 83.

Acanthodactylus aureus Günther, 1903; localities 80 and 90a.
Lacerta tangitana Lataste, 1880; localities 3, 6, 18, 19a, 19d, 24, 32, 32a, 34, 34a, 40a, 40b, 45a, 45b, 61, 63a, 63b and 75. Currently referred to Timon tangitanus (Arnold et al., 2007), and may represent a species complex in Morocco (Paulo, 2001). While Debdou (locality 24) is within the range typically assigned to Lacerta pater, specimens from here are still L. tangitana.

Lacerta andreanszkyi Werner, 1929; localities 62 and 63. Currently referred to Atlantolacerta andreanszkyi (Arnold et al., 2007). Found under rocks in the open high mountain meadow of Oukaimeden, with Podarcis hispanica and Scelarcis perspicillata on the larger rocks and walls surrounding the meadow.

Mesalina guttulata (Lichtenstein, 1823); localities 25, 45a, 48, 54a, 54b and 86c. These new citations fill some gaps in the widespread distribution of this species.

Mesalina olivieri (Audouin, 1829); localities 20, 24, 47 and 65a. The specimen from the last locality (10km NE of Marrakesh) corresponds to the subspecies M. o. simoni. All Moroccan Mesalina are small, shy species found in dry open areas running between small bushes used as refugia.

Ophisops occidentalis Boulenger, 1887; found only in locality 23.

Podarcis hispanica (Steindachner, 1870); localities 1, 2, 2b, 3, 8, 8c, 8d, 18, 19a, 19b, 19d, 24, 32, 32a, 33, 34, 34a, 42, 61, 61a, 63b and 75. Locality 61 (El Azib n-Iriri, Jbel Siroua): Most Moroccan and Southern Spanish populations are now referred to Podarcis vaucheri (Busack & Lawson, 2005). Pinho et al. (2006, 2007) show that the populations from locality 61 are not related to other Moroccan populations, but rather to a Tunisian form of the Podarcis hispanica species complex. Generally Podarcis were found in areas with Mediterranean climate, and especially near water courses such as streams. However some populations, such as that from within the town of Midelt, were on walls in quite dry areas.

Psammodromus algirus (L., 1758); localities 2a, 2b, 3, 4, 7, 9a, 13a, 19, 19a, 19b, 19d, 19e, 25, 31, 32, 32a, 33, 34, 40, 41a, 45b, 59, 59a and 61. Locality 45b (25km W of Talsimnt): Two other Mediterranean species (P. vaucheri and S. perspicillata) have isolated records from this region. This adds another Mediterranean species to this isolated group. Scelarcis perspicillata was confirmed at the same place, although P. vaucheri was not observed. The two accepted subspecies in Morocco do not appear to be genetically distinct based on analysis of mtDNA sequences (Carranza et al., 2006).

Scelarcis perspicillata (Dûmeril & Bibron, 1839); localities 17, 19, 19a, 19b, 19e, 24, 31, 32, 32a, 33, 40a, 45, 59, 61, 63b and 75. Scelarcis perspicillata has three distinct morphological forms in Morocco. Considerable mtDNA variation was reported (Harris et al., 2003b), and a 100% coincidence of morphotypes and mtDNA lineages was observed at a contact zone of two forms near Taza (Perera et al., 2007), indicating a probable species complex with forms separated by perhaps 5.5 million years (Arnold et al., 2007). However, there are only two distinct genetic lineages, and in other areas populations with similar colour morphs do not coincide with these. Specimens were found predominantly on high cliffs and large rocks, often near running water, where their flattened morphology allows them to take refuge in very narrow crevices. Occasionally also seen climbing on trees.

Family Scincidae

Chalcides colosii Lanza, 1957; only found in locality 2b.

Chalcides minutus (Caputo, 1993); only found in locality 24a.

Chalcides mionecton (Boettger, 1874); localities 15, 15a, 68 and 89.

Chalcides ocellatus (Forsskål, 1775); localities 13a, 14, 20, 22 and 24.

Chalcides polylepis Boulenger, 1890; localities 19b and 36.

Chalcides pseudostratus (Caputo, 1993); only found in locality 2a. All Chalcides specimens were found turning rocks. Recently an extensive review suggests that future taxonomic changes for some species are likely (Carranza et al., 2008).

Eumeces algeriensis Peters, 1864; localities 9a, 16, 19e, 28, 30, 36, 39, 59, 65a, 68 and 79. Eastern localities fall within an area where the form Eumeces (algeriensis) meridionalis could have been expected, but all samples corresponded to E. a. algeriensis.
Sphenops boulengeri (Anderson, 1896), only found in locality 82.

AMPHIBIA NA

Family Amphibiaenidae (currently Blanidae following Kearney & Stuart, 2004).

Blaus mettetali Bons, 1963; found only in locality 40.

