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The dama gazelle *Nanger dama* (Pallas, 1766) in Saharan rock art

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COUVERTURE/COVER:

Un troupeau de probables gazelles dama (*Nanger dama* (Pallas, 1766)) gravées sur une paroi rocheuse dans le Wadi In Elobu, Mesak Settafet (Fezzan, Libye).
Crédit photo: K. H. Striedter / *A herd of presumptive dama gazelles (Nanger dama (Pallas, 1766)) engraved on a rock wall in the Wadi In Elobu, Mesak Settafet (Fezzan, Libya). Photo credit: K. H. Striedter.*

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The dama gazelle *Nanger dama* (Pallas, 1766) in Saharan rock art

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ABSTRACT

Twenty-five original prehistoric rock images from the Sahara in Libya, Niger, Mauritania and Algeria are presented which evidently or likely represent dama gazelles (Mammalia, Bovidae: *Nanger dama* (Pallas, 1766)). A literature revision of gazelles in North African rock art serves to interpret these new examples. Recurrent stylistic devices of engraved antelopes in rock surfaces are inferred. The rock images extend the known prehistoric range of the dama gazelle into the Fezzan (southwest Libya), the Western Desert of Egypt and the border triangle region Egypt/Sudan/Libya. Some rock paintings reveal the subspecies identity of dama gazelles, confirming the red-necked gazelle (*N. d. ruficollis* (Hamilton Smith, 1827)) for southwest Egypt. A long brown dorsal saddle patch combined with extensive white areas in their head skins likely proposes *N. d. dama* (Pallas, 1766) for the hitherto taxonomically undetermined populations in east-central Algeria, extinct since before taxonomists could study them. Our revision suggests that published conjectures of gerenuks (*Litocranius walleri* (Brooke, 1878)) or dibatags (*Ammordorcas clarkei* (Thomas, 1891)) depicted in Saharan rock images or in Pharaonic Egyptian art sometimes refer to misidentified dama gazelles, as far as they are interpretable at all.

KEY WORDS
Rock engravings,
rock paintings,
Antilopinae,
Sahara,
animal ideography,
North African
prehistory.

RÉSUMÉ

La gazelle dama Nanger dama (Pallas, 1766) dans l'art rupestre du Sahara.

Vingt-cinq images rupestres préhistoriques originales provenant du Sahara en Libye, au Niger, en Mauritanie et en Algérie sont présentées, illustrant de manière évidente ou probable des gazelles dama (Mammalia, Bovidae: *Nanger dama* (Pallas, 1766)). Une étude de la littérature sur les gazelles dans l'art rupestre nord-africain sert à interpréter ces nouveaux exemples. Des procédés stylistiques récurrents d'antilopes gravées dans les surfaces rocheuses sont déduits. Les images rupestres étendent l'aire de répartition préhistorique connue de la gazelle dama au Fezzan (sud-ouest de la Libye), au désert occidental d'Égypte et à la région du triangle frontalier Égypte/Soudan/Libye. Certaines peintures rupestres révèlent l'identité de la sous-espèce des gazelles dama, confirmant la gazelle à cou rouge (*N. d. ruficollis* (Hamilton Smith, 1827)) pour le sud-ouest de l'Égypte. Une longue tache brune sur la selle dorsale, combinée à de vastes zones blanches dans la peau de la tête, propose probablement *N. d. dama* (Pallas, 1766) pour les populations jusqu'ici indéterminées du point de vue taxonomique dans le centre-est de l'Algérie, éteintes avant que les taxonomistes ne puissent les étudier. Notre étude suggère que les conjectures publiées de gerénuks (*Litocranius walleri* (Brooke, 1878)) ou de dibatags (*Ammordorcas clarkei* (Thomas, 1891)) représentés sur des images rupestres sahariennes ou dans l'art égyptien pharaonique font parfois référence, pour autant qu'elles soient interprétables, à des gazelles dama mal identifiées.

MOTS CLÉS
Gravures rupestres,
peintures rupestres,
Antilopinae,
idéographie animale,
préhistoire nord-
africaine.

INTRODUCTION

The many thousands of images of animals, humans and symbols in the prehistoric rock art of the Sahara have been studied intensively over the last 150 years, laid down in a rich, albeit extraordinarily scattered literature (e.g., Striedter 1983; Hallier 1990; Hallier & Hallier 1992; Le Quellec 1998; Le Quellec *et al.* 2005). Hardly anywhere else worldwide can one find such a multitude of prehistoric rock images. They are concentrated in the rock faces and shelters of central and southern Saharan mountain ranges, i.e. the Tassili n'Ajjer and Ahaggar (Algeria), Akakus and Mesak (Libya), Tibesti and Ennedi (Chad), and Djado and Aïr (Niger). Representing pecked or incised linear contours, or contours with interior laminar surface marking details, or alternatively being colorful paintings, many details of the regional prehistoric fauna become evident for researchers in prehistory, arts, ethnology and zoology. There are literally many thousands of images showing preferentially the most iconic species, e.g., rhinoceros, giraffe, elephant, hartebeest, etc. (Mauny 1956). Gazelles are depicted much more rarely (Striedter 1983), and even those examples represent mostly unidentifiable species, sometimes being merely “small, slender quadrupeds with short horns”. Examples specifically of dama gazelles (*Nanger dama* (Pallas, 1766)) in Saharan rock art, though not necessarily identified as such by the authors, are confined to von Gagern (1978) and Holl (2004) for Algeria, and to Zboray (2009), Kuper (2013), and tentatively Riemer (2011), for southwest Egypt/Sudan. Lutz & Lutz (1995) published rock engravings of supposed gerenuks which we interpret as dama gazelles. Our knowledge about gazelles in Saharan rock art, including the dama gazelle, therefore remains rather limited.

During his studies in the Sahara, one of us (K. H. S.) found several additional sites where early historic hunters or pastoralists had depicted gazelles on rock surfaces. Both authors of this contribution have evaluated these pieces of art critically, and concluded that quite a few of them indeed represent dama gazelles. Insights by one of us (A. S.) from a comprehensive museum study of dama gazelle morphology (Schreiber *et al.*, ongoing study) facilitated the critical evaluation of our rock images. We discuss the most convincing examples of dama gazelles from Saharan rock art here, and their implications for the original distribution and the geographical variability of this poorly known animal.

The rational of our species identifications is characterized by caution to avoid overinterpretations, and all images unable to serve the primarily zoological interest of our study are omitted. Clearly, zoological inferences based on Saharan rock art depend on the precise, detailed and accurate representation of the depicted animals. One cannot assume *a priori* that prehistoric engravers or painters showed the animals in a naturalistic style, just as in modern visual arts exact realism is but one of many stylistic schools. Artificiality, supernatural elements, and stylization easily lead to erroneous interpretations of a morphological detail represented by different individual creators, artistic schools, and ethnic groups over extended historical periods. Moreover, authen-

ticity is not the same as realism: Lutz & Lutz (1995) found a striking example of a hybrid theriomorph from the Wadi Gedid (Mesak, Libya), consisting of an antelope head (in our eyes perhaps a dama gazelle) plugged onto an avian body, apparently an ostrich, and they termed this dyadic creature a “Straussengazelle” (ostrich-gazelle); Le Quellec (1998) designated similar, albeit somewhat less antelopine hybrid monsters from the Mesak “ostriches with bovine heads”, and Gauthier & Gauthier (1994) even described monstrous ostrich-giraffes and four-legged ostriches from this region. These composite creatures represent weird cases of fantasy, but still the anatomical details of the contributing animals are presented partly true to life. Such supernatural organisms were not found in our material, but still we observe a wide spectrum from fully naturalistic dama gazelles to fully stylized or crudely primitive sketches, including intermediate cases which may have been inspired by dama gazelles, even though the creator had not intended or succeeded to deliver a lifelike image. Partly, this gradient may reflect the talents, abilities, and motivations of the creators, modifying their technique by applying stylistic rules by individual taste, tribal tradition, religion or historical fashion. A zoologist using such rock art has to start with the decision which images can be interpreted at all. For this contribution, we based our species diagnosis on at least one diagnostic morphological character in a selection of the most naturalistic images. Many other rock images left out from our compilation rather represented other wildlife species or they were executed in an overly stylized or crude manner to prohibit conclusions. There remain not few additional images in between these extremes, i.e. animals which could be dama gazelles in principle, but where doubts remained. It is possible that the originators of questionable images may have been inspired by dama gazelles too, however blending this inspiration with elements taken from further bovids or from fantasy. Several of our engraved bovids seemed to be composite bovids with elements of, for example, gazelles (and sometimes perhaps dama gazelles) and hartebeests, or gazelles and domesticated sheep or goats. Preferring a critical selection, such images were discussed with additional zoologists having experience with antelopes, but when doubts prevailed we omitted them.

A short introduction to our species, the dama gazelle (Bovidae, Antilopinae: *Nanger dama*), is warranted: it is the tallest of all contemporary gazelles (Fig. 1), and used to range widely in North Africa, i.e. in the Atlantic hinterlands of southern Morocco, Mauretania and Senegal, and from there eastwards through the semideserts and the southern Sahelian fringes of the Sahara in Mali, Niger and Chad to northwestern Sudan. The species has never occurred east of the Nile. Since the early 20th century this range has continued to decrease by overhunting, and today the species is barely surviving in tiny population fragments in Chad and Niger, while further, albeit unconfirmed, relict populations may possibly linger in Mali and Sudan. Various subspecies of the dama have been described on the basis of pelage pigmentation, of which most often three are recognized at present (Cano Perez 1991), while the others are so poorly known that a taxonomic evaluation



FIG. 1. — Dama gazelles (*Nanger dama* (Pallas, 1766)). **A**, the western subspecies *N. d. mhorri* (Bennett, 1833). Captive specimens from Estación Experimental de Zonas Áridas, Almería (Spain); **B**, **C**, two phenotypes from a zoo population imported from east-central Chad, which displays marked variability in the extension of the dorsal saddle patch. The taxonomy of this population is not finally established, although it may be a naturally intergrading hybrid stock of the two subspecies *N. d. dama* × *N. d. ruficollis*. Al Wabra Wildlife Preservation, Al Shahaniya (Qatar). Photos credits: Roland Wirth (**A**), Jens-Ove Heckel (**B**, **C**).

is difficult. Recent years saw an increased scientific interest in the dama gazelle, with intensive projects to prevent its extinction both by conservation in Africa and chiefly by coordinated captive breeding in European and American zoological gardens. In particular, the geographical variability and the subspecies taxonomy have become subjects of actual research interest, since these topics are important in developing a (sub)species conservation strategy. For this aim, ancient rock art is of interest if it can augment the knowledge of the pelage phenotypes in otherwise barely explored regional populations, which had been exterminated prior to the collection of museum and study samples. Moreover, most published range maps are extrapolations from a few scattered geographical records, charging the literature with conflicting and often unauthenticated cartography (Schreiber 2021). At the same time, the original distribution range should be known exactly, in order to plan reintroduction projects of zoo-bred gazelles in North Africa. The evidence provided by the very rich record of prehistoric and historic rock art in the Sahara has not been investigated so far to improve our knowledge of this poorly known gazelle.