Blanus tingitanus Busack, 1988; localities 8c, 19a and 19b.

Currently two species of Blanus are recognised in Morocco, B. mettetali and B. tingitanus, and one in Iberia, B. cinereus. Vasconcelos et al. (2006) indicate that B. cinereus is a species complex, and that one individual was found in Taza (locality 19). The existence of this form in North Africa needs further investigation.

Family Trogonophidae: Trogonophis wiegmanni Kaup, 1830; localities 1, 9a, 19e, 23, 35, 36, 38 and 59. Mendonça & Harris (2007) reported the two localities for T. w. wiegmanni in the Moulouya river valley region, that link the northern and southern populations of this form in Morocco. They indicate that three genetic lineages exist in North Africa, corresponding to the accepted subspecies in Morocco plus an additional lineage in Tunisia. All the amphibiaenians observed were found under rocks or litter.

SERPENTES

Family Colubridae (s.l.)

Hemorrhois hippocrepis L., 1758; Localities 7, 9, 9a, 17, 19b, 19c, 24a, 31a, 32, 66 and 67. As with all the following colubrid snakes, many specimens were roadkills.

Hemorrhois algirus (Jan, 1863); found only in locality 54.

Coronella gironica (Daudin, 1803); localities 19d, 24, 49 and 63.

Macroprotodon cucullatus (Geoffroy Saint-Hilaire, 1827); localities 3, 9a, 19b, 19d, 26, 30, 32 and 33. In a recent morphological analysis Wade (2001) recognized four species of Macroprotodon, with three, M. cucullatus, M. mauritanicus and M. abubakeri in North Africa and M. brevis in North Africa and the Iberian Peninsula. Assessment of mtDNA variation indicates considerable variation in North Africa and a recent colonization of the Iberian Peninsula (Carranza et al., 2004; Vasconcelos & Harris, 2006). However exact delimitation of genetic units in North Africa requires further analyses (Fig. 1E).

Malpolon moilensis (Reuss, 1834); found only in locality 85a.

Malpolon monspessulanus (Hermann, 1804); localities 1a, 2c, 8c, 17, 18, 19d, 33, 61 and 65.

Natrix maura (L., 1758); localities 3, 5a, 8d, 10, 11, 46, 59 and 61. Several specimens were caught swimming in small ponds, streams or irrigation channels. All were collected very close to such water bodies.

Psammophis schokari (Forsskål, 1775); localities 20, 45, 54b and 60. Although three colour morphs have been described for Morocco (Bons & Geniez, 1996), all three form part of the same mtDNA genetic lineage (Rato et al., 2007).

Psammophis and Malpolon are the only non-viperid Moroccan snakes belonging to the Subfamily Psammophiinae. Since the recognition of Atractaspidae and Elapidae make traditional Colubridae paraphyletic according to the last molecular phylogenies (Lawson et al., 2005), this well defined group probably merits Family status.

Spalerosophis dolichospilus (Werner, 1923), only found in locality 47a, currently the easternmost report in Morocco.

Family Viperidae

Cerastes cerastes (L., 1758); found only in locality 57a. A roadkilled specimen, without the typical horns.

Macrovi pera mauritanica (Gray, 1849); localities 14, 73a and 20. Currently referred to Daboia mauritanica (Lenk et al., 2001). These new localities fill gaps in the range of this widespread species, particularly in the low Moulouya basin (Fig. 1F).

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**Appendix 1**: Localities sampled (coordinates in WGS1984; LAT D: Latitude, Degrees, LAT M: Latitude, Minutes, LONG D: Longitude, Degrees, LONG M: Longitude, Minutes). Codes in bold letter indicate the localities represented in Map 1. Due to the big number of localities sampled, localities that are close together are grouped together.

1: ASSILAH; N 35° 28.264'; W 6° 1.873'; 1a: Road Larache-Tetouan; N 35° 23.245'; W 5° 55.788'; 2: CHEFCHAOUEN; N 35° 10.023'; W 5° 15.145'; 2a: 3km S of Derrara crossroad; N 35° 5.543'; W 5° 18.445'; 2b: Bab Taza; N 35° 3.98'; W 5° 12.08'; 2c: After Bab Taza; N 35° 3.669'; W 5° 6.965'; 3: KETAMA; N 34° 52.694'; W 4° 36.652'; 4: MOULAY BOUSSELHAIM BEACH; N 34°