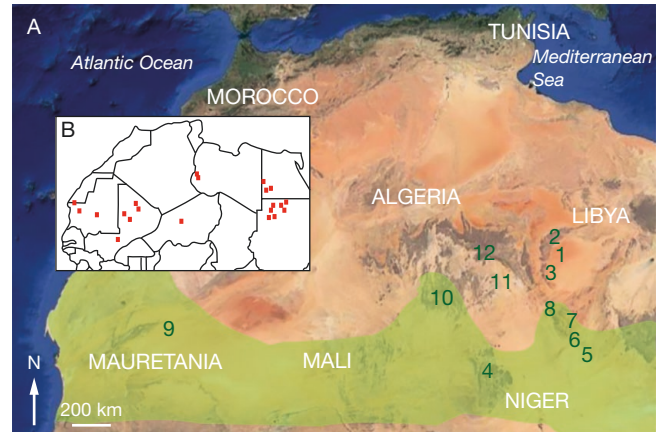


FIG. 2. — Sites with rock images of the dama gazelle (*Nanger dama* (Pallas, 1766)) presented in the present study. **A**, the numerals in green correspond to the localities listed in Table 1. The yellow-green shading delimits the approximate distribution range of the dama gazelle, as it had been a few decades ago, according to site-defined specimens in natural history museums and field observations reported in historical travel accounts (adapted from Cano Perez 1991); **B**, excavation sites where archaeozoologists found bones of the dama gazelle originating from the last 12000 years, after Jousse (2017).

MATERIAL AND METHODS

The second author travelled extensively in parts of the Sahara from 1971 to 2006, in the context of two research projects, “Néolithisation en régions sahariennes et ses incidences sur la désertification” (Centre national de la Recherche scientifique, Paris/Alger, 1989-1992), and “La Tadrart algérienne” (Convention sur la Coopération de l’Office du Parc national du Tassili, Djanet, et du Frobenius-Institut, Universität Frankfurt, 1993-2000). All rock images from these projects showing possible gazelles were evaluated in the context of antelope images encountered in the literature referring to Saharan rock art. Details of the phenotypes are discussed against the background of the morphological variability and the zoogeography investigated in a series of hundreds of study specimens kept at twenty natural history museums across Europe.

All photographs of the rock images have been taken by K. H. Striedter, if not indicated otherwise in the legends. The dama gazelles from El Rhallaouiya were photographed by Robert Vernet, specialist of Mauretania prehistory, when studying rock art in this part of the Sahara.

RESULTS

This study presents rock images of dama gazelles from twelve sites spread across the Sahara, including examples that are diagnosable with certainty, and ones which appear likely diagnosable. The names and locations of these sites are explained in Figure 2 and in Table 1, which also indicates the technical nature of this artwork, and the assignment of each image to the widely accepted relative chronology of Saharan rock which is based on stylistic elements and the design of the depicted subjects.

TABLE 1. — Sites with rock images mentioned in this study, with the geographical coordinates of their location, the artistic technique of their creation, and the stylistic assignment to the relative chronology of Saharan rock art.

Country	Site	Geographical coordinates	Artistic technique	Relative chronology
Libya	In Elobu (1)	25° 45' N / 11° 47' E	Engraved	Hunter Period
	Wadi Erahah (2)	26° 01' N / 11° 45' E	Engraved	Hunter Period
	Wadi Taleschout (3)	25° 04' N / 11° 40' E	Engraved	Hunter Period
Niger	Iwelen (4)	19° 46' N / 8° 26' E	Engraved with pigments probably added	Libyco-Berber Period
	Dao Timmi (5)	20° 34' N / 13° 33' E	Engraved	Hunter Period
	Arkana (6)	20° 59' N / 12° 41' E	Engraved	Hunter Period
	Enneri Yentas B (7)	21° 09' N / 12° 30' E	Engraved	Hunter Period
	Enneri Kolo Kaya (8)	21° 28' N / 12° 14' E	Engraved	Hunter Period
Mauretania	El Rhallaouiya (9)	21° 35' N / 10° 36' W	Engraved	Unknown
Algeria	Tagmart (10)	22° 58' N / 5° 25' E	Engraved	Hunter Period
	Oued Afeifo (11)	24° 18' N / 8° 47' E	Painted	Cattle Period
	Tikudawin (12)	25° 21' N / 8° 02' E	Painted	Cattle Period



FIG. 3. — Rock images with dama gazelles (*Nanger dama* (Pallas, 1766)) from the Wadi In Elobu, Mesak Settafet (Libya). Photos credits: Karl Heinz Striedter.

LIBYA

Wadi In Elobu, Mesak Settafet (Libya)

Figure 3A shows a group of many gazelles from a valley cutting at Wadi In Elobu in the Mesak Settafet (Black Mesak; also Messak Settafet) of Fezzan, southwestern Libya. The stones in this region are often overlain by dark desert varnish rich in manganese (Perego *et al.* 2011). Since their discovery for western science in 1850 by Heinrich Barth, tens of thousands of rock images were found in this high plateau descending towards the east, which is deeply dissected by valley gorges (Lutz & Lutz 1995). Wadi In Elobu is one such a valley in the center of the range. The depicted gazelle herd (Fig. 3A) is spread over a breadth of 120-140 cm; the body contours are incised deeply. Slender bodies, the long neck and horn shape indicate convincingly that dama gazelles are represented. Most faces and snouts appear white, because the corresponding stone surfaces have been polished. Extensive white areas on the head are typical of the subspecies *Nanger d. dama* (Pallas, 1766) and *N. d. ruficollis* (Hamilton Smith, 1827), although exceptionally fairly light faces also occur in specimens from other populations; overall, the gazelles in Figure 3A correspond best to the phenotype of *N. d. dama* (see Discussion for the taxonomic interpretation of these faces). Other engraved fauna in the vicinity comprises hartebeest, other big game, ostrich, and cattle.

Figure 3B, C reveal further gazelles from In Elobu, with however fewer diagnostic features of the dama gazelle in comparison. Nevertheless, in their spatial context next to the convincing dama gazelles of Figure 3A, and with their long necks, these additional images might also fit this species.

Wadi Erahah, Mesak Settafet (Libya)

The Wadi Erahah runs in the northwest of Wadi In Elobu near the eastern rim of the Mesak Settafet. This site yielded the image of a stylized antelope of 44 cm body height, engraved next to an ostrich with deep contour lines of u-shaped cross section (Fig. 4). The engraver did not leave us a natural portrayal, but an arty creation which is not the exact effigy of a real species. The horns identify the creature as a bovid, but the downward sloping back could point to a giraffe. However, the body proportions, the elongate neck, the slender limbs and



FIG. 4. — Stylized gazelle and ostrich engraved in the Wadi Erahah, Mesak Settafet (Libya). Photo credit: Karl Heinz Striedter. Scale bar: 6 cm.

the horn shape, although stylized, are best compatible with a dama gazelle. The image may be a creative fantasy animal inspired by a dama gazelle or it may even be a somewhat dilettantish engraving of an abstract but still fairly representative dama gazelle if one only explains the sloping spine as the body posture of an animal in the act of walking up a hillside or standing with the forefeet raised on an elevation.

Wadi Taleschout, Mesak Settafet (Libya)

The Wadi Taleschout revealed engravings of likely dama gazelles (Fig. 5A) with not entirely naturalistic phenotypes: they combine an unduly stocky stature with too high muzzles and excessively plump horns (Fig. 5B). Nevertheless, these beasts, which are incised deeply into the rock, do not resemble any other bovids more closely than the dama gazelle. The ox to the right measures 90 cm in body length. The fauna depicted around includes large wild mammals and more cattle.

Figure 6 shows an antelope of 32 cm body length from the Wadi Taleschout that does not seem to represent a dama gazelle at first sight. Its body is squat and bulky, the snout too broad and stocky, the horns overly thick, and the tail overlong and plump, presumably due to long



FIG. 5. — Rock image from the Wadi Taleschout, Mesak Settafet (Libya). **A**, overview of the entire scene; **B**, magnified detail from former section. Photos credits: Karl Heinz Striedter. Scale bars: **A**, 90 cm; **B**, 3 cm.



FIG. 6. — Stylized engraving of an antelope from the Wadi Taleschout, Mesak Settafet (Libya), presumably an antelope inspired by both a hartebeest and a gazelle. Photo credit: Karl Heinz Striedter. Scale bar: 3 cm.

tuft hairs which make the tail look bell-bottomed. These characters, and in particular the downward sloping dorsal contour, suit better a hartebeest than the slender, thinner-horned, and short-tailed dama gazelle with its shorter tail hairs and with its straight, horizontal spine. However, one cannot recognize an unequivocal hartebeest either, and it

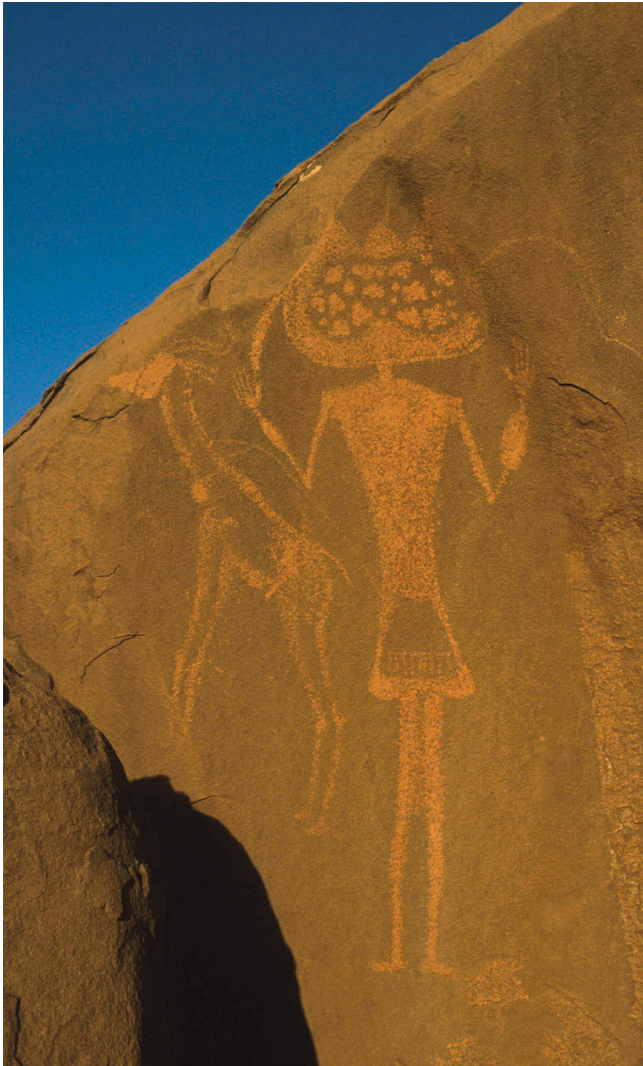


Fig. 7. — Dama gazelle (*Nanger dama* (Pallas, 1766)) engraved next to an anthropomorph at Iwelen, Air (Niger). Photo credit: Karl Heinz Striedter.

is evident that already the engraving shown in Figure 5, photographed in the near vicinity of Figure 6, displays a somewhat similar phenotype, even though in Figure 5, on the balance of all evidence, an almost convincing dama gazelle is referred to. Therefore, the engraver(s) may have had a principal tendency to overemphasize the stockiness of gazelles, beyond a truly naturalistic workmanship, and Figure 6 may add just another phenotype in the same series that extends this stylistic trend. As an alternative, neither Figure 5 nor Figure 6 are natural representations of real animals, but they represent creative combinations of different species, among which both dama gazelle (more so in Fig. 5) and hartebeest (predominant in Fig. 6) can likely be discerned. Of interest, Guagnin (2015) reported a remarkably similar antelope from Wadi al-Ajal (Wadi al-Hayat) in the northern Mesak Settafet (which this author interpreted a dama gazelle without reservation), which indicates that this special “hybrid” morphotype was not the chance product by a single originator only, but that it

is a widespread artistic configuration in the Mesak – apparently therefore this weird antelope had been depicted on purpose, and perhaps with a meaning or a function.

NIGER

Iwelen, Département Arlit (Niger)

Archaeologically and for its rock art, Iwelen in the Air Mountains of Niger might be one of the most important sites in the southern Sahara, displaying rock images of not rarely considerable dimensions. They are carefully pecked into the granitic substrate, so that even minor details are visible. The local rock art has been executed over a millennium – the engravings in the Air Mountains in general have been referred to the period 1500 to 3000 years before present (Coulson 2007). The whole fauna of the prehistoric Sahel belt is shown, most commonly giraffe, but also elephant and rhinoceros, besides various antelopes, aoudad, ostrich and baboons, and also domesticated cattle and dogs.

Figure 7 from Iwelen shows an undoubted dama gazelle in precise representation. A thin light line extends from the hip of the anthropomorph figure to the neck of the gazelle, reminding of a rope in the sense of a lead to guide a tamed animal. This impression is reinforced by what could be a noose surrounding the gazelle’s neck. However, the alleged leash is engraved rather superficially, being incised less deeply than the human and gazelle figures. Accordingly, it could have been added to the composition independently and subsequently by a different engraver – it is not uncommon that Saharan rock images became replenished if not disfigured by later additions. Equally possible, this “rope” represents a mere symbolic connection between the human and the animal. Therefore, and since the contemporaneity of our anthropomorph and the dama gazelle is not guaranteed, the conclusion of a tamed or even domesticated dama gazelle on a leash would be premature. Nevertheless, a closer relation of humans to dama gazelles seems plausible from the many engravings probably showing this herbivore at Iwelen, and a handling of these gazelles by hunters or even by people attempting to capture or to tame dama gazelles cannot be excluded.

Iwelen revealed another convincing dama gazelle with a naturalistic body shape and horn form (Fig. 8A). Less easy is the decision if the engraver had eventually intended to emphasize a skewbald colouration of the body pelage, by pecking the rock surface to lighten up the posterior body against the untreated forefront. As is evident in other rock art sites too (elsewhere in this article), the emphasis of certain body parts by pecking is a widespread technique of Saharan rock engravers, and it is not confined to dama gazelles (which are ornamented by contrasted colour fields in reality), and neither to animals only, but is a stylistic device ornamenting many depicted objects. Since the light appearance of the haunch is not a white pigment, but the result of pecking the stone, it needs not indicate a white pelage patch of the gazelle, but rather a merely different pigmentation or pelage structure on the haunches in relation to the anterior body. However, since the rear pole of real dama gazelles looks whitish in reality, the partly pecked animal in Figure 8A is remarkably suggestive of this gazelle.



FIG. 8. — Dama gazelles (*Nanger dama* (Pallas, 1766)) engraved at Iwelen, Air (Niger). **A**, fairly naturalistic representation of this species; **B**, schematic image proposing an interaction human-gazelle. Photos credits: Karl Heinz Striedter.

The previous interpretation is corroborated by another gazelle from Iwelen (Fig. 8B), which combines the slender limbs and the long neck of what could be a dama gazelle with overlong horns, and an even more creative motif of a body mosaic with unnaturally square-shaped, dark and light blotches. Other than in the presumed dama gazelles of Figures 7 and 8A, and in the assumed goats of Figure 9A,

the animal in Figure 8B with a body brindled in dark and white proves to what constructive degree this body ornamentation by pecking has been enhanced. Comparable to Figure 7, Figure 8B reveals an anthropomorph next to the gazelle, evolved stylistically to the form of a double-triangle in headstand, and with a conjugation line connecting this man with (probably) a dog and a gazelle at his left, and



FIG. 9. — Partly naturalistic rock images of bovids from Iwelen, Air (Niger), inferred to be partly inspired by dama gazelles (*Nanger dama* (Pallas, 1766)). **A**, white stars mark the referred specimens discussed in the text. Photos credits: Karl Heinz Striedter. Scale bar: **A**, **B**, 4 cm.

a further dog to his right. The connection line to the gazelle starts from the man's head, the line to the second dog from the region of his skirt. We doubt that these engraved lines represent real things. Rather they might mark an abstract or symbolic relationship of these subjects, possibly in a context of "hunter, hunting". The term "ideogram", in the sense of a graphic symbol that represents an idea or concept, seems appropriate for such signs. Like in Figure 7, this may or may

not point to these animals being under the direct control of the anthropoid, presumably by symbolism or less likely also by a physical connection with a leash.

Further artwork from Iwelen (Fig. 9A) displays other bovids with "dichromatic" mottling, an effect produced again by pecking the rock. These bovids look goat-like, and with the partly pecked, bipartite body surface they could be piebald goats. However, a neck too long for a goat and the twisted

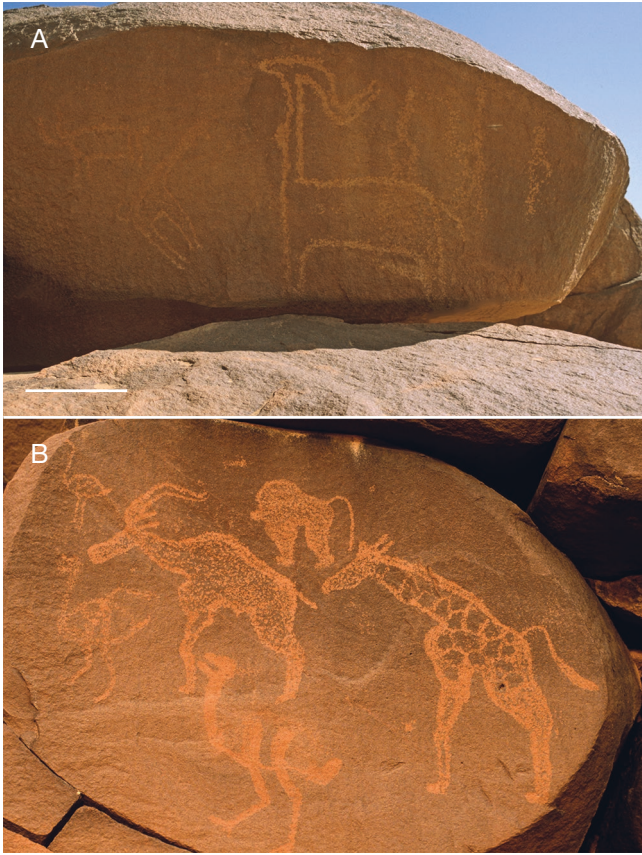


FIG. 10. — Unimposingly naturalistic bovids depicted at Iwelen, Air (Niger), which could be partly inspired by gazelle morphologies. Photos credits: Karl Heinz Striedter. Scale bar: 4.5 cm.

horns are reminiscent of a gazelle. Figure 9B shows yet more examples of crudely antelope quadrupeds with partly pecked bodies. The horns of the three specimens are similar, but details of the pecking differ. Dama gazelles may have inspired the engravers, even though their interest (or technical ability) was insufficient to produce entirely naturalistic representations. Perhaps they did not differentiate clearly between wild gazelles and domesticated goats.

Figure 10A is a further image from Iwelen with yet more artistic freedom in depicting wildlife in a stylized manner. However, despite the seemingly creative modification of this animal, there is no other native species in this area which would fit this image better than does the dama gazelle.

Apart from a giraffe, a male baboon and three birds, Figure 10B displays a bovid that appears rather fictitious. Its body position does not look physiological, and the raised withers and the fairly straight, stretched out face resemble weakly a hartebeest. However, the short tail and the protruding horns are definitely not like in a species of the Alcelaphinae. This animal resembles the antelope in Figure 6 from the Wadi Taleschout, interpreted by us as a creatively modified hartebeest with traits of a gazelle, and the somewhat hartebeest-like specimen of Figure 10B may also be inspired by a gazelle, and in this case, a large *Nanger* gazelle.



FIG. 11. — A stylized (A) and a more naturalistic (B) dama gazelle (*Nanger dama* (Pallas, 1766)) engraved at Dao Timmi, Djado Plateau (Niger). Photos credits: Karl Heinz Striedter. Scale bar: 4 cm.

Dao Timmi (Dao Timmi), Bilma (Niger)

A rock site near Dao Timmi in the Djado Plateau of northern Niger, a mountainous area made of sandstone and basalt, revealed a gazelle of 30 cm body height, followed by a smaller



FIG. 12. — Rock image of a possible dama gazelle (*Nanger dama* (Pallas, 1766)) from Arkana, Djado Plateau (Niger). Photo credit: Karl Heinz Striedter.

one (a juvenile?) (Fig. 11A). Despite its stylized nature the adult seems to be a dama gazelle. Another animal in this composition, perhaps a lizard, is not clearly diagnosable. The dama gazelle is engraved on the wall of a rocky ridge, one of several parallel ridges of this area. Figure 11B looks likely a dama gazelle too, carved into a rock wall together with an ostrich. Its horn shape makes it the most naturalistic representation of a dama gazelle in northeastern Niger.

Arkana, Département Bilma (Niger)

Located only 50 km northwest of Dao Timmi, and also in the Djado Plateau, Arkana revealed a stone plate with incised contours of two slender, long-necked and long-legged antelopes, possibly gazelles (Fig. 12). The horns are not naturalistic for a dama gazelle, but there is no other species locally than *Nanger dama* which would suggest itself as a better model for this engraving. Similar phenotypes appear at various rock sites, so that we conclude that these engravers were inspired by dama gazelles, even though not every morphological detail is indicated precisely, because pure artistic creativity would not have converged on such closely concordant images by mere



FIG. 13. — Presumed gazelle engraved at the Enneri Yentas, Djado Plateau (Niger). Photo credit: Karl Heinz Striedter. Scale bar: 4.5 cm.

chance. Arkana (“confluence” in the Toubou language) denotes the junction of two runoff courses, the Enneri Domo and the Enneri Blaka. Next to this point an elongate rocky ridge emerges, whose flat surface area holds the most important ensemble of rock art of the region. The concrete site of our rock image, called Arkana 1, and some others around under rock shelters or on the flat surface of escarpment outlier hills, have rock engravings from various epochs.

Enneri Yentas, Département Bilma (Niger)

Enneri Yentas (Enneri means “dry or ephemeral riverbed” in the Toubou language) is the name of a narrow valley eroded deeply into a plateau, located at some 20 km distance northwest of Enneri Blaka and Arkana, and within the same Djado Plateau. Rock art is concentrated around the valley mouth created by the Enneri Yentas. One of the sites with engravings in this valley contained a simplistic, stylized bovid (Fig. 13) of 35 cm body length which, in relation to the selection of antelopes occurring during the last millennia in the area, can only be a dama gazelle, on account of its slenderness and the elongated neck and limbs.

Enneri Kolo Kaya, Département Bilma (Niger)

Approximately 40 km northwest of the Enneri Yentas (and also in the Djado Plateau) is located a depression entered by the Enneri Kolo Kaya. Rock art sites have been found around the depression, particularly in its northern portion. There are two noteworthy representations of likely dama gazelles: Figure 14A shows an engraving of 20 cm length, finely ground into the rock plate, and Figure 14B another one of 29 cm body length, incised more deeply into the stone. In both images the gazelles are somewhat stylized, but still they can be rated as moderately naturalistic.

MAURETANIA

El Rhallaouiya, Département Ouadane (Mauretania)

The site El Rhallaouiya is found 150 km northeast of Ouadane in Mauretania, and close to (and below) the cliff bordering



FIG. 14. — Two moderately naturalistic engravings of dama gazelles (*Nanger dama* (Pallas, 1766)) from the Enneri Kolo Kaya, Djado Plateau (Niger). Photo credit: Karl Heinz Striedter. Scale bars: **A**, 3 cm; **B**, 4 cm.

the northeastern extension of the Adrar Plateau. It yielded approximately twenty images of engraved antelopes among more than 200 rock images in total (Vernet 1996). The four animals shown in Figure 15 could be dama gazelles, albeit not engraved with naturalistic precision. We selected them from a greater number of further examples which may possibly represent this species too, but with less likelihood. The animals' contours are schematic, but the slenderness of their bodies and the elongated neck might refer to dama gazelles

more than to any other bovid from the area, either now or in prehistory. The horn shapes vary among the four chosen examples, already indicating that the engravers had not arrived at a naturalistic depiction. The three animals reproduced in Figure 15A-C carry horns which are different from any bovid species known from North Africa, but the fourth gazelle (Fig. 15D) has horns which resemble those of the dama gazelle. Of interest are the pecked hind bodies of more or less all our examples from El Rhallaouiya, reminding of other ga-

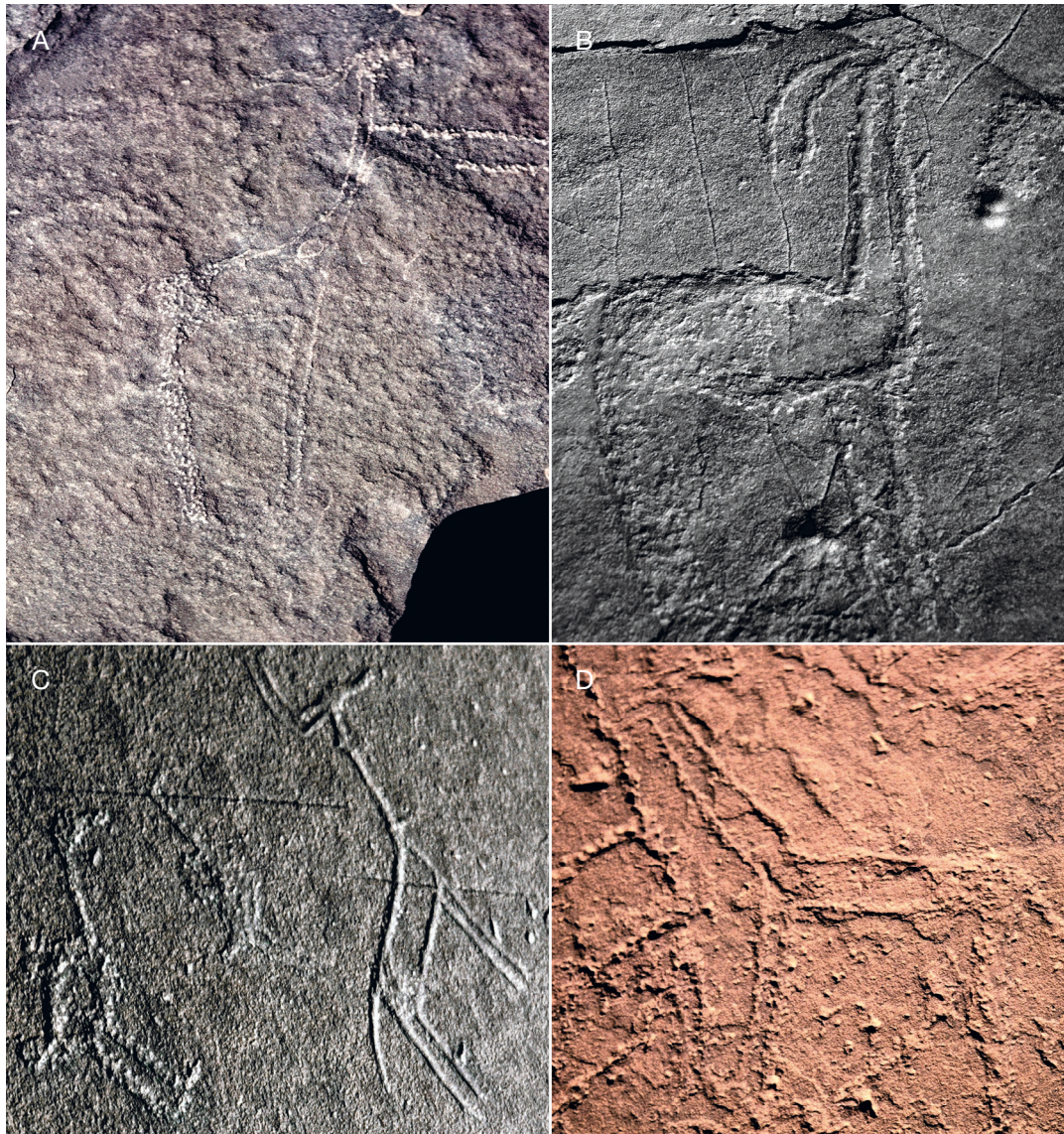


FIG. 15. — Four examples of gazelle-like engravings from El Rhallaouiya (Mauretania), considered to be possible dama gazelles (*Nanger dama* (Pallas, 1766)), despite their schematic representation. Photos credits: Robert Vernet.

zelle bodies engraved with localized pecking elsewhere in the Sahara. Overall, we consider these engravings (and presumably several more of them not shown here) as possible dama gazelles, because alternative species appear less likely; certainty of this conclusion cannot be guaranteed. Vernet (1996) published other engravings from El Rhallaouiya, which may also represent various antelopes even though they are cruder and are in fact simplistic stick figures. Their elongated necks may be, at least partly, a preconceived style element rather than the precise depiction of the organisms, because such long necks are found in a variety of animals engraved at El Rhallaouiya. According to Vernet (1996), the age of this artwork could be rather young, perhaps only 4000 years, which would refer these images to human pastoralist tribes which had less contact to wildlife than ancient hunter-gatherers, and thus perhaps had less competence to engrave naturalistic images.

ALGERIA

Oued Afeifo, Djanet Province (Algeria)

Afeifo is located near the southern edge of the Tassili n'Ajjer Mountains, at about 75 km southwest of the Algerian oasis city of Djanet. Figure 16 shows likely dama gazelles from this site, being one of only a few examples in the Sahara of a colour painting. The bodies display a brown dorsal saddle patch from the neck to the base of the tail, bordering on the whitish ventral skin. This saddle patch matches in general the two western subspecies of the dama gazelle, *N. d. mhorri* (Bennett, 1833) or *N. d. dama* (Pallas, 1766). Since the frontal head is painted largely in white, however, the nominate subspecies seems more likely, if the details of the head are indicated biologically pertinent at all, because the mhorri gazelle has heavily ornamented, eye-catching head patterning (see Discussion).



FIG. 16. — Painted dama gazelles (*Nanger dama* (Pallas, 1766)) from the Oued Afeifo, Tassili n'Ajjer (Algeria). Photo credit: Karl Heinz Striedter.



FIG. 17. — Two possible dama gazelles (*Nanger dama* (Pallas, 1766)) engraved at Tagmart, Ahaggar Mountains (Algeria). Photo credit: Karl Heinz Striedter. Scale bar: 7.5 cm.

Tagmart, Tamanrasset (Algeria)

Tagmart in the Ahaggar Mountains of Algeria is located 20 km northwest of Tamanrasset town. The image of two antelopes with elongated necks from this site (Fig. 17) may show dama gazelles, since no other equally long-necked bovid has ever occurred in this region (giraffes have only short and straight head appendages and their ossicones are not curved). This hill site, covered by large rock boulders and weathering debris, displayed further engravings of elephant, giraffe, gazelle, cattle and humans. The images are executed by pecking, i.e. hammering and chipping away the rock surface.

Tikudawin, Tassili n'Ajjer (Algeria)

The site of Tikudawin in the Tassili n'Ajjer offered images of fairly convincing dama gazelles (Fig. 18). This artwork is another example of the rare Saharan colour paintings, the gazelles apparently caught in the act of movement. Their neck and their shoulders are tinged in red-brown, and the rump of the animals, which is however not represented intact in the specimen of Figure 18B, could be whitish in at least two individuals. In particular when seen in the context of the completely white heads, such a light rump without a trace of longitudinal red-brown stripes running down from the saddle to the (hind)legs is at first sight compatible with the eastern subspecies *N. d. ruficollis*. However, the posterior boundary of the dark shoulder patch is drawn obliquely-upright from as low as the lower breast to the withers, which is a design quite different from the real pattern in any living subspecies of the dama gazelle, and therefore the value of this detail for zoological inference is questionable (see Discussion section on subspecies identification). The head and the horns of this gazelle look remarkably naturalistic. Tikudawin revealed



FIG. 18. — **A**, Paintings of dama gazelles (*Nanger dama* (Pallas, 1766)) from Tikudawin, Tassili n'Ajjer (Algeria). The species is marked by white stars; **B**, enlargement of the left specimen in **A**; **C**, dama gazelle, painted to the right of some working persons who are perhaps cleaning an animal hide before tanning. Photos credits: Karl Heinz Striedter.

further images of gazelles which, concluded from their body shape and the dark flank stripe, might represent the dorcas gazelle (*Gazella dorcas* (Linnaeus, 1758)).

DISCUSSION

Before drawing zoological conclusions from prehistoric rock images, the correctness of identifying dama gazelles from sketchily engraved contours requires critical consideration.

AUTHENTICITY *VERSUS* ARTISTIC CREATION IN PREHISTORIC ROCK IMAGES

Rock images are best not interpreted piece by piece in isolation, but in the context of more examples in the surroundings and from beyond, in order to recognize constant elements of artistic style which reappear in different subjects. A conformation for this rule is provided by the most naturalistic dama gazelles painted anywhere in Saharan rock, i.e. the huge piece of artwork, 480 cm in length and 320 cm in width, detected by Henri Lhote at Iheren in the Algerian Tassili n'Ajjer (von Gagern 1978; Holl 2004). This painting excels by the naturalistic representation of wildlife species (dama gazelle, hartebeest, scimitar-horned oryx, ostrich, elephant, and many giraffes), detailing their phenotypes precisely. Composition VI within an extended assembly of further paintings shows two groups of four and three dama gazelles at the left margin and in the upper right center, the latter devoid of horns and thus presumably juveniles (Fig. 19). The whole tableau was dated by the radiocarbon method to 2900 ± 110 years BCE, although this age does not necessarily refer to the segment with the dama gazelles (Holl 2004; pers. comm. 2021). The species identity as dama gazelles cannot be doubted, with the clearly visible red-ochre saddle patch sending out a stripe across the haunches and towards the hindlegs (Fig. 19). Although this perhaps best true-to-life representation of dama gazelles anywhere in ancient artwork reveals the phenotype correctly, closely adjacent rock images repeat similar skin pigmentation patterns in domesticated sheep, with dorsal and cephalic colour fields identical to those of the gazelles. Apparently, the painters used the same overriding style of how to image different bovids, although in this case they might have been inspired by dama gazelles indeed, and have transferred their body pigmentation to sheep. The opposite direction is also conceivable elsewhere, i.e. the transfer of morphological elements from other species to dama gazelles so that, in principle, a modern zoologist must reckon that even the image of a dama gazelle executed with realistic naturalness may contain single anatomical details added as an inspiration from further species.

Systematically applied, constant stylistic elements which reduce the zoological value of rock art include the “ovaloids” (Hallier 1990): these are elliptical symbols, egg-shaped and standing upright, which abound in Saharan rock images, either as geometrical figures in isolation or as body appendages attached to anthropomorph or theriomorph outlines.

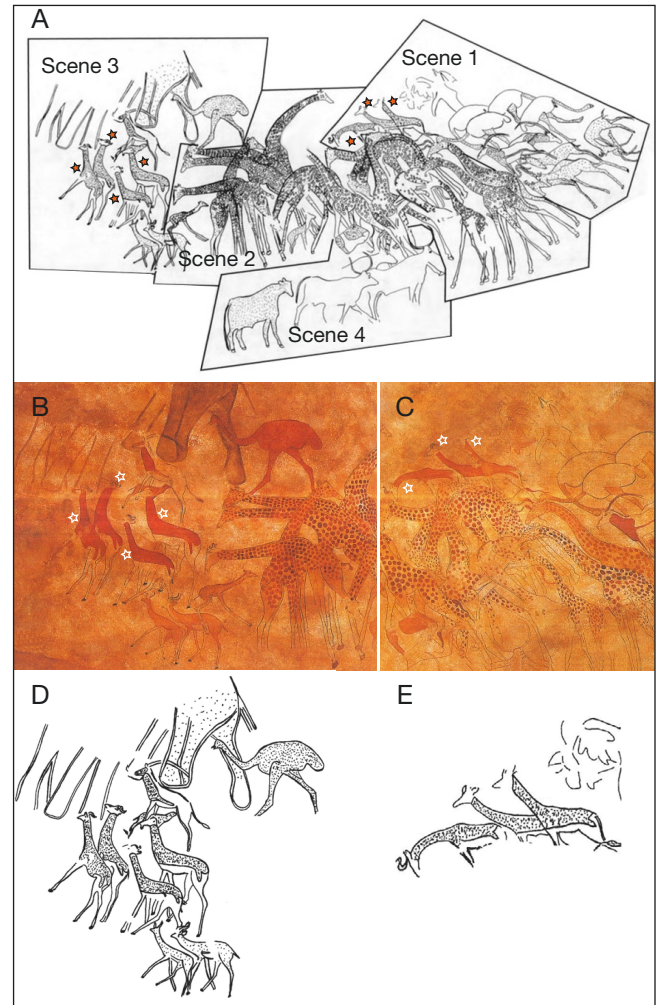


FIG. 19. — Wall painting of a herd of mixed wildlife from Iheren, Tassili n'Ajjer (Algeria). The dama gazelles (*Nanger dama* (Pallas, 1766)) are highlighted with stars. **A**, ink sketch of the complete scene; **B**, image of the scene 3; **C**, image of the scene 1; **D**, **E**, enlarged extracts from sketch **A**. Credits: sketches originally drawn by P. Colombel, one of the painters on Lhote's expedition to the Tassili region, reproduced here from Holl 2004 (**A**, **D**, **E**); photos reproduced from von Gagern (1978) (**B**, **C**).

Sometimes, ovaloids decorate the heads of engraved antelopes, where they stand either in the place of horns or appear as accessory attachments in addition to the horns (illustrations in Hallier & Hallier 1992). Hallier (1990) hypothesized from a broad analysis of the contexts that originally ovaloids had been derived from a symbol for a human penis sheath, and Hallier & Hallier (1992) proposed that when posed on the head of an animal, such a headdress would indicate that this animal was earmarked by its owner for sacrifice to the gods. We feel that various authors, when interpreting antelopes in rock art, arrived at wrong species diagnoses by confusing ovaloids with elongate, lyre-shaped horns (for an example, see the section on misidentified gerenuks below). We refrained from conclusions based on assumed horn shape when the putative “horns” could have been inspired by the ovaloid theme. In any case it is, surprisingly, the shape of horns rather than the body contours, which we found most frequently

untypical for the very bovid species which apparently were the model for a depicted beast. This is a pity for the zoologists, because horn shape as such would be a good pictorial marker for species identity.

In the end, zoological interpretations of prehistoric rock art must remain tentative, even though some conclusions are often more plausible than others. Certainty and hard evidence cannot be easily expected. There are degrees of zoological precision, from fully naturalistic images via quasi or partly naturalistic cases to hardly interpretable images due to crude or stylized execution. Border cases are sometimes those rock images where dama gazelles may have inspired the figure, although single features such as the sloping dorsal profile are more reminiscent of a hartebeest. Such weird “composed creatures” can sometimes be seen in published rock images too, where they have been perceived by different authors as a variety of antelope species. Interestingly, such – ultimately unidentifiable – subjects are found with similar morphology at dispersed localities, suggesting that they are not mere chance products of incompetent workmanship by a single creator, but being engraved many times independently but concordantly they were realized on purpose: compare our Figure 6 of such a “composite bovid” with the very similar, alleged dama gazelle reported by Guagnin (2015) from another locality. Sometimes we also felt unsure if a certain rock image represented a gazelle or small domesticated bovids such as sheep or goats. These useful animals, on which entire pastoralist cultures have been based, are not only extremely abundant in Saharan rock art, but they are presented in quite variable morphologies. Such “partly naturalistic” images abound in many places (Hallier 1990). Transitions between different animal species may refer to all aspects of creative execution, such as the body shape, the morphology of single organs (heads, horns, limbs, and tails), or the surface ornamentation.

IDENTIFIABILITY OF DAMA GAZELLES

Gazelles are less common in Saharan rock art than are elephants, giraffes, rhinos or hartebeests. Among those gazelles which can be identified with some plausibility, the small-bodied species in the genus *Gazella* prevail, most of them likely representing dorcas gazelles, which is the most abundant species of the Antilopinae in North Africa. The larger *Nanger* species are much rarer by comparison in life and in rock art, although the conspicuous dama gazelle cannot be easily mistaken. The general body structure is conserved in all gazelles, but *N. dama* is considerably larger than are the *Gazella* species, and has a longer neck and longer limbs – this species stands out by its slenderness. The dama gazelle has an even longer neck (by one fifth to one third) than its congeneric sister species in *Nanger* (Oboussier 1974), approaching in this regard the gerenuk that has the relatively longest neck of all antelopes. Dama gazelles are morphologically specialized for cursorial life adapted to the open Sahelian and (semi)desertic biotope (Oboussier 1974). Therefore, the dama gazelle should usually be well identifiable from engraved body contours only. Its long neck could, in principle, lead to confusion with giraffes, which appear prolifically in Saharan rock art. But essentially

all of the many rock images of giraffes that we checked could be distinguished by the steeply upward rising back, by the characteristic pelage ornaments, or by both – the upright posture of giraffes standing in clear contrast to the horizontal dorsal profile of the dama gazelle. However, the typical giraffoid neck mane is only sometimes depicted in rock art. Moreover, since antique times many text authors have confused in script dama gazelles and deer, chiefly the fallow deer (*Dama dama* (Linnaeus, 1758)), which according to prehistoric and ancient artwork may have possibly inhabited North Africa historically (Joleaud 1935) despite an absence of fossil bones (Gentry 2010). In fact, both scientific species names “*dama*”, included alike in *N. dama* and in *Dama dama*, are thought to be derived from the same root, presumably the name for an unknown North African bovid in the Berber or Touareg languages (Joleaud 1935). The influential Roman author Pliny the Elder wrote in Latin of *damae* which became, as *damae Pliniae*, the ubiquitous, generic designation for various kinds of small bovids and cervids in the literature of the Roman Empire and also later on in various European languages. We are unaware, however, of problems to distinguish our gazelle from deer in rock art, since the palmated antlers of fallow deer usually stand out unambiguously in engravings.

MISIDENTIFIED DAMA GAZELLES, AND ALLEGED GERENUKS AND DIBATAGS IN SAHARAN ROCK ART

However, remarkable cases of misidentification concern two antelopes from the Horn of Africa, the gerenuk or giraffe gazelle (*Litocranius walleri* (Brooke, 1878)) and the dibatag (*Ammordorcas clarkei* (Thomas, 1891)). Lutz & Lutz (1995) found the rock image of our Figure 3A in parallel, and described it as “a herd of twenty gerenuks” instead of dama gazelles. Previously, Lutz (1993) had been aware that this species diagnosis was problematic, because the gerenuk has never been confirmed from the Mesak and even its very wide surroundings, and this author reasoned that the rock site might indicate a species other than the giraffe gazelle; nevertheless, he did not consider the dama gazelle and Lutz & Lutz (1995) repeated the identification as gerenuk. However, gerenuks are regional endemics from the Horn of Africa, and during their evolution have never come close to the Sahara. The linear distance from the nearest recorded locality of gerenuks to southwest Libya is approximately 3700 km, spanning vast intervening biotopes which now (and formerly) are (were) uninhabitable for the species. No zoologist, traveller or hunter, either modern or historical, has ever encountered a gerenuk anywhere close to the Sahara, neither do fossil sites, nor the numerous and often every rich archeozoological excavations of wildlife bones from the Sahara reveal gerenuks. Moreover, gerenuks are not social animals, living singly or in small groups hardly exceeding five to six individuals, and a herd of twenty heads can scarcely be expected (Leuthold 2013); dama gazelles are often gregarious. An even more severe counter-argument is the fact that all individuals of this Libyan herd, as far as is visible on the rock image, carry horns. In the dama gazelle, both sexes are horned, but twenty horned gerenuks would imply as many males spaced closely together, which might be

biologically impossible in an unsociable species where even mixed-sex aggregations of this size are not observed. Guagnin (2015) also recorded a “gerenuk” in rock engravings from the Wadi al-Ajal in the northern periphery of the Mesak; this author was evidently led to her species diagnosis by Lutz & Lutz (1995). Guagnin (2015) believed that the “slender torso, long neck and S-shaped forward curving horns left no doubt in the identification of this species”. However, her reproduced rock image does not show a single distinctive feature of a gerenuk, being a highly stylized artistic creation. This specimen truly has S-shaped horns in side view, but contrary to what Guagnin (2015) claimed such a horn shape is not found in gerenuks; one may add that no African gazelle-like species has such horns. Guagnin (2015) reasoned that this “gerenuk” resembled a dama gazelle but was a gerenuk nevertheless; but this conclusion rests on her identification of a dama gazelle in an adjacent rock image which is however remarkably similar to our fictitious antelope from Wadi Taleschout (Fig. 6), an evidently compound beast that we propose to be a creative composition of chiefly hartebeest and to a lesser extent dama gazelle. For us, none of these rock images from the Libyan Mesak represent gerenuks, since any supporting evidence for this identification is absent and all biological knowledge argues against this interpretation.

The story of gerenuks in North African artwork is complex, but it is of interest to review it here, since it seems to be a remarkable case of misguided scholasticism which caused a tradition of almost universal acceptance despite the absence of evidence. It starts with a slate from the Nagada Period of Predynastic Upper Egypt from the late 4th millennium BCE (named Battlefield palette, kept by the Ashmolean Museum today and a part of it in the British Museum, AM inv. no. 1892.1171 and BM inv. no. EA 20791; A. Brémont, pers. comm.), which shows fragments of two extraordinarily high-legged animals with a long neck, a giraffe-like (or perhaps camel-like) head, and a neck covered for its complete length by a mane of short hair (Legge 1909). A consultant requested to comment on this animal, the zoologist Ray Lankester, advised that these giraffes should be gerenuks, but Legge (1909) did not accept this, since the body shape, the overlong legs, the face, and not least the unmistakable neck mane excluded the gerenuk with certainty, but were doubtless giraffoid characters. Moreover, very similar slates kept in the Louvre Museum at Paris showed further unmistakable giraffes in almost the same morphology. One must accept Legge’s (1909) diagnosis of giraffes, and may point to further similar palettes in other museums, e.g., the Prunkenpalette at Berlin (inv. no. 23301; <http://www.francescoraffaele.com/egypt/hesyra/palettes/prunk1.htm>, last consultation on 18 May 2022) or a cylinder seal at Cairo (<https://www.flickr.com/photos/manna4u/26086201274>, last consultation on 18 May 2022), on which scientific consensus agrees that they show giraffes (A. Brémont, pers. comm.). Petrie (1953: plate D, fig. 13) republished the Battlefield palette under the name of “Two Gazelle palette” and explains the depicted giraffes as “long-necked gazelles”, comparing them to gerenuks. Petrie’s (1953) opinion is repeated in the current internet catalogue

of the British Museum (https://www.britishmuseum.org/collection/object/Y_EA20791, last consultation on 18 May 2022). Midant-Reynes (1992: 243) reprinted a simplified ink sketch of this same palette, clarifying that two giraffes were shown, and also pointing to the very similar image scene depicted in the Giraffe or Four Dogs palette kept in the Louvre collection, Paris (inv. no. E 11052). Nevertheless, Manlius (2011) reproduced Midant-Reynes’s sketch (albeit under a wrong quotation hinting to another figure in this volume), reinterpreting it as showing gerenuks, although even in his reproduction the giraffoid face, the tail, the neck mane, and the much longer legs than the neck, exclude a gerenuk without doubt.

Winkler (1938) wrote of gerenuk motifs in prehistoric rock art in the Egyptian eastern desert only with a question mark (added wherever this species name was printed), and he gave no illustration to support his assumption (his figures of antelope-like beasts from this culture are not at all reminiscent of gerenuks). Soon afterwards, Winkler (1939) published what he deemed a doubtless gerenuk, this time from the Western Desert of Egypt, where an anthropomorph figure leads a quadruped on a rope tied around its neck. The leashed animal is a most simplistic, schematic sketch of a slender quadruped with overlong legs. The head is adorned by two long, antidromic curvatures, shaped like the bulged contours of an amphora, which have been interpreted as horns by all authors, although they remind us of the ovaloid symbols which abound in North African rock art, and which might have a symbolic meaning in mythology, not necessarily denoting horns (see the section Authenticity *versus* artistic creation in prehistoric rock images). We conclude that Winkler’s (1939) “gerenuk” was a crudely stylized stick figure of some imaginary mammal found worth by the engraver to carry ovaloids. In case these figures are not ovaloids but horns indeed, the animal would be identifiable as a bovid, but not further. The beast is sized as big as the human figure, much too tall for a gerenuk, and the only similarity with a gerenuk is the slenderness of the body. However, the adjacent human is also extraordinarily slender, and if this person was not intended to be shown anorexic, presumably the slimness of these figures results from the artistic style, and lacks diagnostic significance. Despite his flimsy argument, Winkler’s (1939) claim has survived as an accepted proof of Egyptian gerenuks to the present date, his figure reprinted over decades, e.g., in Schomber (1966) and Leuthold (2013). The influence of Winkler (1939) profited from the detailed confirmation of his alleged gerenuk by Keimer (1942), who opined, as such reasonably, that Winkler’s “gazelle” could not represent the short-legged and short-necked dorcas gazelle. The latter was then the only gazelle known to inhabit Egypt, before later archaeozoologists could confirm prehistoric dama gazelles in that country. Keimer (1942) was prudent enough to note that Winkler’s (1939) animal was too tall in relation to the human beside it for a gerenuk, and that its horn shape did not resemble a gerenuk, and so he speculated that the engravers had only a vague impression of gerenuks from memory, since this

species had already disappeared locally before the creation of the rock image. Keimer (1942) added another case, an engraving from Bet el-Wali (Beit el-Wali), a rock-cut temple built by Ramses II south of Aswan, which depicted the donation of wild animals as a tribute to a ruler. Among other animals, long-legged gazelles are imaged, which could not be dorcas gazelles for Keimer (1942). We concur that this might be correct, but the derived consequence that in this case they must be necessarily gerenuks is as inappropriate as it was in the case of Winkler's example.

Cooney (1967) perceived a gerenuk on a polychrome limestone relief from the reign of the Egyptian king Amenhotep III. Other than the previous examples, this gazelle looks remarkably naturalistic, and reveals details of the genus *Gazella*, presumably being a dorcas gazelle. Cooney (1967) in fact recognized the absence of any similarity with a gerenuk (small body size, short limbs), and so he defended his unfitting diagnosis by assuming that the painter had to falsify the gerenuk morphology by modified body proportions when downscaling the image, to make it fit into the limited space of the composition, in which the dominant figure of a god left no room to paint a gerenuk correctly. Cooney (1967) further claimed that gerenuks were easy to identify by their horns heavily ridged almost up to the smooth, unridged tips which are springing forward, and by having a black or brown band running down the back. The first of these two alleged characters is however not exclusive to *Litocranius*, and the latter supposed character is erroneous.

Brentjes (1962) identified as gerenuks several bovids painted schematically on a pottery box from El Amrah in Egypt (and kept in the British Museum [inv. no. EA32639]). Extraordinarily short-legged, stocky and compact, and enormously long-horned, with protruding horns which are straight for the greatest length before terminating in a sharp apical hook, these unnaturalistic sketches do not fit any bovid species neatly. A safe species diagnosis is precluded, although in our eyes the animals could perhaps represent caprines (Nubian ibexes [*Capra nubiana* F. Cuvier, 1825]). Not unreasonably, already Budge (1902) suggested them as ibexes. In any case, hardly any antelope could be more dissimilar to these figures than the gerenuk, since the very short and thickset legs under a stocky body exclude a gazelle with certainty. Nevertheless, Brentjes (1962) arrived at gerenuks for the single, perplexing reason that their necks were illustrated longer than their legs. This painting is a good illustration how profoundly uncritical interpreters can differ in their species diagnoses: Glanville (1926) identified these same figures as "horned deer" (*sic*), and an advisor consulted by this author perceived kudus (*Strepsiceros strepsiceros* (Pallas, 1766)).

Osborn & Osbornova (1998) criticized previously published gerenuk identifications in Egyptian art as erroneous, but they added to the confusion by proposing yet more "gerenuks" from Pharaonic artwork in the guise of crude, hardly interpretable engravings that preclude any serious reasoning.

Pachur & Altmann (2006) were aware of the problems caused by their diagnosis of an alleged gerenuk engraved into a rock at "Elubu" in Fezzan (Libya). To explain such an abrupt case of grossly extraterritorial occurrence, thousands of kilometers outside the geographical range of the species,

these authors postulated fossil gerenuks immigrating from Somalia into Libya via the palaeo-drainages of the ancient Lake Chad, an entirely speculative idea devoid of any support from palaeontology. For us their very specimen from Elubu represents a rather convincing dama gazelle.

Schomber (1966) uncritically reproduced Winkler's (1939) crude rock image, and only from this evidence he elaborated a distribution map extending the historical range of the gerenuk over thousands of kilometers along the Red Sea coast to Egypt. Schomber's (1966) book is till date the only monograph dedicated to giraffe gazelles exclusively, and therefore it has influenced many subsequent authors (Le Quellec *et al.* 2005; Manlius 2011; Leuthold 2013; Yeakel *et al.* 2014). For example, the review by Yeakel *et al.* (2014) did no longer question Egyptian gerenuks, on account of the multitude of authors who had reported them from ancient artwork.

Retracing the evolution of this story reveals an evident example of a scientific tradition initiated chiefly by one mistaken pioneer author (Winkler 1939), who succeeded to be accepted by two influential master papers serving as fundament for all subsequent reviewers (Keimer 1942; Schomber 1966). We think it is high time to lay to rest the view of gerenuks in (pre)historical art from North Africa. Most such alleged gerenuks are barely interpretable, being schematic representations of stylized beasts, sometimes not even safely interpreted as bovids. An exception is the naturalistic "herd of twenty gerenuks" by Lutz & Lutz (1995), which however qualifies so evidently for dama gazelles that no *ad hoc* hypothesis for grossly extraterritorial gerenuks is required. In body size, physical proportions and slenderness, gerenuks resemble dama gazelles, and the most typical character visible in rock engravings, i.e. the thin, elongated neck, is only slightly longer in gerenuks than in dama gazelles. At best, a piece of rock art would have to be extraordinarily naturalistic to differentiate both species, and this high degree of realism is not fulfilled by any of the quoted rock images. Most of the alleged gerenuks from North Africa are undiagnosable quadrupeds, although most might be bovids, and single ones could be gazelles, and if so presumably *Nanger* gazelles, either *N. dama* or *N. soemmerringii* (Cretzschmar, 1826). A convincing example of a gerenuk in a prehistoric rock engraving or in Pharaonic artwork remains to be detected.

We concur with Riemer (2011), who observed long-necked gazelles engraved at a rock at Meri 06/12, an isolated hill in a desert plain approximately 60 km southwest of the Dakhla Oasis in Egypt: aware that gerenuks are also long-necked, Riemer (2011) nevertheless knew that giraffe gazelles have never been found in the rich archaeozoological databases from this part of Africa, and also that dama gazelles use to carry their long necks in a raised position. Indeed, the details of Riemer's (2011) specimen are not only easily compatible with the dama gazelle; one may even add that it is most likely a juvenile of this species, with the typical, forward-bent horns of immatures engraved in a naturalistic manner. We accept this image as a piece of convincing evidence of a young dama gazelle in the Western Desert of Egypt. There are no dama gazelles in Egypt now and recent records from the last centuries are also unavailable, but chiefly Pöllath (2009) identified

numerous bones from many sites in the Western Desert of Egypt as *N. dama*, spanning the period from 9000 years BCE to 3500 years BCE, in part already mentioned by Van Neer & Uerpmann (1989) and Berke (2001). More locally, Gautier (1980, 1993) had reported dama gazelle bones from the last interglacial and the early last glacial from Bir Tarfawi and possibly from Nabta Playa, Gautier (2001) from Nabta and Bir Kiseiba, and Gautier & Van Neer (1989) from the Late Pleistocene Fayum. There are no more recent bones of Egyptian dama gazelles that could be dated into the Dynastic Period of Egypt. Reviews of gazelles in Pharaonic art do not mention the species (Osborn & Osbornova 1998; Stolberg-Stolberg 2003; Strandberg 2009), with the exception of the forgotten records by Hartmann (1864, 1868), who claimed this species from two pieces of Pharaonic artwork from Gizeh and Abu-Sir. The latter claim is difficult to evaluate in the absence of illustrations or detailed descriptions. The current evidence proposes that dama gazelles became extinct in Egypt by the beginning of the Pharaonic era or little later, but before that period they had abounded in the Western Desert.

Another identification problem is posed by the lama gazelle or dibatag. Osborn & Osbornova (1998) reinterpreted Keimer's (1942) alleged gerenuk as a dibatag, since the animal was deemed too small-bodied to be a gerenuk – in reality the dibatag is only moderately smaller, the size difference being too subtle to be recognized from a crude engraving. Polkowski (2018) diagnosed (albeit with question mark) a rock image from the Dakhla Oasis in Egypt showing a group of six gazelle-like animals as a “herd of dibatag”. However, dibatags move in small family parties of three to six animals, which never comprise more than one male, and bigger herds are not observed (Wilhelmi 2013). All six closely spaced “dibatags” from the Dakhla rock site are horned, although in this species only the males but not the females carry these appendages. This would imply a unisexual herd of six males, which is even more implausible for reasons of lacking social tolerance among bucks. Moreover, neither the rich archaeological excavation sites of Egypt and Sudan (Gentry 2010) nor a single historical or modern explorer or hunter have ever recorded dibatags from Egypt or Sudan, and the nearest dibatags are living 3000 km further southeast. Polkowski (2018) was apparently unaware that juvenile dama gazelles have their horns also curved to the front, similar to adult dibatags indeed, and have it in both sexes, so that this herd from Egypt should represent a group of immature dama gazelles. In any case, and if one allows the rather crude precision of rock art, dibatags cannot be differentiated from young dama gazelles from such engravings at all.

A few additional authors have interpreted single slim, long-necked quadrupeds with hornlike appendages as Egyptian dibatags with even less than justification than Polkowski (2018). Manlius (2011) went so far to juxtapose two extremely slender, long-legged and long-necked animals of unrecognizable affinity as examples for an Egyptian dibatag next to an Egyptian gerenuk. Unfortunately, both images are extraordinarily stylized, crudely outlined stick figures without providing anatomical details, and they cannot be identified.

AGE DATING OF DAMA GAZELLE ROCK IMAGES

We dispense of estimating ages for the various rock images of dama gazelles. Radiochemical analyses of the worked rock surfaces under the engraved incisions are unavailable from our sites, and even if available they would not be free of interpretation problems. In this context, scholars of Saharan rock art developed a system of relative chronology, subdividing the images on the basis of stylistic elements, the technical details of imaging, the design of the figured subjects, and of the presence or absence of depicted domesticated cattle, horses or dromedaries (which arrived only late in the Sahara) into periods which are understood as successive stages. This relative chronology is not precise, because allocations to a style period can be difficult if an artwork appears transitional between two such phases, and also different sites may propose different style periods even when likely contemporaneous. Such limitations notwithstanding, the relative chronology offers an orienting temporal assignment. In our periodical allocations provided in Table 1, most engraved dama gazelles are referred to the earliest phase of Saharan rock art, the Hunter or Wild Large Fauna Period, when chiefly wildlife was engraved rather than domesticated animals, typically with deeply incised contour lines. The paintings from Oued Afeifo and Tikudawin are more recent, qualifying for the subsequent Cattle or Pastoral Period, when cattle had arrived in the Sahara during a mid-Holocene phase with a more humid climate. The youngest images are those from Iwelen, pertaining to what we designate as the Libyco-Berber Period, which might be related to the more widely known Horse Period, although at Iwelen horses are not depicted. The translation of this relative chronology into absolute ages is complicated by hypothetical and partly controversial issues, wherefore we dispense with such conclusions. We offer our periodization primarily for the perusal of specialists with experience in the chronology of rock art, who are able to ponder such information in a context. In general, one expects that rock images from the Hunter Period originated before the Cattle Period, which should have begun in the mid-Holocene, when a pluvial phase had made grasslands spread into the Sahara, permitting human cultures based on cattle pastoralism. Our Libyco-Berber Period assumed for the rock sites of Iwelen, similar to the Horse Period elsewhere, could correlate with a yet later date in the two latest millennia before the current era, when the regional climate had aridified again.

ZOOLOGICAL INFERENCES: ZOOGEOGRAPHY

The zoological inferences drawn from prehistoric rock art refer to the former distribution range of the dama gazelle, and to the question which of its different subspecies had occurred in a region.

Although all modern literature indicates a pan-North African distribution of the dama gazelle across the southern/central Sahara (depending on the humidity prevailing in any period of the recent past), the Sahel and partly the adjacent dry savannah zones, from the Atlantic coast to the Nile valley, this consensus obfuscates many knowledge gaps. The species has been largely exterminated over at least one century, and likely for much longer, with only few scattered individuals known to survive in Chad and Niger, and further

ones perhaps in Sudan and Mali. Therefore, only historical evidence can indicate the original geographical range. Literary records by historical travellers, explorers and hunters, and the specimens preserved in natural history museums yield an incomplete picture: records are clustered in regions accessed by many observers, separated by rarely visited lands without confirmed occurrence (Schreiber 2021). In many areas the species had surely been exterminated before modern zoologists arrived. Therefore, scattered records do not necessarily indicate that the dama gazelle had a dispersed range separated by unoccupied zones, but a continuous trans-Saharan range is hypothetical too. The distribution range in Figure 2 is based on the perhaps most precise cartography available for this species, adapted from Cano Perez (1991), who had based her map on reproducible sources (museum specimens and historical travel accounts). Interestingly, the 22 archaeozoological sites across North Africa which have yielded dama gazelle bones from the last 12 000 years, as mapped by Jousse (2017), agree reasonably well with the literary records, in that the dama gazelle could be recorded in spatial clusters but not everywhere across North Africa. In this context of incomplete knowledge, prehistoric rock art may provide useful ancient range records.

DAMA GAZELLES IN LIBYA AND ADJACENT LANDS

Our rock art sites agree with the known range of the dama gazelle in general, confirming the well-established occurrence in Mauretania, central Algeria and Niger. However, we add records for southwest Libya, a region that did not longer hold dama gazelles for most recent-historical explorers to encounter and report upon; there are no museum samples from there. The colonial literature of the earlier 20th century about Libia Italiana (Zavattari 1934), even specialized treatises of the Fezzanese fauna (Scortecci 1942), was unaware of dama gazelles. Hufnagl (1972) considered a hypothetical immigration of vagrants from Tibesti in adjacent Chad, where the species is known to have ranged (Dalloni *et al.* 1936; Scortecci 1943; Malbrant 1952; Blancou 1958), into the periphery of southeasternmost Libya (and very distant from our prehistoric records in Fezzan). More recent reviews (Essighaier 1980; Beudels-Jamar *et al.* 1998; Khattabi & Mallon 2001; Masseti 2010) could not add additional records for Libya, which therefore is not at present an accepted range country. Our rock images from the Mesak (also in Lutz & Lutz 1995, and perhaps Guagnin 2015) extend the historical range of the species. On a closer look, however, the former presence of the dama gazelle in this area has only sunk into oblivion (Lhote 1946; Masseti 2010). The German pioneer explorer Heinrich Barth found a mother and two juveniles of an antelope designated by local tribes as “mereia” and by Arabs as “mohor”, in the Idinen Range close to the town of Rhât (the modern Ghat), on 15th July 1850 (Barth 1857a: 231). Barth’s (1857a) locality is situated only some 150 km from our site in the Mesak. The details of this encounter are presented with minor variation in different editions and translations of Barth’s travel book: e.g., one of the English versions (Barth 1859: 46)

employed another name, “maraiya (*Antelope Soemmerringii*)”, which would point to different species, the Soemmerring’s gazelle (*Nanger soemmerringii*). However, the latter is, and has always been, confined to the lands east of the Nile River and nowhere it approaches Libya, and Barth confuses this species with the dama gazelle also in the case of the *Nanger* population in the Air Mountains of Niger (Barth 1857a: 419), and on the lower Chari River (Barth 1857b: 291). One may add that several authors in the 19th century used to confound the two *Nanger* species (Schreiber 2021). The Franco-Algerian traveller Ismail Bu Derba found “meha antelopes”, which he differentiated from “gazelles”, and which may possibly represent dama gazelles, in the area south of the Algerian township Ouargla (before arriving at Ghat), and he mentioned in particular the Wed (Wadi) Iban Halt, located close to the Wed Ighegharen (the modern Igharghar valley) (Ravenstein 1860). Henri Duveyrier (1864) recorded *Antelope mohor* as common in the “plaine d’Admar” in the lands of the touaregs Azdjer, being presumably the Admer plain southeast of Zaouatallaz (Fort Gardel) and southwest of the Erg d’Admer, off the escarpment of the Tassili n’Ajjer. Subfossil bones excavated in the Tadrart Acacus (Cassoli & Durante 1974; Gautier & Van Neer 1982; Corridi 1998; Garcea 2003) provide additional evidence for dama gazelles in southwest Libya. A previous presence of dama gazelles in the Idinen Highlands and the Tadrart Acacus is highly plausible anyway, these ranges being topographically the eastward extensions of the Tassili n’Ajjer Range in Algeria, where prehistoric rock art and several reports by travellers and explorers of the 19th and early 20th centuries have aptly confirmed the common presence of the dama gazelle. Not unexpectedly therefore, this well-known Algerian population extended into adjacent Libya.

Masseti (2010) included Gharbi Island in the Kerkennah archipelago, 10 km off the Mediterranean coast near Sfax (Tunisia), in the former range of the dama gazelle, citing Vigne & Callou (1996), who had excavated leg bone fragments at this site that suggested an origin from a gazelle but were too large to represent a dorcas gazelle. However, the senior author of this cited study himself does not place too much weight on this speculation, and he proposed to us (J.-D. Vigne, pers. comm. 2021) to await the genomic identification of these bone fragments before concluding the species diagnosis. Moreover, bones excavated in an old Phoenician and Roman settlement, rather than in the wilderness, would not automatically indicate a free-running, native population of this gazelle anyway, which appears unlikely in a small Mediterranean island (c. 6000 hectares); other insular populations of the dama gazelle have never been found anywhere. There is a big question mark behind the alleged dama gazelle from Gharbi Island, a notion fully shared by the excavator of these specimens (J.-D. Vigne, pers. comm. 2021).

Jebali *et al.* (2019) reasoned that the French explorer Pervinquier (1912) might have seen dama gazelles in south Tunisia, but this claim does not stand critical evaluation. Pervinquier (1912) mentioned generic “gazelles”, of which

local inhabitants distinguished three species, without indicating their proper names. The descriptive details in this book permit to identify the dorcas gazelle and the dune gazelle (*G. leptoceros* (F. Cuvier, 1842)), but are vague concerning a “gazelle rouge” which was “little larger” than the dorcas and more “reddish”. Jebali *et al.* (2019) attributed this “gazelle rouge” to the dama gazelle, which is however much taller (shoulder height: 90–120 cm) than the dorcas gazelle (55–65 cm), and therefore this cited hint plausibly refers to the Cuvier’s gazelle (*G. cuvieri* (Ogilby, 1841)), which is indeed a bit taller (60–69 cm) and darker than the dorcas, or to the Algerian red gazelle (*Eudorcas rufina* (Thomas, 1894)). Lhote (1946) had already warned of the severe risk of error when recounting vague hearsay information from native pastoralists about the zoological identity of gazelle species. Finally, a project report by Kacem *et al.* (1994), quoted favourably by Gharaibeh (1997) and Jebali *et al.* (2019), claimed that dama gazelles had inhabited Tunisia in earlier history, but with no supporting evidence. Kacem and his colleagues worked in a project funded by international developmental aid which aimed to “enrich” the Tunisian national parks with attractive fauna to develop ecotourism, and therefore they had an economic interest to import zoo-living dama gazelles from Europe for release in Tunisia – one of the coauthors actually delivered further wildlife (sub)species for this purpose to a Tunisian national park, even though these were demonstrably alien to the regional fauna. So far, Tunisia remains outside the confirmed range of the dama gazelle, and the critical comment by Kock (1990) still stands, namely that the release of captive-bred dama gazelles from European zoological gardens in the Bou Hedma National Park did not represent a case of “nature restoration”, as which it had been praised unwarrantedly in Tunisia and worldwide. The population released at Bou Hedma in the early 1990s, representing an introduction rather than a re-introduction (Abaigar *et al.* 1997), established initially but became extinct by 2020 (Anonymous 2020). Our site record in the Mesak is located 400 km from southern Tunisia, and close to 1000 km from Bou Hedma, and the record in the Temassinin/Tanmacine district in Algeria mentioned below is about 350 km from Bou Hedma.

Apart from the Tassili n’Ajjér, the closest records of dama gazelles to the Mesak originated from Temassinin (the modern town of Tamacine or Témacine) in Touggourt Province of northeastern Algeria, where Geyr von Schweppenburg and Paul Spatz found dama gazelles (termed “*Gazella mhorr*”) common, and collected some, during February 1914 (Geyr von Schweppenburg 1917; Spatz 1926). This area is located approximately 600 km north-northwest to our site in Libya, and it is a northerly outlier of the dama gazelle range, whose northernmost boundary in Algeria used to be, in ignorance of Geyr von Schweppenburg (1917) and Spatz (1926), expected much further in the south (Joleaud 1935; Devillers 1940; Dupuy 1966, 1968; Kowalski & Rzebiak-Kowalska 1991). Geyr von Schweppenburg’s (1917) precise record matches the vaguer statement by Foureau (1895a: 18) that the “cerf morr” was common in the Ahaggar Mountains, from where it

descended via the Wadi Ighargar towards Temassinin. In the late 19th century two different wadis in Algeria were designated as Ighargar according to the authoritative Stieler’s Handatlas (Stieler 2007), one of them further south in Algeria, but the context provided by Foureau (1895a) refers to the northern valley descending through the lowlands north of the Ahaggar (Joleaud 1935). Foureau (1893, 1895b) detailed the geography of Temassinin, mentioning “antilopes” as abundant hunting game, without naming the species or providing diagnostic details; in agreement with the preceding, these may have been dama gazelles too. These records for the Touggourt province of Algeria refer to sites 200 km distant from the African north coast, either the Gulf of Gabes or the Algerian north coast. They are the northernmost records in this part of Africa, twice as close to the ocean than our sites in southwest Libya.

Rock art clarifies that the Fezzan in Libya has to be added to the former range of the species. In this context, unpublished finds of dama gazelle bones are of interest which have been excavated at a Roman military post on the fortified Limes Tripolitanus, near the oasis of Gheriat el-Garbia (Al Qaryah al Gharbiyah) on the edge of the Libyan pre-desert, and about 400 km south of Tripolis (N. Pöllath, pers. comm. 2015). Since gazelles were also kept as pets and used in circus games by the Romans, and many were exported from their native lands even to the capital Rome and beyond, bones from a Roman settlement need not represent a local wild population with necessity. However, these specimens seemed to represent kitchen remains and hunting trophies, which may indicate a more local origin. Their preliminary age dating into the 5th century of the current era points to the final stage of the Roman occupancy in this region, so that the likelihood for circus games with imported wildlife is reduced, and rather local hunting of these gazelles may be assumed (N. Pöllath, pers. comm. 2015).

ZOOLOGICAL INFERENCES: SUBSPECIES TAXONOMY

Rock art may also indicate which subspecies of the dama gazelle lived at a prehistoric site, even in areas from where no study specimens became available for modern zoologists before local extinction. The dama gazelle has a variable pelage pigmentation depending on geography, and different subspecies are known, three of which found wide acceptance (e.g., Cano Perez 1991). Some of the pelage characters are too subtle for recognition from rock images, but the regionally variable and eye-catching red-brown dorsal saddle patch, which sends out dark stripes to the front and the hind legs, may be evident in the more naturalistic prehistoric art. Near the Atlantic coast from southern Morocco to Mauretania and perhaps until or just outside Senegal the mhorr gazelle (*N. d. mhorr*) is the morph richest in colour contrast, with an extensive, glossy and brightly red-brown saddle patch on the dorsal trunk, which borders sharply on the whitish underparts that are particularly shiny in this subspecies (Fig. 1A). Further to the east, in the Sahel belt and the southern Sahara (Mali, Niger, Nigeria, Chad), the populations reduce the dorsal saddle by the expanding whitish skin of the underparts, and they dull its brightness,

and tend to lose the haunch and the leg stripes (subspecies *N. d. dama* in the wide conception of this taxon as by Cano Perez 1991). In the easternmost range portion in Sudan (subspecies *N. d. ruficollis*) only the neck and the shoulder region are pigmented in matt brown, and the remainder of the body is creamy whitish. In certain regions of Chad a great variability of mutable individual colour morphs is observed (Fig. 1B, C). In addition to the differentiated dorsal saddle, *N. d. mhorrr* has the head vividly ornamented with dark marks, i.e. a brown patch on the bridge of the nose, a darkened cheek field, and a blackish streak in front of the eyes, interspersed by only limited white insignia, while all *N. d. ruficollis* have completely white heads without markings; the cephalic colours of *N. d. dama* are intermediate.

The dama gazelle had been exterminated by human persecution in many regions of North Africa before museum specimens could be collected locally or the herds be described by scientific explorers. Therefore, the distribution ranges of the three subspecies are insufficiently known, and additional subspecies may have been overlooked – indeed, several more of them were proposed from single or few specimens, but cannot be evaluated for a lack of study materials (Schreiber *et al.*, ongoing study). Therefore, the phenotypes shown in rock images from underexplored regions are of interest for taxonomists.

The subspecies of the dama gazelle can be recognized in colourful rock paintings rather than in unichrome engravings. The several paintings reported by Zboray (2009) and Kuper (2013) from the Wadi Sura in southwestern Egypt, and by Zboray (2009) from Karkur Talh in the nearby Jebel Uweinat in the extreme corner of Sudan, and close to the border triangle of Egypt, Sudan and Libya, show dama gazelles with a reduced brown saddle field, and entirely light underparts without leg stripes; wherever visible the head is represented white, devoid of any dark markings. This very light and invariant phenotype matches neatly the modern subspecies *N. d. ruficollis*, which in the present fauna is known only from north-west Sudan and likely the forelands of Tibesti (NE Chad). Rock images extend this subspecies's range during the prehistorical era, to include the Western Desert of Egypt. Therefore, most likely the subfossil bones unearthed throughout the Western Desert (e.g., Pöllath 2009) might also adhere to *N. d. ruficollis*.

Taxonomists can no longer study Algerian dama gazelles, of which no museum skins had been collected and of which no detailed phenotypes had been described by explorers prior to the extermination of this stock in the 20th century. The only study specimen from this large country preserved in a natural history museum is a single skull conserved at Paris from Béchar-Tindouf in far western Algeria (and fairly distant from the Tassili), whose horns resemble *N. d. dama* more than *N. d. mhorrr* (Schreiber, ongoing study). The rock image from Tassili n'Ajjer (von Gagern 1978; Holl 2004) offer the first insight into the morphotype previously living in this part of the Sahara (Fig. 19). Fortunately, this image is a superb colour painting, demonstrating clearly long, red-brown saddle patches, which match the colour tone of

living specimens quite well. Even the haunch stripe aiming toward the hind legs is partly visible. Such details prove a realistic depiction. Overall, the painted phenotype resembles to some extent the mhorrr gazelles, but the fairly white heads, although those are not represented in great detail, argue better for the nominate subspecies *N. d. dama*. Also, the similar, independent paintings from our two other sites in east-central Algeria (Figs 16; 18), show dama gazelles with entirely (at Tikudawin) or partly (Oued Afeifo) whitish heads, supporting again *N. d. dama* (in the wide conception of this subspecies, see Cano Perez 1991). Only the Tikudawin gazelles have their rear body tinged in light or whitish, suiting *N. d. ruficollis* more than *N. d. dama*, but we do not attach importance to this detail since the posterior body appears neglected by the painter and possibly may even be unfinished, and the brown shoulder patch ends abruptly with a vertical border running down to the belly, which does not look nearly naturalistic. There is another possibility to interpret the white faces of the Algerians gazelles, because the poorly known subspecies *N. d. permista* (Neumann, 1906) is also said to combine an extended saddle field rich in contrast with predominantly whitish heads (Neumann 1906). This form was described on the basis of only a few captive gazelles kept at the Berlin Zoological Gardens thought to be imports from West Africa, and it has never been re-investigated or confirmed since its original description. Neither have further study materials turned up, so that both the geographical range and the taxonomic validity of *N. d. permista* remain undecided. We found skins with similar phenotypes in the museums of Berlin and Bruxelles (Schreiber, ongoing study), all of them lacking proper origin data. The paintings from near the Tassili n'Ajjer remind us of the phenotypes of these museum specimens, and detailed analysis is required if *N. d. permista* is another valid form of the dama gazelle, with a range perhaps intercalating between *N. d. mhorrr* and *N. d. dama*. The heads painted at all of these Algerian rock sites are not depicted in sufficient detail to decide such questions, neither are they incompatible with ordinary *N. d. dama* or even, albeit less likely, *N. d. mhorrr* having aberrantly light faces. The multitude of rock images of many wildlife species in east-central Algeria offers hope that additional paintings of dama gazelles can be found, permitting a resolution of this identification problem.

The non-chromatic technique of engraving only the body contours into a rock surface predominates in our series of rock images, omitting the pelage colours. Nevertheless, many engravings suggest a patterned body surface, created by pecking the stone surface here and there. Pecking removes the surface layer and the dark patina of the stone by hammering with a sharp and hard tool, punching out small conical cavities. Thinning or removing the patina of the desert varnish, which is accumulating when iron or manganese salts dissolved in evaporating moisture precipitate on the rock surface, lightens the substratum. In several of our examples only the haunches of the gazelles are pecked, and sometimes strikingly reminiscent of the whitish portions on the posterior body of living dama gazelles. One must

remember, however, that this visual effect is not due to the purposeful addition of a white pigment, and one preferably understands the pecked haunches as domains which were specially emphasized by the engraver for whatever unknown purpose, rather than necessarily meant to represent white skin fields. In any case the pecked area should indicate the rear edge of the dorsal saddle patch, which also yields an auxiliary hint for subspecies diagnosis. Unfortunately, a broad comparison of rock art reveals that partial pecking of engraved figures is very common in rock images which represent a great variety of animal species, including ones with homogeneously pigmented bodies, and also non-living subjects, and therefore partial pecking will often be just an uninterpretable stylistic element. Likewise, the polished faces of the gazelles from In Elobu in Fezzan may or may not indicate white skin patches in the face, which if pertinent would perhaps indicate adherence of this hitherto ignored population to *N. d. dama* or, less likely on zoogeographical grounds, *N. d. ruficollis*. Still, from our knowledge of subspecies ranges one would really expect *N. d. dama* in the Fezzan, with fair white areas on their heads interspersed with reduced dark marks, and such a phenotype is unfolded by a straightforward interpretation of the pecked faces as white facial areas.

CONCLUSIONS

The many prehistoric rock images of dama gazelles found by us suggest that the previous scarcity of published pictorial documents of this antelope rested predominantly on neglect and insufficient research efforts, rather than on a great paucity of such materials. Additional scientists specialized in Saharan rock art are encouraged to screen their databases for further examples, and to publish them. Rock images show beyond reasonable doubt that the Fezzan district of southwest Libya and the Western Desert of Egypt should be added as meaningful geographical expansions to the known ancient range of this species. This expansion is relevant, because it adds further options for plans to reintroduce captive-bred dama gazelles into their original homelands, from where poaching and overexploitation by humans had exterminated them. Rock art further proposes that the former population in the Western Desert and in the border triangle region Egypt/Sudan/Libya adhered to the red-necked gazelle (subspecies *N. d. ruficollis*). Rock art may ultimately also clarify the unknown subspecies identity of the extinct population in east-central Algeria, from where no study specimens are available in research museums. Additional prehistoric images from this area so richly blessed with prehistoric rock art of wildlife would be desirable for safer conclusions, but already now the paintings from east-central Algeria suggest that this zone might have been populated by the nominate subspecies *N. d. dama*, although the enigmatic and virtually unexplored subspecies *N. d. permista* could also represent the autochthonous form in this region (if it is a valid taxon at all).

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