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53.761'; W 6° 17.266'; 4a: 1km before Moulay Bousselhaim; N 34° 53.27'; W 6° 15.5'; 5: ROAD TO MOULAY BOUSSELHAIM 1; N 34° 46.24'; W 6° 5.195'; 5a: Road to Moulay Bousselhaim 2; N 34° 41.799'; W 6° 1.552'; 6: CLOSE TO BASRA; N 34° 47.483'; W 5° 43.533'; 7: 5Km AFTER HAD KOURT; N 34° 39.059'; W 5° 39.628'; 8: ZOUMI; N 34° 46.102'; W 5° 30.971'; 8b: 5km before Zoumi; N 34° 44.759'; W 5° 25.366'; 8c: 15km before Zoumi; N 34° 47.361'; W 5° 18.201'; 9: 2KM BEFORE OUAZZANE; N 34° 44.759'; W 5° 33.543'; 9a: Close to Ouazzane; N 34° 37.814'; W 5° 32.283'; 10: TAOUNATE; N 34° 31.797'; W 4° 38.085'; 11: MOUTH OF OUED MOULOUYA; 9KM W OF SAIDA; N 35° 7.243'; W 2° 19.981'; 12: 3 KM E OF MOULOUY RIVER BRIDGE; N 34° 52'; W 2° 36'; 13: ROAD TO TAFORALT; N 34° 50'; W 2° 25'; 13a: 11km S of Berkane; N 34° 51.435'; W 2° 25.525'; 14: 10KM N OF ELAIOUN; N 34° 38.666'; W 2° 26.471'; 15: FORET DE LA MAMORA; N 34° 6.279'; W 6° 33.73'; 15a: Kenitra (highway); N 34° 12.264'; W 6° 33.715'; 16: VOLUBILIS (ROMAN RUINS); N 34° 4.532'; W 5° 33.445'; 17: NEAR MOULAY IDRIS; N 34° 3.867'; W 5° 21.337'; 18: HALOUANE; N 34° 6.791'; W 4° 7.283'; 19: RAS-EL-OUED, TAZZEKA; N 34° 9.313'; W 5° 4.096'; 19a: 15km S of Zoumi; N 34° 6.788'; W 5° 1.652'; 35: N - CASABLANCA (HIGHWAY); N 33° 42.675'; W 7° 18.922'; 36: EL JADIDA; N 33° 12.725'; W 8° 33.058'; 37: JORF LASRAR; N 33° 5.282'; W 8° 39.192'; 38: MOUSSA; N 33° 36.182'; W 9° 11.5'; 39: MECHRA BEN ABHOU; N 33° 38.549'; W 9° 15.754'; 40a: EI Ksiba Area; N 33° 33.599'; W 6° 4.135'; 40b: Titt-n-Tazzart; N 33° 29.281'; W 6° 0.852'; 41: KERROUCHEN; N 33° 24.106'; W 5° 19.386'; 41a: Tizi-n- Rechou; N 33° 24.762'; W 5° 13.508'; 42: MIDELT; N 33° 20.972'; W 4° 44.568'; 43: TAMDAFEL BRIDGE; N 33° 25.471'; W 4° 15.916'; 44: 25KM S OF MISSOUR; N 33° 24.987'; W 4° 4.371'; 45: 22KM W OF TALSINNT; N 33° 38.328'; W 3° 38.489'; 45a: Unnamed village 30km W of Talsinnt; N 33° 35.158'; W 3° 45.631'; 45b: 25km W of Talsinnt; N 33° 34.143'; W 3° 42.255'; 45c: 18km S of Talsinnt; N 33° 29.045'; W 3° 25.989'; 45d: 25km S of Talsinnt; N 33° 19.321'; W 3° 28.777'; 46: AIT CHICCHOU; N 33° 25.133'; W 3° 46.232'; 47: 10KM E OF GOURRAMA; N 33° 21.063'; W 3° 57.967'; 47a: Gourrama; N 33° 20.094'; W 4° 4.469'; 48: AR-RACHIDIA (CAMPING); N 31° 51.922'; W 4° 17.177'; 48a: 5km S of Source Blue de Merski; N 31° 50.935'; W 4° 15.308'; 48b: Aoufouss; N 31° 47.087'; W 4° 13.525'; 49: LAKE TISLI; N 32° 11.564'; W 5° 38.054'; 50: ERFoud; N 31° 26.215'; W 4° 13.264'; 50a: 5km N of Erfoud; N 31° 30.012'; W 4° 12.111'; 50b: 10km N of Erfoud; N 31° 31.098'; W 4° 11.566'; 50c: 15km N of Erfoud; N 31° 31.205'; W 4° 11.533'; 50d: 12km N of Erfoud; N 31° 32.343'; W 4° 11.152'; 51: 5Km W OF RISSANI; N 31° 16.217'; W 4° 21.865'; 52: ERG CHEBBI; N 31° 4.356'; W 3° 58.173'; 53: 2KM E OF ALNIIF; N 31° 7.117'; W 5° 8.577'; 53a: 10km E of Alniif; N 31° 9.609'; W 5° 2.237'; 54: MERZOUGA TO OURAZZATE DESERT ROAD 1; N 31° 27.708'; W 5° 35.661'; 54a: Merzouga to Ourazzate desert road 2; N 31° 22.414'; W 5° 52.564'; 54b: