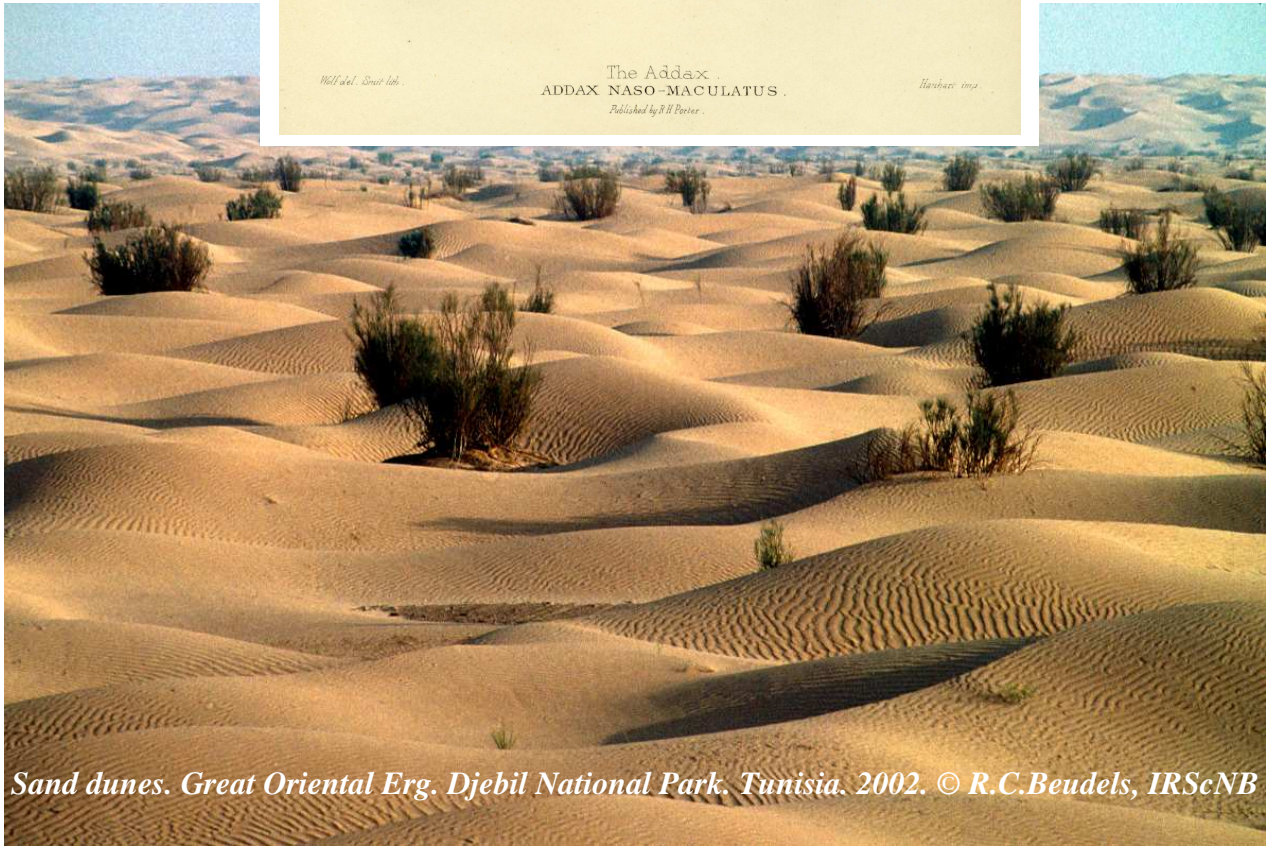


Addax nasomaculatus



Sand dunes. Great Oriental Erg. Djebil National Park. Tunisia. 2002. © R.C.Beudels, IRScNB

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ADDAX NASOMACULATUS

1. TAXONOMY AND NOMENCLATURE



Female Addax. Termit. 1998. Niger.
© Cdt Hama A. Souleymane-DFPP-Niger.

1.1. Taxonomy.

Addax nasomaculatus belongs to the tribe *Hippotragini*, sub-family *Hippotraginae*, family *Bovidae*, which comprises one extinct species, seven surviving species, and two evolutionary distinct subspecies in genera *Oryx*, *Addax* and *Hippotragus* (Simpson, 1945; Murray, 1984; Corbet et Hill, 1986; Wachter, 1988). All hippotraginids are adapted to the exploitation, generally at low density, of difficult, low-productivity habitats (Kingdon, 1982; Murray, 1984; Wachter, 1988; Beudels, 1993). The genus *Addax* is comprised of a single species, adapted to the desert.

1.2. Nomenclature.

1.2.1. Scientific name.

Addax nasomaculatus (De Blainville, 1816). Described as *Cerophorus nasomaculata* de Blainville, 1816. Bull. Sci. Soc. Philom. Paris, 1816:75. Type locality: None given. Lydekker (1914:148) stated it was “probably

Senegambia”, but Grubb (2005) noted that it was more probable that British hunters or collectors obtained Addax from the Tunisian Sahara, to which he restricted the type locality.

1.2.2. Synonyms.

Antilope nasomaculatus, *Antilope addax*, *Addax nasomaculatus addax*, *Antilope naso-maculata*, *Cerophorus nasomaculata*, *Antilope suturosa*, *Antilope mytilopes*, *Antilope gibbosa*, *Oryx addax*, *Oryx naso-maculatus*, *Addax suturosus*, *Addax addax*

1.2.3. Common names.

English : Addax

French : Addax, Antilope addax, Antilope de Mendès

German: Mendes Antilope

Arabic : Begaar el Ouach, Akash, Abu-Akach, Anjidohl, Auel, Bakra el onash, Tamita

Tamashek: Amellal

Toubou: Turbo

1.2.4. Description.

A predominantly white, stocky-bodied, medium-sized antelope inhabiting the sand seas and gravel plains of the Sahara. Head light grey or beige, with contrasting white patches in front of the eyes, linked across the bridge of the muzzle. Small white patches behind the eyes. Nose beige, lips and chin white. Crown and forehead sporting a prominent, wig-like tuft of dark brown hair. Ears white with a long basal tuft of pale hairs. With the exception of the throat and chest, which are beige, overall body colour is bright matte white. During the hot season (Apr-Oct), pelage is short, but in the colder months (Nov-Mar) it lengthens on the neck, chest, shoulders, back and flanks, becoming greyer, a characteristic especially obvious in Addax held in zoos with cold winter climates (Renshaw, 1902). Adults of both sexes develop a beige fringe of variable length on the lower neck. In Niger, old adult males can develop a dark brown front coat (Ascani, pers. comm). Legs white with beige patches on the knees. Hooves broad and splayed. Tail short and white, sporting a sparse tuft of dark terminal hairs. Other than slight differences in size, weight and horn development in adults, sexes essentially similar.

Nipples: 2 + 2 = 4.

Both sexes bear corkscrew shaped horns, which grow upwards and outwards, reaching over one metre in length. The horns of the adult male are stockier than those of the female, often having two to two-and-a-half turns to the female's one-and-a-half to two. Horns heavily annulated over the first two-thirds of their length in both sexes. Over time, and with violent sparring, the horns of the male may become lost, damaged or blunted.

The Addax probably takes its name from the vernacular Arabic 'agas or 'adas. The specific name *nasomaculatus* - meaning 'spotted nosed' - refers to the contrasting white patches on the otherwise darker head.

TL : 125 - 170 cm
T : 30 - 32 cm
H : 105 - 115 cm
weight : 70 - 150 kg



Niger. Temet. Air. © John Newby

2. BIOLOGY OF THE SPECIES

2.1. General Biology

2.1.1 Habitat.

The main Saharan range of the Addax corresponds to the desert formations of White (1983), including the desert dunes with perennial vegetation of his unit 70 together with the regs, hamadas and wadis of his unit 71. It also extends to White's unit 54, which contains the grassy and shrubby formations of the northern Sahel, entered by Addax in search of pastures during periods of drought.

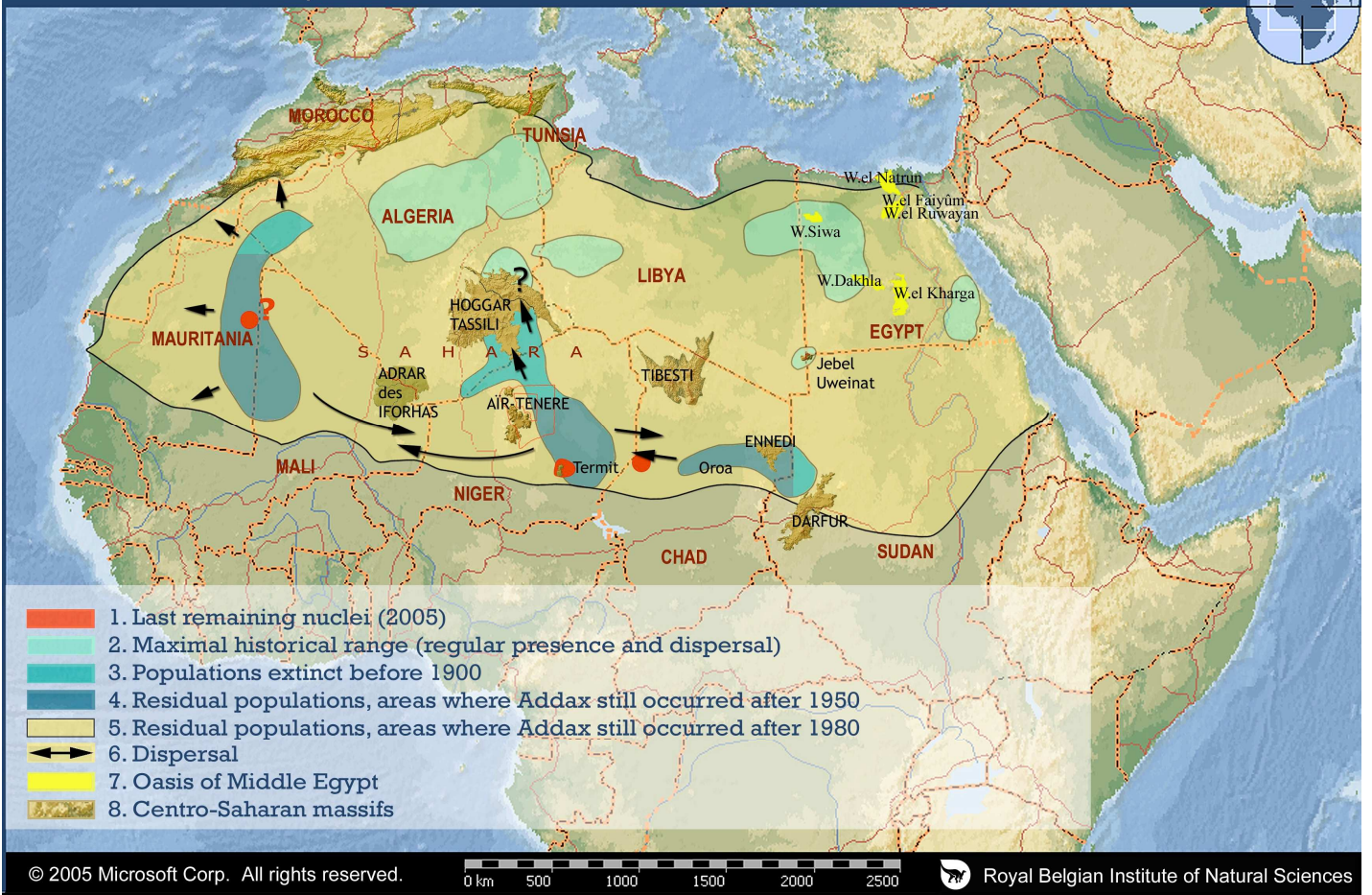
The Addax is well known for its utilisation of extremely desolate, inhospitable, and arid habitats (Dragesco-Joffé, 1993). It has anatomical, physiological, and behavioural characteristics which allow it to exploit habitats where life seems impossible (Lavauden, 1934; Bourgoïn, 1955; Gillet, 1965; Newby, 1974). A specialist of sandy desert regions, the Addax is the characteristic occupant of Saharan dunes, adapted to very dispersed pastures (Heim de Balsac, 1936; Malbrant, 1952; Gillet, 1969; Newby, 1984; Grettenberger and Newby, 1990; Dragesco Joffé, 1993).

The precise data available on the habitat of *Addax nasomaculatus* have been gathered in Chad (Malbrant, 1952; Gillet, 1965, 1969; Newby, 1974; Dragesco Joffé, 1993), in Niger (Lhote, 1946; Grettenberger and Newby, 1989) and in Mauritania and Mali (Lamarche, 1980, 1987). The conjunction in the southern Sahara of the extreme extension of tropical summer rains and of sporadic winter depressions of Mediterranean origin allows, in favourable years, a year-round production of green pastures by plants that react to both phenomena (Gillet, 1969). The plants capable of greening with the passage of humid air linked to the northward shift of the tropical front, are precisely those which provide the basic food of the Addax, in particular the drinn (*Aristida pungens*), *Aristida plumosa*, the had (*Cornulaca monacantha*), plants of broad distribution reaching far north into the desert (Gillet, 1965).

In the southern part of its range at least, during the dry season, Addax approach areas of human occupation in the south, their distribution then being determined by the presence of wild melons, *Colocynthis vulgaris* (*Citrullus colocynthis*), particularly characteristic of sub-desert Sahelian steppes and representing for the species the principal source of water at this time of year (Newby, 1974; Dragesco Joffé, 1993). As soon as the first rains renew their Saharan pastures, Addax return rapidly to the security of their remote grazing grounds. Newby (1974) shows that, in Chad, the southern limit of Addax during the rainy season corresponds approximately to the southern limit of had (*Cornulaca monacantha*), a chenopodid shrub that is a good source of water.

In the ephemeral pastures of the rainy season, the Addax feeds on graminids such as *Aristida pungens*, *Stipagrostis plumosa*, *Tribulus sp*, *Cyperus conglomeratus*, young green leaves of *Panicum turgidum*, and a variety of leguminous plants such as species of *Tephrosia* and *Indigofera*. During recent periods of drought, Addax have survived by grazing mainly on the perennial grass *Stipagrostis vulnerans*, which is usually only consumed in the dry season (Newby, 1974). Other plants utilised by the Addax in the dry season are the Apiaceae *Schouwia thebaica*, the Amaranthaceae *Aerva javanica* and the Euphorbiaceae *Chrozophora brocchiana* (Newby, 1974), or grasses like *Aristida acutiflora* (Dragesco Joffé, 1993).

The Addax can go without water for very long periods (Malbrant, 1952; Gillet, 1965, 1969; Newby, 1974; Dragesco Joffé, 1993), as noted, in particular, in Niger (Lhote, 1946; Grettenberger and Newby, 1989). Some plants having surface hair or glands capable of trapping night-forming dew, such as *Tephrosia vicioides*, are very sought after by the Addax (Gillet, 1965). It seems that the Addax can make use of viscous liquids at high osmotic pressure secreted by several plant species that it consumes (Gillet, 1969).



Chad. sandsheet with Cornulaca



In the 70'. Addax. Issaouane. Niger. © John Newby

One of the main types of Saharan pastures is the “gizu” or “jizzu”, ephemeral pastures that form after occasional rains, without which the Addax could probably not survive (Wilson, 1978; Newby, 1984). The combination of cool winter nights and good water retention of the soil allows the pastures to remain green until summer. The animals that graze on the gizu can stay almost indefinitely independent from waterholes (Newby, 1984). The main elements of gizun are *Indigofera berhautina*, *I.hochstetteri*, *Neurada procumbens*, *Tribulus longipetallus*, *Fagonia bruguieri*, *Cyperus conglomeratus* and *Stipagrostis acutiflora* (Newby, 1974, 1984; Wilson, 1978).



Citrullus colocynthis. Niger. © John Newby

2.1.2. Adaptations

The Addax displays a large number of morphological, physiological and behavioural adaptations to life in a hot, dry environment, including pale colouration to reflect radiant heat, pelage length and density to assist with thermoregulation, barrel-bodied shape to reduce surface area/volume ratio, and large, splayed and spongy hooves for moving in a hot and sandy environment. They also have a highly efficient moisture extraction and retention system.

Behavioural adaptations include feeding during cooler hours and at night, and sheltering and resting during the heat of the day. Seasonal distribution and frequentation of traditional sites are often influenced by presence of shade (Newby 1981). Excavation of shelter behind vegetation or on the shade side of dunes with both hooves and horns have been recorded (Lamarche, 1980; Dragesco-Joffe, 1993).



Addax, adult and calf. Souss-Massa National Park. Morocco.
© Fatima Oumzai. Service Forestier Morocco

2.1.3. Social behaviour

Addax generally live in small herds of up to 15 animals, composed of males and females of all ages (Lhote 1946, Lamarche 1980, Walters 1981, Mackler 1984). The larger groups observed in the past, sometimes numbering several hundreds, were probably the result of many smaller herds congregating seasonally and temporarily in areas of exceptional grazing (Nachtigal 1881, Lavauden, 1926, In Tanoust 1930, Newby 1978, Monod 1990). With increasing persecution, and as a result of mortality due to the severe droughts of the past four decades, average Addax herd size today is rarely more than half a dozen individuals (Dragesco-Joffé 1993). In Niger, between 1980 and 1991, average herd size was 2.2 (range=1-5; n=27) (Rapant 1992, Poilecot 1993).

2.2 Distribution.

2.2.1. Historical distribution.

The historical range of permanent or periodical presence and movements of the Addax encompasses all of desert and sub-desert North Africa between the Atlantic and the Nile. Within this range, the distribution of the species is conditioned by that of large zones of ergs and sandy regs (Lhote, 1946; Schnell, 1977; Quézel, 1965; White, 1983; Walter and Breckle, 1986; Le Houérou, 1986; Grettenberger and Newby, 1990; Ozenda, 1991; Kacem *et al.*, 1994), of temporary pastures (Grettenberger and Newby, 1990; Dragesco Joffé, 1993), and of ecotones between the sub-desert steppes and the desert (Gillet, 1969; Newby, 1974).

The Addax is a species of the true desert, adapted to very dispersed pastures (Heim de Balsac, 1936; Gillet, 1969; Newby, 1984; Grettenberger and Newby, 1990; Dragesco Joffé, 1993). The distribution seems to have been organized in a number of large ensembles between which exchanges were probably possible.

In the west, a large body of data identifies populations linked to the great Mauritania-Malian ergs of the Majabat al Koubra and to the Iguidi and Chech ergs (Monod, 1958; Gillet, 1969; Trotignon, 1975; Walter and Breckle, 1986; Lamarche, 1987). It is probably these populations which occupied, with an unknown regularity, the Atlantic Sahara in the region of Dakhla

(Morales Agacino, 1950; Valverde, 1957; Loggers *et al.*, 1992) and gave way to observations east of Zagora in the region of the upper Drâa in Morocco (Marçais, 1937; Loggers *et al.*, 1992).

More to the east, substantial zones of presence are centred on the Grand Erg Occidental (Gillet, 1969; Kowalski and Rzebik-Kowalska, 1991), the Grand Erg Oriental (Lhote, 1946; Gillet, 1969; Kowalski and Rzebik-Kowalska, 1991; Kacem *et al.*, 1994), the large sandy zones (Walter and Breckle, 1986) of the Hamada de Tinrhert and the southern part of the Hamada el Hamra (Lhote, 1946; Gillet, 1969; Hufnagl, 1972; Kowalski and Rzebik-Kowalska, 1991), and the entire piedmont of the Hoggar and the Tassili des Ajers, in particular in the Erg Admer (Lhote, 1946; Gillet, 1969; Kowalski and Rzebik-Kowalska, 1991). Beyond, in Libya, the data, relatively few and dispersed, suggest a possible presence in the piedmont slopes of the Haruj al Aswald, in the region of Koufra, and in the vicinity of the Calanshio Sand Sea (Hufnagl, 1972). In the Western Desert of Middle Egypt, the Addax was known from large oases and depressions or their periphery, in particular from Siwa in the northwest and from the Libyan oasis adjacent to Jaghbug, from the depression of Qattara, from Faiyum, from Bahariya, from Farafara, from Dakhla, and from the Kharga complex (Osborne and Helmi, 1980). It was noted also in the extreme northeast of the Mediterranean coastal desert, in the Nubian Desert southwest of Bir Kiseiba, and in the region of the Jebel Uweinat.



Hadd (Cornulaca monacantha) and Addax tracks.
© John Newby

In the transition zone between the desert and the Sahelian steppes, regions of significant presence of the Addax existed at least in the periphery of the Adrar des Iforas (Lhote, 1946), in the Ténéré, in the foothills of the Aïr, and in the Termit massif (Lhote, 1946; Brouin, 1950; Grettenberger and Newby, 1990; Millington *et al.*, 1991), in northern Chad south of the Tibesti (Gillet, 1969; Newby, 1974), in the Sudano-Chadian regions of the Mourdi depression and Wadi Howar (Gillet, 1969; Kock, 1970; Wilson, 1980), in the Nubian Desert of the Northern region and of northern Kordofan in Sudan (Kock, 1970). The southern limit of the main range of the Addax is located between 17° and 19° N in central northern Mauritania, between 17° and 19° N in central Mali, at 16° N in Niger, at 15° N in Chad, and at 14° N in Sudan. It is situated in the semi-desert Sahelian steppe belt of White (1983). During the hot season, the Addax may migrate south into the Sahelian zone in order to meet the first showers and rain-generated pastures. Available data indicate that the historical distribution of the Addax was relatively continuous over the entire Sahelo-Saharan region.

2.2.2. Decline of the range.

Like that of the Oryx, the range of the Addax has regressed continuously since the drying up of the Sahara (Gillet, 1969). During the entire Neolithic Age, it was at least as abundant as the Oryx in all of North Africa (Gillet, 1969). Like the rest of the Saharan fauna, the Addax suffered from the effects of increased aridity, but it found refuge on the periphery of the desert (Gillet, 1969). This was a very temporary refuge, as the Addax, like the rest of the large North African fauna, underwent massive taking during the Roman era (Le Houérou, 1986; Newby, 1988).

The Addax was still widespread throughout the Sahara around 1840 (Dragesco-Joffé, 1993). It had completely disappeared from the northern Sahara and its fringes by the end of the 19th century (Newby, 1986; Kowalski and Rzebik-Kowalska, 1991; Loggers *et al.*, 1992). The decline accelerated as of the beginning of the 20th century, and even more during the period between the two world wars (Gillet, 1969). The rapid decline of the Addax coincided with colonisation, oil prospection, and the militarisation of the desert (Gillet, 1969; Dragesco Joffé, 1993). The increase in off-road vehicles allowed a much more efficient penetration into the remotest regions. The Addax is particularly sensitive to disturbance; it gallops until exhaustion if chased (Dragesco Joffé, 1993). Narratives recount how entire herds were destroyed in a single hunt (Lhote, 1946; Gillet, 1969). The intense periods of drought and the desertification that they have generated these last decades (end of the 1970's and early 1980's) have clearly contributed to the general decline of the species (Newby, 1989).



Addax poached by soldiers in the 70'. Réserve de Faune du Ooadi Rimé-Ouadi Achim. Chad. © Jon Newby

Up until the 70's, the Addax was still widespread and locally abundant in the centre and the south of its range (Newby, 1986). Like that of the Oryx, the decline of the Addax was spectacularly rapid everywhere. In one generation, the Addax lost 90% of its range (Newby, 1986).



Towards the end of the 19th century, explorers in Central Sahara all described the abundance of gazelles and Addax in the Tassili (amellal in tamâhaq), in the vicinity of dunes formations in particular. Over-hunting drove this beautiful species to extinction in that area
HACHID, M. Le Tassili des Ajjer. Edif 2000, Alger.

Photo taken in 1946 and published in :
GAUTHIER, E.F. 1950. Le Sahara. Payot, Paris.



Addax horn. Tin Toumma.Termit. Niger. 2004 © Tim Wacher - ZSL

Addax horn. Niger. 2004 © John Newby



Addax tracks. Ouadi Rimé-Ouadi Achim. in the 70'. Chad. © John Newby

Table 1. Current status and dates of probable extinction of the Addax in range states, according to Newby (1984) or other authors as indicated.

Country	Current status of the Addax <i>in situ</i> , and probable dates of extinction	Reintroduced populations within large fences in protected areas
Morocco	extinct	NP Souss-Massa NP Bou-Hedma
Atlantic Sahara, Ex-Spanish Sahara	extinct (1942)	
Algeria	extinct?	
Tunisia	extinct (1932) (Kacem, 1994)	
Libya	extinct (end of the 1960's)	
Egypt	extinct (around 1900)	
Sudan	extinct?	
Chad	endangered	
Niger	endangered	
Mali	endangered	
Mauritania	endangered	

2.2.3. Residual distribution.

The current range of the Addax is reduced nowadays to a few very small pockets, highly fragmented, distributed over two or three regions across Southern and Central Sahara :

- In the massif and erg of the Termit-Tin Toumma survives what is probably the only viable population of Addax today, around 200 individuals (Wacher *et al.*, 2004).
- Further East, towards the border with Chad, in the regions of Agadem (Niger), North Manga and Eguey-Bodélé (Chad), solitary animals or very small groups are sometime observed. Nine individuals and tracks of groups of 1 to 6 individuals were observed in November 2005 (CMS, SCF and APF Survey, Nov. 2005).
- West of termit, towards the Air Mountains (Niger) and northwards to the border with Algeria, there have been sporadic but no really good reports of Addax over the past few years (Newby, SCF communication, Sept. 2005).
- To the West, the Majabat-alKoubra desert, between Mauritania and Mali, has, far a long time, been considered by several authors to be a key area for Addax survival (Lamarche, 1987; Dragesco Joffé, 1993). This area has never been formally censused Today, if it is still possible that a population of addax survives in the Majabat-al-Koubra, there is no data available or numbers nor trends. Moreover, the region is nowadays highly insecure and the implementation of Conservation measures are very unlikely.

2.2.4. Recolonisation prospects.

Any prospect of recolonisation of the Addax must necessarily integrate, on the one hand, new attempts at in situ conservation of the Addax and its habitat, and, on the other hand, attempts at reintroduction or reinforcement of populations from individuals born in captivity, in parallel with measures of habitat management. The techniques of reinsertion in the wild of captive-born animals are relatively well mastered today for antelopes, and there are more than a thousand Addax in captive herds around the world.

The chances of recolonisation are perhaps better for the Addax than for the Oryx. The species is capable of living in extreme habitats which man and his livestock cannot use, and it has a reproductive strategy that allows it to rapidly exploit favorable climatic conditions. The potential range of the Addax is the desert and the sub-desert. Its distribution within desert regions does not seem to have limits other than the periodic carrying capacity of temporary pastures dependant on a pattern of sporadic precipitation. The Addax roams in a region reached, although in attenuated form, by tropical summer rains at their extreme extension, and also, sporadically, by winter storms of Mediterranean origin that cross the Sahara in its southern part (Gillet, 1965). Towards the desert, the limit of its range corresponds to that of availability of feeding grounds. Towards the Sudanese regions, the limit of the range, reached by the Addax during dry periods, situated near the 15th parallel in the driest years (Gillet, 1965), is probably set by competition with other species, domestic livestock in particular.

Newby (1989) believes that the decline of the Addax in Niger over the last 50 years can be attributed essentially to three determinant factors: direct taking (hunting and poaching), drought and disturbance by tourism. According to his 1989 analysis, the influence of hunting and disturbance caused by tourism should be decreasing in Niger. Consequently, even taking into account the fact that in certain areas and for certain types of habitat the recent periods of drought most certainly caused irreversible damage, Newby considered that, in 1989, prospects for conservation and reintroduction projects were probably better than they had been in the preceding decade.

In situ conservation measures : measures that need to be sustained or initiated to improve the perspectives of recolonisation in a number of Range States, as follows:

Niger. A proposed protected area in the Termit region would offer the only possibility to save the Addax *in situ*, and it should be supported and implemented. The Air-Ténére National Nature Reserve, created in 1988 for the conservation of Sahelo-Saharan antelopes, has suffered these last years and human presence has never been sufficiently controlled (Newby, 1988), but the size of the reserve (77,360 km²) and the Addax sanctuary that it encloses constitute an important asset.

Chad. The rehabilitation of the Ouadi Rimé-Ouadi Achim Reserve is a national and international priority for the restoration of the Oryx and the Addax. New prospections have been undertaken in 2005 in North-Eastern Chad, in the Mourdi depression, North Ennedi and Erdi, and the North-West, in the North Manga and Eguey, near the border with Niger. A small population of addax was discovered in Egey-Bodélé. Conservation measures are being drafted (CMS, SCF, APF, 2006, *in prep.*)

Mali. The establishment of a protection area specifically for the Addax in the



Addax habitat. Niger. Tin-Toumma and Termit
© John Newby-SSIG-SCF mission 2004

Majabat al Koubra could be studied. The Adrar des Iforas is also a potentially important region. Field prospection must be conducted in the area, with a view to develop concrete proposals.

Mauritania. The possibility of implementing the proposal of a Tilemsi reserve (Hamerlynck, in litt.) near Oualata and Tichitt, or another protection area in the Mreyyé needs to be studied. The control of hunting is in any case crucial to any conservation efforts in Mauritania.

Libya. Prospections should be made in the South West of the country.

Sudan. A proposal for creating a reserve exists for the Wadi Howar. There are no available data on the presence of a residual population of Addax in the area.

Population reinforcement or reintroduction measures : the following measures are either based on existing activities or represent new proposals; these actions must accompany the above *in situ* conservation measures in the same or additional Range States, as follows:



in Brockelhurst, 1931.

Tunisia. The essential Tunisian Addax reintroduction programme, so far very successful in its establishment of a viable and successfully-reproducing herd of about 45 animals at Bou Hedma National Park, must be assisted in its progress and supported internationally. Tunisia is about to proceed to the crucial stage of reimplantation of the species in more typical Saharan habitats (2006). This has long been foreseen by Tunisian authorities, but requires complex preparatory management measures in southern Tunisian protected areas, in particular Djebel National Park (2006).

Morocco. An Addax restoration programme is underway, which must be supported. The prospects of reimplantation of the Addax the proposed National Park of Dakhla-Adrar Souttoug are good.

Niger. A programme to reinforce the Addax population in Aïr-Ténéré was studied in detail at the end of the 1980's (Dixon, Knowles and Newby, 1989); it would be reevaluated and updated in the current environmental and socio-economic context.

Chad. An evaluation of the necessity and feasibility of a population reinforcement programme is needed.

Algeria. The existence of national parks of exceptional dimensions, the Tassili des Ajjers National Park and the Hoggar National Park, could be an important favourable element for the restoration of the Addax in Algeria.

Libya. The Zellaf Reserve, in the southern part of the Hamada el Homra, could be considered for a future restoration of the Addax in Libya.

2.4. Evaluation and evolution of populations.

Although there is no estimate of the size of Addax populations in the 19th century or before, it appears that the species was widespread in Antiquity (Lavauden, 1926). Most authors agree that the species was formerly common and locally abundant in its entire range (Sclater Thomas, 1899-1900; Chudeau, 1920; Heim de Balsac, 1931; Harper, 1945; Lhote, 1946; Monod, 1958; Le Houérou and Gillet, 1986; Lamarche, 1987; Newby and Magin, 1989).

In 1966, estimates of total numbers of Addax surviving in the wild were of the order of 5000 individuals (Dolan, 1966).

Around 1980-1981, Newby (1981) estimated that the total number for the species had decreased to fewer than 4000 individuals, and to fewer than 2000 individuals in 1986 (Newby, 1986). Today, taking into account the latest prospections and inventories, on the basis of statistical extrapolation of the latest field observations, and taking into account all other information sources as explicated in 2.2.4., the total world population of Addax is estimated at 200-400 individuals (SCF-SSIG, 2005). Today, it appears that the last viable population of Addax in the world is the Termit-Tin Toumma population in Niger.

2.5. Migration.

The Addax is described by several authors as being in perpetual movement, like a tireless nomad who roams large areas in search of pastures and which exploits environments where all life seems impossible, such as the ergs and the regs (Gillet, 1965, 1969; Lamarche, 1987; Dragesco Joffé, 1993). Because of the erratic character of Saharan rains, the Addax lives in regions where grassy clumps are extremely dispersed, making it necessary to perform large daily movements (Gillet, 1967; Newby, 1984). In addition to local movements made throughout the year, numerous authors have described annual

migratory movements, with a penetration in the desert at the time of rains and during the cool season, and a reverse movement, towards the periphery of the desert, in summer (Newby, 1984). These movements are closely linked to the search for shade and, above all, to the absolute need to consume plants capable of satisfying both the nutritional and water needs of the species (Newby, 1984); they thus vary considerably from year to year, although they are not unpredictable (Newby, 1974).

Annual movements were described for Chad and Niger by Gillet (1965, 1969) and Newby (1974), for Mali and Mauritania by Monod (1952) and Lamarche (1980, 1987), and for Sudan by Wilson (1980). Gillet (1969) and Newby (1974) compare, in Chad, the seasonal migrations of the Oryx and of the Addax and note that these seasonal movements are of a lesser amplitude for the Addax than the Oryx (Newby, 1974) and stay almost always in a more northerly position (Gillet, 1969). At the end of the dry season, the Addax moves well into the sub-desert Sahelian steppes, between the 15th and 17th parallels, and in very dry years descends as far as the 14th parallel (Newby, 1974). In Chad, Gillet (1965) distinguishes between populations which make regular movements, populations which are relatively sedentary, and individuals or small groups that perform large amplitude but erratic movements.

Cyclic migrations, seasonal or interannual, of Addax have, or had, a cross-border character, at least between Mali and Mauritania, between Mauritania and the former Spanish Sahara, between Mali and Algeria, Niger and Algeria, Chad and Algeria, Niger and Chad, Chad and Sudan, between Sudan, Egypt, and Libya, between Algeria and Tunisia, and between Algeria and Libya (Lhote, 1946; Dupuy, 1967; Kowalski and Rzebik-Kowalska, 1991; Dragesco Joffé, 1993).

3. CONSERVATION STATUS, BY PARTY

Morocco : : Extinct in the wild ; reintroduced in large fences within protected areas.



Dakhla, Morocco. © Didier Vangeluwe et Marie-Odile. Beudels-IRScNB

It is probably the populations linked to the large Mauritania-Malian ergs of the Majabat al Koubra and to the Iguidi and Chech ergs which occupied, with an unknown regularity, the Atlantic Sahara in the Dakhla region (Morales Agacino, 1950; Valverde, 1957; Loggers *et al.*, 1992) and gave rise to observations east of Zagora in the upper Drâa region of Morocco (Marçais, 1937; Loggers *et al.*, 1992). The few data from around Saquiat el Hamra suggest that they do not refer to permanent populations (Morales Agacino, 1950; Valverde, 1957; Loggers *et al.*, 1992). The last herd was eliminated in 1942, and the last report dates from 1963, relating to an isolated female.

Tunisia: Extinct in the wild ; reintroduced in large fences within protected areas.

The Addax was present in the Tunisian part of the Grand Erg Oriental, where the last animals were hunted around 1900, between Bir-Aouïn and the El Jenaïen Erg (Kacem, 1994). Kacem (1994) situates the date of extinction at around 1932. The species was successfully reintroduced in Tunisia in the Bou Hedma National Park in 1985 (Bousquet, 1992; Kacem, 1994). The translocation and reintroduction of the Addax in more Saharan environments, especially those of the Djebil National Park, is planned, and will be carried out once reinforcement of the protection of Saharan parks is assured (2006).

Algeria: Probably extinct.

Until the middle of the 19th century, the northern limit of the range of the Addax in Algeria reached the northern part of the Grand Erg Occidental (Colomb, 1856 and Mares, 1857 in Kowalski and Kowalska, 1991), and the southern part of Ouargla and Touggourt (Aucapitaine, 1860 in Kowalski and Kowalska, 1991). In the beginning of the 20th century, the northern limit of the range was much farther south, and at the same time, data appear on presence of the species in southern regions of Algeria which were until then inaccessible to prospectors. Grenot (1979) dates the extinction of the species in the northwestern Sahara at around 1905 with the disappearance of the last herd in the Er Raoui Erg. The Addax



Tassili N'Ajjer PN. Algérie. 2001.
© Marie-Odile Beudels-IRScNB

probably disappeared from the Grand Erg Oriental in the beginning of the 20th century (Kowalski and Kowalska, 1991). Lhote (1946) reported presence of the species in 1938-1939 in the Hamada de Tinrhert; he observed the species in the Ténéré Erg at the Niger-Algeria border, and traces of Addax near the Malian border south of the Tanezrouft, to the north of the Adrar des Iforas. The species was still present in the north of the Iguidi Erg until the 1930's, but does not seem to have survived beyond that except on the Mauritanian side (Heim de Balsac, 1948). The presence of the Addax around the Hoggar massif, in the Tassili des Hoggar, in the Tassili des Ajjers, the Ténéré Erg, and the Hamada de Tinrhert was reported by several authors until the 1970's and even the 1980's (Lhote, 1946; Regnier, 1960; Dupuy, 1966, 1967b; De Smet, 1988). The Addax might currently still be a very occasional visitor, entering Algeria along the southern border with Mauritania, Mali, Niger, and perhaps even Libya.

Libya: Probably extinct

In Libya, the scanty data suggest a former presence of the Addax on the piedmont slopes of the Haruj al Aswald, in the Koufra region and in the vicinity of the Calanshio dunes (Hufnagl, 1972). Hufnagl (1972) thought that it had become very rare, and even extremely rare in the Hamada el Homra, where the Tripoli museum specimens were taken in 1938. In the 1970's, Hufnagl records it again in the northeast and southeast, towards the Egyptian border (Kufra Oasis), as well as in the center of the Haruj el Aswad. Osborn and Krombein (1969) had reported, in the Jebel Uweinat region, the probable periodic presence of migrating Addax coming from the south, while Misonne considered it extinct in the area in 1977. Some individuals were pursued by hunters in 1975 in the Edyin de Murzuk (Gillet, 1971). Some individuals might still survive in 2005 in the Jabal al Awaynât, close to Egypt and Sudan (Essghaier, com. pers.)

Egypt : Extinct

Kock (1970) and Osborn and Helmy (1980) summarized the observations of Addax in Egypt. Until the 1870's, they are numerous. They pertain to the Western Desert of Middle Egypt, where the Addax was known from the large oases and depressions or their peripheries, in particular from Siwa in the northwest, as well as from the Libyan oasis adjacent to Jaghubub, from the Qattara Depression, from Faiyum, from Bahariya, from Farafara, from Dakhla, and from the Kharga complex (Osborne and Helmi, 1980). The Addax was also observed in the extreme northeastern part of the Mediterranean coastal desert, in the Nubian Desert southwest of Bir Kiseiba, and in the region of Jebel Uweinat. This concentrated distribution is characteristic of most mammals in the Western Desert (Osborn and Helmi, 1980) and most likely reflects the reality of the distribution in this desert empty of vegetation (Osborn and Helmi, 1980). The last data refer to animals killed in 1900, 65 km west of Alexandria (Flower, 1932), and in 1931, in Scheb (Osborn and Helmi, 1980).

Mauritania: Critically endangered

Eastern Mauritania is part of the range of Addax populations which were linked to the large Mauritania-Malian ergs of the Majabat al Koubra and to the Iguidi and Chech ergs (Monod, 1958; Gillet, 1969; Trotignon, 1975; Walter and Breckle, 1986; Lamarche, 1987). The southern limit of this part of the range descends to southeastern Mauritania between the 17th and 19th parallels. The Addax was still largely distributed in Mauritanian desert regions until the 1940's, but the Mauritanian range has greatly shrunk since (Sournia and Verschuren, 1990). The species probably survived until recently in several parts of the eastern deserts, especially the Dahr Tichit (Trotignon, 1975). Since 1980, the Addax has survived only in the Mreyyé area in the eastern part of the Majabat al Koubra (Lamarche, 1987); this range is occupied by the population also found in western Mali, which makes cross-border seasonal movements over distances of several hundred kilometres (Lamarche, 1987). This moving population was for a long period considered the biggest reservoir of Addax (Lamarche, 1987). It was already considered as threatened by uncontrolled motorized hunting in the 80's and the 90's (Sournia and Verschuren, 1990).

Mali: Critically endangered

Western Mali is also part of the range of Addax populations that were linked to the big Mauritania-Mali ergs of the Majabat al Koubra and to the Iguidi and Chech ergs (Monod, 1958; Gillet, 1969; Trotignon, 1975; Sayer, 1977; Walter and Breckle, 1986; Lamarche, 1987). The Addax is still present along the Mauritania-Malian border (Sayer, 1977; Lamarche, 1987); it is the same population also found in eastern Mauritania and that makes seasonal movements of many hundreds of kilometres, movements which, in the cold season, bring it to Mauritania in the region of the Mreyyé (Lamarche, 1987). The southern limit of this part of the range descends to the centre of Mali between the 17th and 19th parallels. This moving population was, for a long period, considered as the largest reservoir of Addax (Lamarche, 1987). But it was already considered as threatened by uncontrolled motorized hunting in the 80's (Heringa, 1990; Sournia and Verschuren, 1990), and has not been observed for many years now (Niagaté, com. pers.). The Addax is not found in any protected area in Mali (Heringa, 1990). In the transition zone between the desert and the Sahelian steppes, regions of significant presence of Addax existed at least in the periphery of the Adrar des Iforas (Lhote, 1946). Lhote (1946) observed traces of the Addax near the Algerio-Malian border south of the Tanezrouft and to the north of the Adrar des Iforas ; nevertheless there is no data available since the end of the seventies for this area.

Niger: Critically endangered

The Addax was formerly widely distributed in the desert zone of Niger, but it was eliminated from the largest part of its former range (Grettenberger and Newby, 1990). In the transition zone between the desert and the Sahelian steppes, large populations of Addax existed at least in the Ténéré, the piedmont slopes of the Aïr, and the Termit massif (Lhote, 1946; Brouin, 1950; Grettenberger and Newby, 1990; Millington *et al.*, 1991). It is currently still present in dune zones, in the east and northeast of the region of the Termit, the Ténéré desert, and in the northwest near the Algerian border (Grettenberger and Newby, 1990). The northern limit is situated around the 16th parallel. In 1990, Grettenberger and Newby estimated the population in Niger to be less than 200 individuals, of which about fifty were in the western part of the Ténéré desert inside the Aïr-Ténéré National Nature Reserve.



Addax skeleton. Niger. 2004. © John Newby



Grettenberger and Newby (1990) also believed that the density of the Addax population around the Termit massif was probably greater than that of the Aïr-Ténéré Reserve.

This was largely confirmed during a recent survey: 128 Addax were observed (with 3 ULM on an area of 9300 km²) in september 2004 in the Termit (SOS Faune du Niger/DFPP/SZP mission). The termit-Tin Toumma population is now estimated at around 200 individuals (SCF/SSIG, 2005)

Addax. Chad. November 2005 © Roseline Beudels-IRScNB

Chad : Critically endangered

The Addax was formerly widely distributed in the sandy zones of the desert and semi-desert steppes north of the 15th parallel. It could even be locally abundant north of the Erguei and the Bodélé (Kanem), east of the Mourdi depression and farther east in the Ennedi, south of the Tibesti (Gillet, 1969; Newby, 1974), and in the Sudano-Chadian regions of the Mourdi and Wadi Howar (Sudan) depressions (Malbrant, 1952; Gillet, 1969; Kock, 1970; Wilson, 1980). Chad was, for several decades, the most important stronghold of the Addax, at a time when the species was disappearing under hunting pressure practically everywhere else (Thomassey and Newby, 1990). In the beginning of the 1970's, there were still undoubtedly several thousand Addax in Chad (Thomassey and Newby, 1990), but the situation has strongly degraded since, under the combined effects of hunting, years of drought, competition with domestic livestock, and military activities in the north of the country (Thomassey and Newby, 1990). In the 1970's, there were still a substantial number of Addax (around 800 individuals) in the north of the region of the Oued Achim-Oued Rimé, and these Addax moved northwards in the direction of the Tibesti during the rainy season (Thomassey and Newby, 1990). Military events occurring in 1978 compromised protection efforts achieved, and pushed the Addax farther and farther away towards even more marginal regions as far as the survival capacity for the Addax is concerned, than those areas where the species had been established (Newby, 1974). There are currently probably only a few individuals or a few very small groups left in the desert zones, remote and difficult to access, between the 15th and 17th parallels. Recent prospectations, involving aerial censuses and ground observations, carried out by Pfeffer in 1990 and 1991, and renewed ground observations by Tubiana in 1995, indicated the presence of small groups of Addax on the Oued Achim, in the Mourdi depression, especially in its eastern part, on the Oued Chili, between Kalaït and Fada, and in the east of the Ennedi, between Bao Bilia and the Sudanese border (Pfeffer, 1995). Even more recent prospectations have shown that the Addax is probably only present in very low densities. Only two individuals were observed North of Egeui in september 2001 (Monfort *et al.*, 2003). A group of 9 individuals and tracks of groups of 1 to 6 individuals were observed in November 2005 (CMS, SCF and APF Survey).

Sudan: Probably extinct.

In the past, the Addax was widely distributed in the zones of desert and semi-desert steppes of northern Sudan, in the Nubian Desert of the North province and of northern Kordofan, in northern Darfur (Audas, 1951; Kock, 1970; Wilson, 1980; Hillman and Fryxell, 1988). It was widespread and even locally abundant until the 1930's-1940's (Brockelhurst, 1931; Shaw, 1936). By the end of the 1930's, the numbers had diminished considerably in the Kordofan (Audas, 1951) and elsewhere in the 1940's. From the 1950's onwards, information become rare (Wilson, 1980). No sign of presence of the

Addax were recorded during aerial prospections conducted in the 1970's in northern Sudan (Lamprey, 1975; Wilson, 1980), but the species survived in small numbers in the Darfur until the end of the 1970's (Hashim, *in litt.* Nov. 1996).

4. ACTUAL AND POTENTIAL THREATS

The decline of the species cannot be attributed to a single cause, but rather to an ensemble of factors which acted simultaneously and concurrently and were mutually reinforcing, that is, hunting associated with bad land management, drought and the desertification it entails, disturbance and insufficient protection (Newby, 1988).

4.1. Degradation and regression of habitats.

Recent periods of great drought, in the 1960's-1970's and the 1980's, induced a catastrophic expansion of desertification over the entire desert and sub-desert region of North Africa. Their effects on Addax populations were disastrous: reduction of winter pastures, increased scarcity of pasture lands in the dry season, loss of shade, and general disappearance of vital organic water resources (Newby, 1988). Previously, during comparable periods of drought, the Addax probably occupied more significantly the north-Sahelian zone of steppes (White, 1983, unit 54a). Sahelian steppes are subjected to a growing pressure for pastures by the livestock of nomad populations fleeing the drought. Livestock in the Sahelian zone is now in direct competition with the large natural fauna of the region. The Addax populations, in search for pastures, are forced to approach zones of human occupation, and have thus become more exposed to direct exploitation.

4.2. Direct exploitation.

Traditional methods of hunting, such as those practised until the 1960's (hunting with nets), and still, nowadays, hunting with spears and dogs, horses, and dromedaries, although resulting locally or periodically in large takes, could not have had a significant impact on Addax numbers (Brouin, 1950; Gillet, 1965, 1969; Newby and Grettenberger, 1986; Newby, 1988; Dragesco-Joffé, 1993). For the last 30 or 40 years, excessive hunting with modern arms has reduced the populations to such a degree that traditional hunting can practically no longer be done (Newby and Grettenberger, 1986).

Man is clearly the main instrument of the decline of the species, mainly since the end of the 1940's, with the advent of the deadly combination of firearms and off-road vehicles, as documented by Gillet (1965, 1969), Newby (1986, 1988) and Dragesco-Joffé (1993), who show that hunting, carried out in an irresponsible way by mining, military, and administrative

personnel, is the principal cause of the staggering decline of the Addax.

These (illegal) taking still continue today, e.g. in the Termit 11 to 14 Addax were reported to killed in august 2002, and 3 to 5 in 2003 (SOS Faune du Niger; Greth *et al.*, 2003).



4.3. Other threats.

Tourism is and has been an additional threat to the Addax, particularly in Niger where Newby (1989, 1990) notes tourists chasing Addax with off-road vehicles. Chased and harrassed in this manner, the Addax starts galloping and can die within ten minutes.

All of the indirect human pressures likely to affect the species, such as the increase of wells, the extension of domestic livestock, and the invasion of available habitats, have an effect through the degradation or the regression of habitats and the rise in vulnerability to taking and harassment. These have been treated in the preceding paragraphs.



*Addax horns in a poacher's camp. Termit. Niger.
© mission ASS/CMS/SOS FAUNE/DFPP November 2003*

*Niger 2004. Garbadge left by illegal hunters.
© John Newby. Mission SSIG-SCF 2004*

5. REGULATORY PROVISIONS

5.1. International.

Bonn Convention: Appendix I, Resolution 3. 2, paragraph 4.
Washington Convention (CITES): Appendix I

5.2. National.

6. CONSERVATION MEASURES, PER PARTY

6.1. Ban on taking.

6.2. Habitat conservation.



Addax. & Oryx. Bou-Hedma NP. Morocco. 2002.
© R.C. Beudels-IRScNB.

Morocco :



Addax. Souss-Massa NP. Morocco. 2005
© Heiner Engel. Hannover Zoo.

The proposed parks of the Drâa basin and of Dakhla-Adrar Souttouf (Müller, 1966) seem suitable for reintroducing the species. The few existing data for these zones suggest that they did not support permanent populations of Addax. The current practical impossibility of ensuring security of movement towards other regions will perhaps necessitate active management of the habitat.

Tunisia:

The Addax has been extinct in Tunisia since the 1930's. In 1980, the Tunisian Government established the Bou Hedma National Park, 16,488 hectares of steppes and *Acacia raddiana* woodlands, of which 4500 hectares are managed under a system of total protection. The Bou Hedma Park, in which a programme of habitat restoration has been successfully conducted (Bertram, 1988; Bousquet, 1992; Kacem, 1994), represents an optimal site for reintroduction of *Oryx dammah*.

It represents for the Addax more a reproduction centre for its restoration in to more suitable areas in Saharan parks such as Djebil National Park, once planned reinforcement of these parks is assured. Management of the habitat at Djebil may have to be considered. Translocation of the Bou-Hedma Addax into Djebil NP is planned by the Tunisian authorities in 2006.

Algeria:

The Tassili des Ajjers National Park and the Hoggar National Park offer, because of their exceptional size and environmental diversity (Bousquet, 1992), possibilities for reintroduction. The rarity of observations in these regions for the last few decades does not allow exclusion of the need for habitat management.

Mali:

The shifting population of several hundred individuals that could still survive in western Mali, at the Mauritania-Malin border, is threatened by uncontrolled motorized hunting (Heringa, 1990; Sournia and Verschuren, 1990). At present the Addax is not found in any protected area in Mali (Heringa, 1990). Local energetic protection efforts for this last large Addax population are essential to the survival of the species.

Mauritania:

Since 1980, the Addax has survived in Mauritania only in the Mreyyé region in the eastern part of the Majabat al Koubra (Lamarache, 1987); this population is the same as the one found in western Mali, and that performs seasonal cross-border migrations of several hundred kilometres between Mali and Mauritania (Lamarache, 1987). This shifting population of many hundred animals could be one of the largest reservoir of Addax today (Lamarache, 1987). Hunting practices in Mauritania expose this population to considerable risks (Lamarache, 1987; Sournia and Verschuren, 1990). Strict protection measures

must be taken to prevent irresponsible motorized hunting in the Mreyyé (Lamarche, 1987). The Addax is at present not found in any protected area in Mauritania. Local energetic protection efforts for this last sizeable population of Addax are essential to the survival of the species. Special efforts must imperatively be made to control hunting.

Niger:



Addax. Temet. Niger. © John Newby

Within the perimeter of the Air-Ténéré National Reserve (RNNAT), a sanctuary was created in 1988 specifically for the preservation of the Addax. Unfortunately, the Addax was eliminated from the RNNAT through poaching. A proposed protected area (2006 ?) in the region of the Termit-Tin Toumma ,where the last viable population of Addax in the world still occurs, might represent the last chance of survival of the species *in situ*. Reintroduction in the RNNAT might be considered in the future in the light of the current environmental and social context, after new evaluations of the chances of survival of the species in the wild.

Chad:

The Ouadi Rimé-Ouadi Achim Reserve is an essential site for Addax and Oryx restoration in the future (Grettenberger and Newby, 1990; Pfeffer, 1993a, 1995). Addax have still been sighted recently in the north of the Reserve. Rehabilitation of the Reserve, badly treated since the military conflicts and decimated by poachers, is a prerequisite for any action (Grettenberger and Newby, 1990). The implementation of strict protection measures for the habitat and the fauna is crucial.. Conservation measures need to be developed for the Egey-Bodélé region.



*Wadi Rimé-Wadi Achim Reserve in the 70'.
Projet WWF-UNEP. © John Newby.*

Sudan:

A proposal to establish a protected area in Wadi Howar in Northern Darfour, would provide an opportunity to restore populations of Addax if it became necessary and feasible. Considering the degraded conditions of the steppe areas in Sudan, substantial habitat restoration measures may be a necessary prerequisite. To control poaching within large protected areas may be extremely difficult (Cloudsley-Thompson, 1992).

6.3. Attenuation of obstacles for migratory animals.

Given the present state of the populations, the question is without object. In the event of restoration, or as reintroduction projects progress, it could become a new concern. In the short and medium term, only the creation of protected areas large enough to include the entire range, including migratory movements necessary during periods of drought, and, in particular, cross-border reserves, seems to be an adequate answer. It seems indeed unlikely that security of movement between protected areas can be realistically assured in the foreseeable future.

6.4. Regulations concerning other detrimental factors.

6.5. Other measures.

Outside range:

The species is raised in captivity or semi-captivity in various countries in North Africa, the Middle East, Europe, and North America.



*9 Addax in Egey-Bodélé. November 2005. Chad.
CMS. SCF. APF Survev © R. Beudels-Jamar-IRScNB*

7. RESEARCH ACTIVITIES

7.1. Public authorities.

New prospection efforts are needed to evaluate the residual populations of Addax, essentially in Niger and Chad.

Research and experiments must be conducted in the domain of rational use of the Addax as an exceptional resource capable of utilizing extreme environments.

7.2. N.G.O.s

8. NEEDS AND RECOMMENDED MEASURES

Recommended measures are detailed in ASS-CMS Action Plans (Beudels *et al.*, 1998). The principal needs that they meet are listed below. However, the survival of the Addax, and the future of the Saharan biodiversity, will depend mostly on right political decisions taken at the highest levels, in key Range States such as Niger and Chad. A moratorium on hunting, for example, would be particularly useful until efficient protected areas can be implemented, with proper buffer zones established between protected areas and hunting concessions.



Talking with nomads. Niger. Mission SSIG-SCF. 2004. © Tim Wachter-ZSL

8.1. Total protection of the species.

Required in all the countries of the historical range in order to prepare a possible redeployment of the species.

8.2. Conservation measures.

Establishment of networks of protected areas in all parts of the historical range of the Addax, based on the guidelines stated in point 2.2.4., with absolute priority given to zones where the species could be surviving in the wild, most importantly, to the protection of the Termit-Tin Toumma massif in Niger; the prospection and preservation of large areas within the Majabat-al-Koubra in Mauritania and Mali, the rehabilitation of the Ouadi Rimé-Ouadi Achim Reserve in Chad, and to the reinforcement of the Air-Ténéré Reserve in Niger, require also urgent attention.

8.3. Location and monitoring of residual populations, and clarification of their ecological requirements:

Niger: Further prospections to evaluate exact range of the Addax population around the Termit massif.

Chad: Urgent need for new prospections to evaluate residual populations of Addax.

8.4. Reinforcement of populations and reintroduction into the potential range.

Support for the Tunisian reintroduction programme.

Support for the Moroccan reintroduction programme.

Preparation of programmes in other regions of the historical range, according to the guidelines stated in point 2.2.4.

New evaluation of the possibilities of reinforcing the populations in Niger and Chad.

Study the possibilities of reviving the project to establish a captive breeding centre at the former ranch of Gadabedji, as proposed in the 80's (Oryx, Dama gazelles and Addax).



Addax. Bedding site. Termit. Niger. 2004. © Tim Wachter - ZSL

9. CONSERVATION AND RATIONAL USE

In the recent past, large mammals were important as a source of protein and for their exchange value in all the desert and semi-desert zones of North Africa, and represented an important resource in particular for the people of the desert. For the last sixty years, these large mammals have gradually disappeared, but the number of livestock, in Niger for example, has increased significantly in certain periods (Newby and Grettenberger, 1986). During periods of drought, this livestock diminished considerably. If large mammals could be reintroduced or their numbers increased until they reach sufficient levels, and if they could be managed as a natural resource, these species, adapted to survival in extreme conditions, could become highly valuable for sustainable development of these regions. Research and experimentation should be undertaken in this sense.



Addax habitat. Tin-Toumma. Niger. 2004 © John Newby



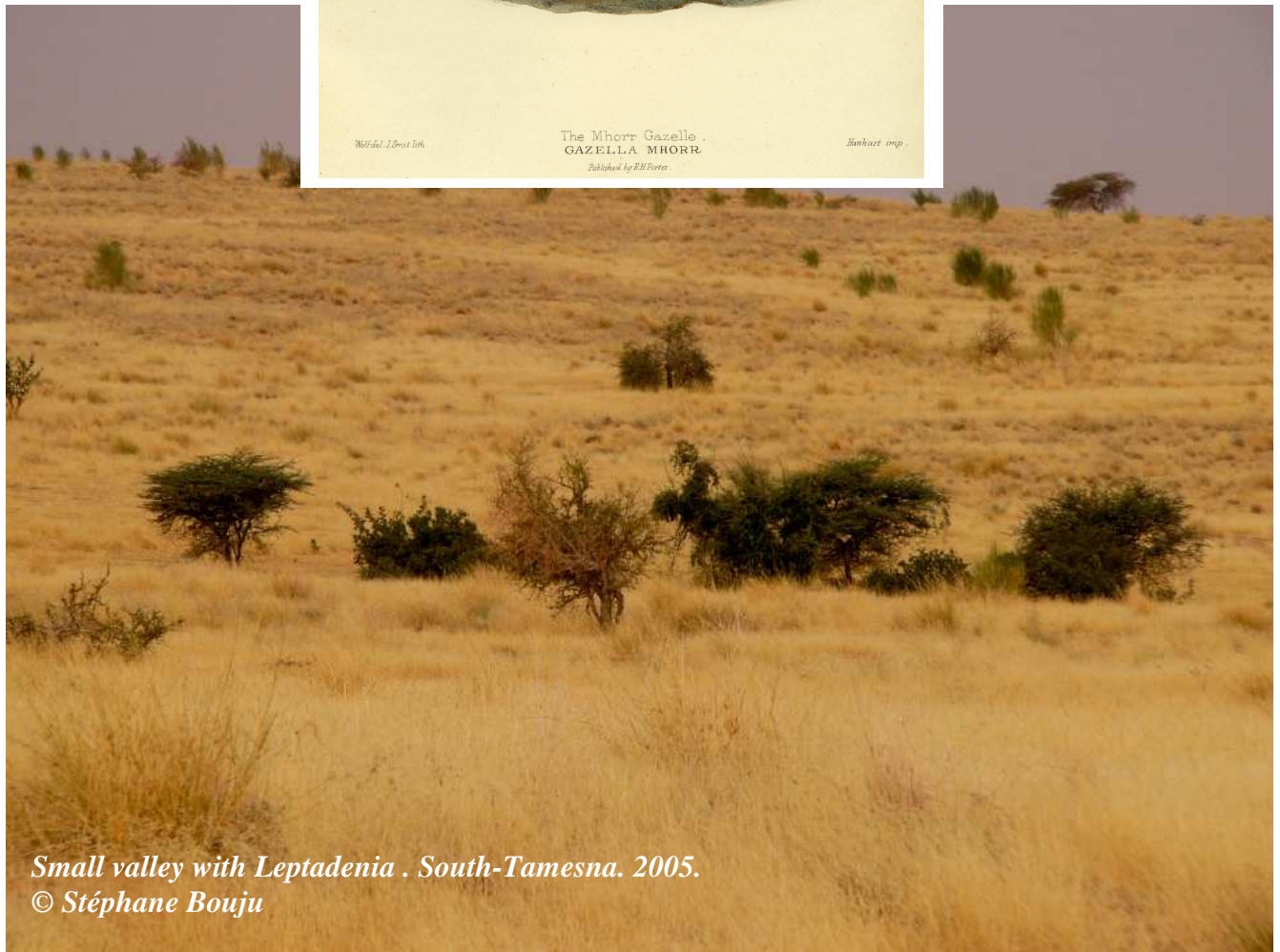
Addax habitat and tracks. SSIG-SCF Mission. Niger. 2004. © John Newby



- *Stone carving of a Gazella dama. Rupestrian art. Air, Niger. © Nils Robin*
- *Tadjelahine. Art protoberbère. Tassili N'Ajjer*



Gazella dama



*Small valley with Leptadenia . South-Tamesna. 2005.
© Stéphane Bouju*

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GAZELLA DAMA

1. TAXONOMY AND NOMENCLATURE



Gazella dama. Bou-Hedma National Parc. Tunisia.
© Heiner Engel. Hannover Zoo. 2005.

1.1. Taxonomy.

Gazella dama belongs to the tribe Antilopini, sub-family Antilopinae, family Bovidae, which comprises about twenty species in genera *Gazella*, *Antilope*, *Procapra*, *Antidorcas*, *Litocranius*, *Ammodorcas* (O'Regan, 1984; Corbet and Hill, 1986; Groves, 1988). Genus *Gazella* comprises one extinct species and from 10 to 15 surviving species, usually allocated to three sub-genera, *Nanger*, *Gazella* and *Trachelocele* (O'Regan, 1984; Corbet and Hill, 1986; Groves, 1988). *Gazella dama* is one of three species forming the group of giant gazelles (Groves, 1988) of sub-genus *Nanger* (O'Regan, 1984). The other two species, *Gazella soemmerringi* and *Gazella granti*, are linked to the semi-deserts, dry thickets, dry woodlands, steppes, and open savannas of northeastern and eastern Sudanian Africa. *Gazella dama* is polytypic, comprising three to nine recognised sub-species (Cano, 1984; Groves, 1988; Alados *et al.*, 1988; Dragesco-Joffé, 1993; Cano *et al.*, 1993; Kacem *et al.*, 1994; Abaigar *et al.*, 1997). The geographical variation appears clinal, with regions of steepening of the gradient (Groves, 1988); geographical variation is

somewhat obscured by individual variation (Brouin, 1950; Malbrant, 1952; Dragesco-Joffé, 1993). Usually three sub-species are distinguished: *Gazella dama mohrr* in the Atlantic Sahara, *Gazella dama dama* in the western and central Sahel, and *Gazella dama ruficollis* in the eastern Sahel (Cano, 1984; Cano *et al.*, 1993; Kacem *et al.*, 1994; Abaigar *et al.*, 1997). Uncertainty exists about the identity of the extinct Sahelian populations of Senegal, included in *Gazella dama dama* after the work of Sclater and Thomas (1898), and again recently by Kacem *et al.* (1994), in *Gazella dama mohrr* by Cano (1984), Cano *et al.* (1993), and Abaigar *et al.* (1997). This uncertainty contributes to doubts about possible geographical isolation of the Atlantic form *Gazella dama mohrr*, morphologically the most distinct. Kacem *et al.* (1994) suppose a hiatus in distribution between *Gazella dama mohrr* and *Gazella dama dama* in the south of Mauritania. This is not apparent on the map of distribution drawn by Trotignon (1975), but is confirmed, however, by an examination of the historical data he collected. In any event, possible future efforts to reintroduce, and even more to reinforce, populations must respect the geographical variation of the species as far as possible, even if its clinal character does not require differential treatment of sub-species. The only probable exception is that of *Gazella dama mohrr* whose geographical isolation and coastal desert specialisation are probable.

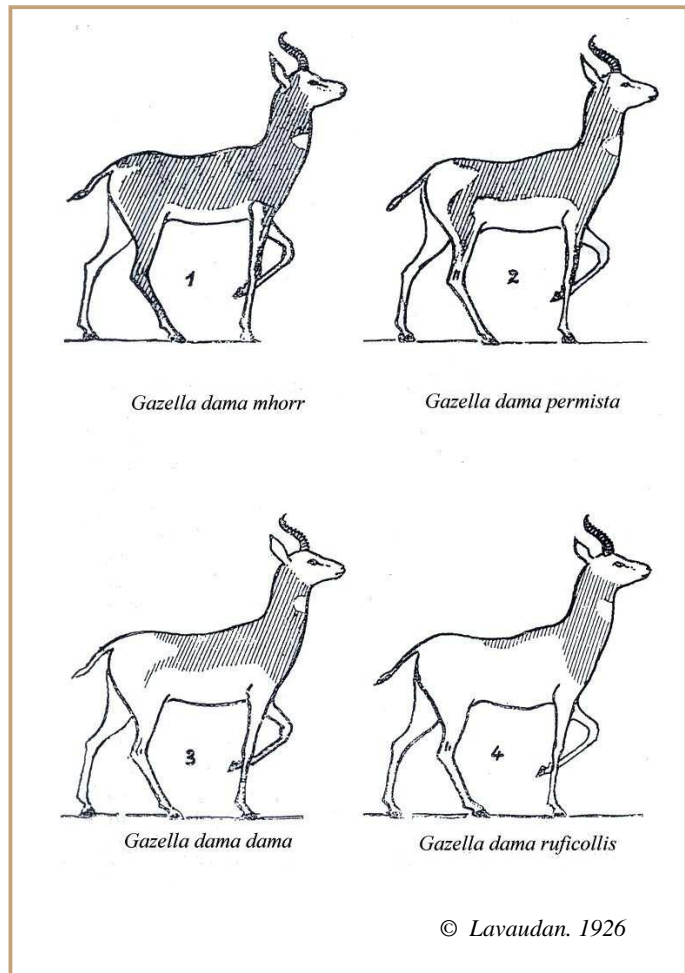
1.2. Nomenclature.

1.2.1. Scientific name.

Gazella dama (Pallas, 1766).

1.2.2. Synonyms.

Antilope dama, *Cerophorus dama*, *Cemas dama*, *Antilope nanguer*, *Gazella nanguer*, *Antilope mhorr*, *Nanger mhorr*, *Gazella mhorr*, *Gazella mohr*, *Antilope mhoks*, *Antilope dama*, var. *occidentalis*, *Antilope ruficollis*, *Gazella ruficollis*, *Antilope addra*, *Antilope dama*, var. *orientalis*



© Lavaudan. 1926

1.2.3. Common names.

English:	Dama Gazelle, Addra Gazelle
French:	Gazelle dama, Biche-Robert, Mohrr, Gazelle mhor, Mohor, Gazelle mohor, Nanguer (Buffon), Ména, Grande gazelle
German:	Damagazelle
Tamachek:	Tenhert
Arabic:	Ariel, Ril
Tamashek:	Enir

1.2.4. Description

The coloration of the coat is quite variable, and is used to distinguish subspecies. The face and underparts are white in all described forms. The coat is bright white, with reddish brown or chestnut on the neck. However, as one travels from east to west through this species' range, the extent of coloration increases dramatically, with the western-most subspecies being almost completely red except for the undersides and rump. All races have a small white patch on the throat. The face has relatively few markings, being completely white in eastern subspecies, but with red cheek patches and thin black stripes running from the eyes to the corners of the mouth in the western subspecies - the Mhor gazelle. The body is supported by thin legs, and the neck is long and slender. The horns are found in both sexes, though generally larger and thicker in males. They are "S" shaped, slanting backwards, then curling upwards. The tail is short and white, with a sparse fringe (Mallon & Kingswood 2001).

TL :	95 - 165 cm
T:	26 - 35 cm
H :	90 - 120 cm
Weight:	(male) 40-75 kg (female) 35-40 kg
Horns :	25-35 cm

2. BIOLOGY OF THE SPECIES

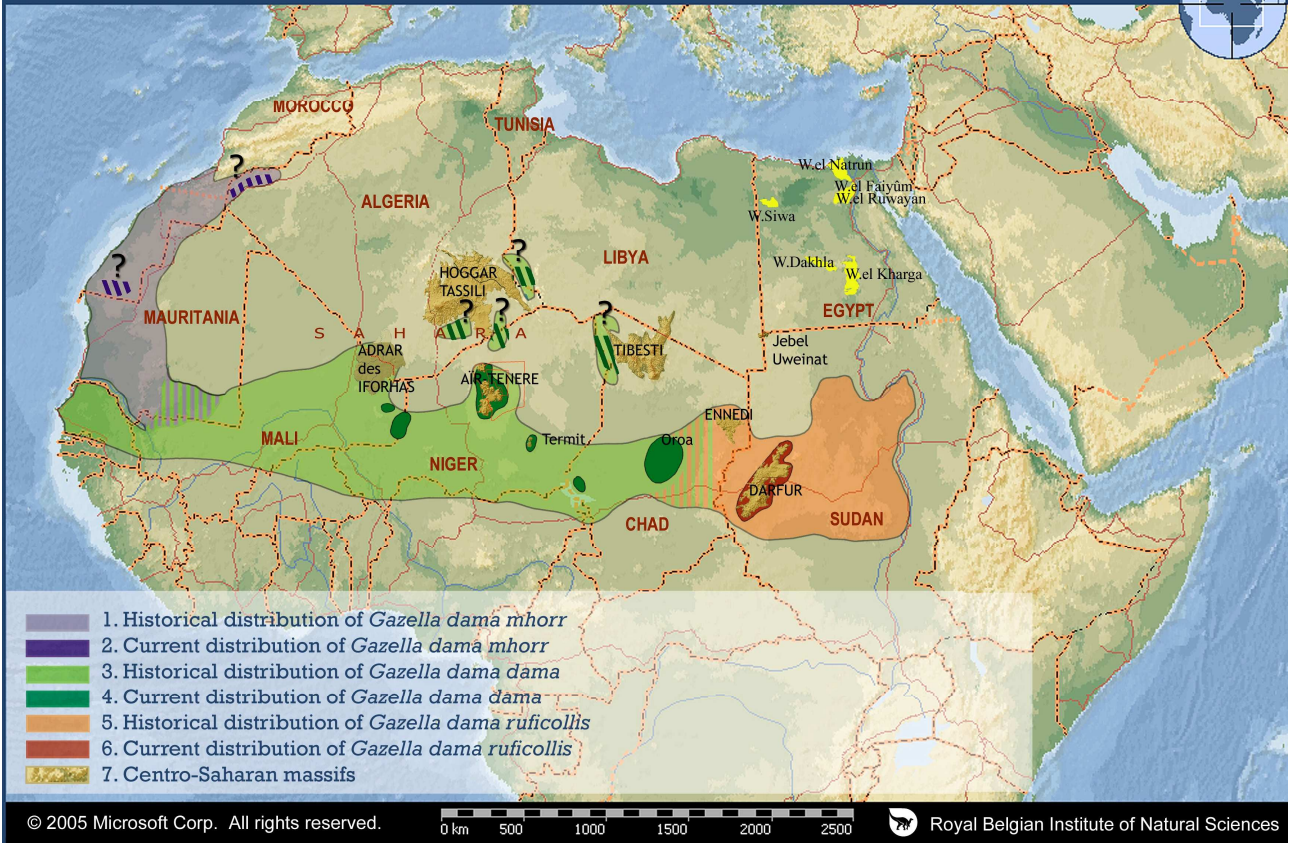
2.1. General Biology

2.1.1. Habitat.

Characteristically, the Dama Gazelle has a mixed diet of grazing gramineous or non-graminid herbaceous plants, and of browsing the foliage of ligneous species, which play a particularly important role in its ecological requirements (Newby, 1974). In the Sahelian region the trees and shrubs that are preferentially browsed comprise *Acacia senegal*, *Acacia raddiana*, *Acacia erenbergiana*, *Maerua crassifolia*, *Capparis decidua*, *Capparis corymbosa*, *Cadaba farinosa*, *Boscia senegalensis*, *Guiera senegalensis*, *Grewia villosa*, *Grewia tenax*, *Balanites aegyptiaca*, *Chrozophora senegalensis*, *Leptadenia pyrotechnica*, and *Commiphora quadricenta*. The forbs, frutescents, and grasses grazed include *Limeum viscosum*, *Monsonia senegalensis*, *Boerhavia repens*, *Cucumis melo*, *Tephrosia lupinifolia*, *Tephrosia obcordata*, *Indigofera aspera*, *Tribulus terrester*, *Tribulus ochroleucus*, *Borreria radiata*, *Blepharis linariifolia*, *Commelina forskalaei*, *Eleusine flagellifera*, *Cyperus gemenicus*, *Aristida mutabilis*, *Aristida pallida*, *Schmidtia pappophoroides*, and *Panicum turgidum*, (Brouin, 1950; Malbrant, 1952; Newby, 1974; Grettenberger and Newby, 1986; Dragesco-Joffé, 1993). The gazelle also consumes the pods and flowers of *Acacia spp.* (Dragesco-Joffé, 1993). Its water needs are met in part, as for many other Sahelo-Saharan species, by the wild melon, *Colocynthis vulgaris* (*Citrullus colocynthis*) (Newby, 1974; Dragesco-Joffé, 1993).



The presence and density of trees appear to condition the distribution of the Dama Gazelle (Grettenberger and Newby, 1986). Its close connection with acacia woodlands and their accompanying flora has been noted by numerous observers in various parts of the range (Sclater and Thomas, 1898; Lhote, 1946; Brouin, 1950; Morales Agacino, 1950; Malbrant, 1952;



Faeces and habitatt. Manga. Chad. © Tim Wacher- ZSL



Tracks of *Gazella dama*

Northern Termit, Niger. © SSOG-SCF



Sud-Tamesna, Mali. 2005 © Stéphane Bouju

Valverde, 1957; Kowalski and Rzebik-Kowalska, 1991; Dragesco-Joffé, 1993; Kacem *et al.*, 1994). In Niger, Grettenberger and Newby (1986) documented its strong preference for the major wadis and their flood plain, secondarily for the steppes of zones of water movement and the dunes invading the wadi beds, environments in which trees remain in better condition during the dry season and bring shade and fodder in the hot season. In the same way, in the Atlantic Sahara, *Gazella dama mohrr* mainly occupied wadis dotted with acacia woods of variable density (Morales Agacino, 1950; Valverde, 1957). There they ate the leaves of *Acacia seyal* with a complement of leaves from *Maerua*, *Calotropis*, *Balanites*, *Salvadora*, *Leptadenia*, and *Ziziphus*.

However, in the Northwestern part of its range, in areas lying some 10-50 km from the Atlantic Ocean, *Gazella Dama* were found in dense wooded steppes without acacia (Cuzin 2003). In the Saharian Northwest, *Gazella Dama* probably fed mostly on *Argania spinosa* foliage, in the same way as *Gazella dorcas* et *Gazella cuvieri* (Cuzin 1998). Nowadays, mostly because of poaching pressure, *Gazella Dama*'s distribution appears limited to areas where vehicle access is practically impossible : the inaccessibility of sites conditions probably now its repartition (Lamarque, com. pers., 2005).

2.1.2. Adaptations.

The Dama Gazelle is a desert/semi-desert species and is drought resistant. Most of its water is obtained from its plant food. It is both a browser and a grazer. The Dama Gazelle browses on various desert shrubs and acacias. In times of drought it also eats rough desert grasses.

Dama Gazelles occupied the same ecological zones as the Scimitar-horned Oryx, and both species ecology were very similar. Like most desert species, the Dama Gazelle is highly nomadic, ranging widely in order to obtain sufficient nutrition. In addition, these gazelles undertake large seasonal migrations, moving north into the Sahara desert during the rainy season, and retreating south into the Sahel during the dry season. To maximize the amount of food available, these gazelles may stand on their hind legs in order to reach leaves above the normal browsing height.

2.1.3. Social behaviuor

The social organization of Dama Gazelles is greatly affected by the seasons. Herds typically spend the dry season in the Sahel where they occur singly or in mixed groups of 10 - 15, composed of a dominant adult male, several adult females, and young. With the onset of the rainy season, they migrate into the desert, where, in the past, aggregations including males and females could include several hundred individuals. (Mallon & Kingswood 2001, AZA Antelope TAG). Male Dama Gazelles become territorial during the mating season

2.2. Distribution.

2.2.1. Historical distribution.

The range of the Dama Gazelle resembles that of the Scimitar-horned Oryx (*Oryx dammah*), with which it largely shares ecological requirements, with however a slightly greater tolerance for desert zones (Dupuy, 1967) and rocky environments. The zone of historical distribution consequently comprises more or less the same Sahelian and Atlantic sections, but extends to the central Saharan massifs. On the other hand, it seems never to have included a Mediterraneo-Saharan sector (Sclater and Thomas, 1898; Lavauden, 1920; Heim de Balsac, 1931; Dupuy, 1967; Kowalski and Rzebik-Kowalska, 1991; Loggers *et al.*, 1992), nor any extension into the oases of the Libyan Desert of middle Egypt (Osborn and Helmy, 1980); the observation of *Antelope dama* by Schweinfurth in Dakhla clearly refers to the oryx, not to the gazelle (Osborn and Helmy, 1980).

The main, Sahelian, range of *Gazella dama* coincides, like that of *Oryx dammah*, with the semi-desert Sahelian steppes belt of White (1983), forming his unit 54a in region XVI, largely corresponding to that of the sub-Saharan *Aristida* steppes of Rattray (1960), comprising his units A11, A13, A15, the sub-desert steppes of Newby (1974), and the Saharan savannas of Schulz (1988) and Ozenda (1991). These steppes extend across the centre-south of Mauritania between 18° (locally 20°) and 16° N, the centre of Mali between 18° and 15°N, of Niger between 17° and 15°N, of Chad between 17° and 14°N, and of Sudan between 17° and 12° 30'N (Lhote, 1946; Malbrant and Maclatchy, 1949; Brouin, 1950; Audas, 1951; Malbrant, 1952; Dekeyser, 1955; Cornet d'Elzius and Gillet, 1964; Newby, 1974; Lamprey, 1975; Schnell, 1976; Wilson, 1978, 1980; Monod, 1986; Grettenberger and Newby, 1986, 1990; Hillman and Fryxell, 1988; Sournia and Verschuren, 1990; Heringa, 1990; Thomassey and Newby, 1990; Millington *et al.*, 1991; Dragesco-Joffé, 1993; Kacem *et al.*, 1994; Hashim, 1996). Towards the south, the distribution of the Dama Gazelle advanced widely in the southern Sahelian band of deciduous shrubs or thickets (White, 1983, region XVI, unit 43) in Senegal (Sournia and Dupuy, 1990), in Burkina Faso (Heringa *et al.*, 1990), in Mauritania (Trotignon, 1975), in Mali (Lhote, 1946), in Niger (Lhote, 1946), in Chad (Malbrant, 1952; Newby, 1974), in Sudan (Audas, 1951), and in Nigeria (Anadu and Green, 1990). The Sahelian range included the southern Saharan massifs of the Adrar des Iforas in Mali, the Air in Niger, the Ennedi in Chad, and the Darfur in Sudan (Lhote, 1946; Brouin, 1950; Chopard and Villiers, 1950; Malbrant, 1952; Newby, 1974; Lamprey, 1975; Wilson, 1980; Monod, 1986; Grettenberger and Newby, 1986; Kacem *et al.*, 1994).

Contrary to the Oryx, the Dama Gazelle was able to survive until the recent past in the insular central Saharan massifs (Heim de Balsac and Mayaud, 1962; Simon, 1965; Ozenda, 1991) which harbour, at the favour of humidity gradients, in particular in the valleys, *Aristida* sub-desert steppes, as defined by Rattray (1960), and multiple ligneous formations (Schnell, 1977; Ozenda, 1991), and locally reproduce conditions somewhat similar to those of the Sahelian sub-desert fringe. Its presence is well documented in the vast mountainous group formed by the Hoggar and the Tassili des Ajers in Algeria (Regnier, 1960; Dupuy, 1967; De Smet, 1989; Kowalski and Rzebik-Kowalska, 1991), mainly in the southern part of the complex (Dupuy, 1967). It was noted several times in the western piedmont of the Tibesti, but was perhaps rarer there than in the Algerian massifs (Dalloni, 1936; Malbrant, 1952).

The range of *Gazella dama mohrr* coincides more or less with the oceanic and sub-oceanic Atlantic Sahara, a cold-current coastal and attenuated desert comprising a sublittoral zone, 200 to 300 kilometres wide, where steppes and acacia woodlands abound, allowing the Sahelian flora and fauna to penetrate far north (Valverde, 1957; Monod, 1958; Rattray, 1960; Quézel, 1965; Schnell, 1977; White, 1983; Edmondson *et al.*, 1988; Dakki and Parker, 1988; Ozenda, 1991). Numerous observations of the Dama Gazelle have been made in this very peculiar desert (Sclater and Thomas, 1898; Morales Agacino, 1950; Valverde, 1957; Trotignon, 1975; Loggers *et al.*, 1992), in a belt which extends from the Oued Noun, in Morocco, to the north, to the Inchiri, in Mauritania, to the south, and almost never exceeds a width of 200 to 300 kilometres. Even though the map of distribution proposed by Trotignon (1975) for the species in Mauritania indicates a continuity between this Atlantic population and the Sahelian populations of southeastern Mauritania, this is not supported by the historical observations he compiled and a cartographic examination indicates, on the contrary, a large gap between the two ranges.

2.2.2. Decline of the range.

In the 1940's the Dama Gazelle still seemed very common in the Sahelian part of its range, but already very rarefied in the Atlantic Sahara and in the central Saharan massifs (Lhote, 1946; Brouin, 1950; Dupuy, 1967). Yet at the end of the 1950's, Valverde (1957) noted a sharp increase in the Spanish Sahara, after near extinction, because of effective protection against poaching. He observed a density close to 150 animals per 100 kilometres of road. However, shortly afterwards, the species practically disappeared from the region, Loggers *et al.* (1992) only collecting one observation for the period 1960-1970, and one other for the period after 1980. *Gazella dama mohrr* is quite certainly extinct in the wild. In the complex of the Hoggar and the Tassili des Ajers, the last data gathered by Kowalski and Rzebik-Kowalska (1991) date from the 1960's and the species is also generally considered extinct (Dragesco-Joffé, 1993).



Poached Dama. Niger. 2004.
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With regard to the Sahelian populations, a significant regression was observed in the 1960's and 1970's with probable extinction in Mauritania (Trotignon, 1975; Verschuren, 1984) and in Senegal (Sournia and Dupuy, 1990). In the early 1980's, relatively large populations were surviving in Mali, Niger, and Chad, and perhaps very small numbers in Sudan (Newby, 1982). In the beginning of the 1990's they had been reduced to dispersed, relict and declining populations, in Mali (Heringa, 1990) and in neighboring Burkina Faso (Heringa *et al.*, 1990), in Niger (Grettenberger and Newby, 1990; Dragesco-Joffé, 1993), and in Chad (Thomassey and Newby, 1990).

2.2.3. Residual distribution.

Very small populations of Dama Gazelle survive in the Sahel, at least in Mali, Niger, and Chad, and perhaps also in Burkina Faso and Sudan, its survival in eastern Mauritania seems very improbable (F. Lamarque, com. pers.). In Mali they are probably several hundred strong and slightly increasing (Duvall *et al.*, 1997). In Niger, where the zone of the Air-Ténéré and the Termit constitutes one of the last bastions of the species, Dragesco-Joffé (1993) evaluated the population at 400 animals. In Chad the species is currently very rare in the Ouadi Rimé-Ouadi Achim Reserve (Moksia and Reouyo, 1996).

It is possible that *Gazella dama mohrr* still survives in a few isolated pockets in parts of its historical area of distribution. Cuzin (1996) notes observations made by nomads in the Drâa basin in 1993. In Adrar Souttouf, the last observation was made in 1973 (F. Cuzin, comm. pers.), and south of the Draa, the last observation was made in 1980, south-west of Assa (Cuzin 1998).

2.2.4. Recolonisation prospects.

The survival of several Sahelian cores makes recolonisation of the entire Sahelian range possible, insofar as an adequate network of protected areas can be established. To be usable by the species, these areas must benefit from a sufficient degree of protection against taking, but also be the subject of environmental rehabilitation, particularly of the woodlands of acacia and other ligneous species on which the Dama Gazelle seems to depend. The central Saharan massifs could eventually be reoccupied from Sahelian sources if these core populations were able to rebuild and regain sufficient vigour. The Hoggar

and the Tassili des Ajjers populations were certainly in communication with those of the Adrar des Iforas and the Air (Lhote, 1946; Dupuy, 1957). However, it is probable, given the inevitable ecological insularisation of protected areas, whether they be Sahelian or Saharan, that the zones where favourable conditions are recreated, but where the species is no longer present, will repopulate naturally only with great difficulty.

With regard to *Gazella dama mohrr*, extinct or on the edge of extinction in the wild, the best possibility of redeployment appears, as for the Oryx, to be in the region of Dakhla-Adrar Souttouf. More to the south, the species was still recently observed in the continental part of the Banc d'Arguin National Park or on its confines. The recent presence of the species at the northern limits of its historical range, in the Drâa basin, offers another possibility.

A number of protected areas, existing or potential, in which restoration of Dama Gazelle's populations could be envisaged, by means of protection, management, and, if necessary, restoration of the habitat, or, in case of current absence, reintroduction of the species, are listed in Table 1. Their choice takes into account the possibility of simultaneous use for *Oryx dammah*.

Table 1. Zones of particular interest for the restoration of *Gazella dama* populations.

Segment de l'aire potentielle	Pays	Site
Nord de l'aire sahélienne	Tchad	Ouadi Rimé-Ouadi Achim
	Niger	Termit
	Niger	Air-Ténééré
	Mali	Nord Tamesna
	Soudan	Wadi Howar-Darfour
	Mauritanie	Sud-est
Sud de l'aire sahélienne	Sénégal	Ferlo
	Mali	Gourma, Ansongo-Menaka, Sud Tamesna
	Niger	Gadabedji
	Burkina Faso	Seno-Mango
Aire saharienne atlantique (<i>Gazella dama mohrr</i>)	Maroc	Dakhla
	Maroc	Drâa
	Mauritanie	Banc d'Arguin
Massifs centro-sahariens	Algérie	Hoggar, Tassili des Ajjers

2.3. Evaluation and evolution of populations.

The populations have experienced a catastrophic decline accompanied by extinction of local populations, perhaps including the extinction of an isolated form, *Gazella dama mohrr* (including *Gazella dama lazanoi*). The most recent population estimates, pertaining to the end of the 1980's and the beginning of the 1990's, is of less than 1500 individuals for the entire range, of which 400 in Niger (Dragesco-Joffé, 1993). The fragmentary indications available for later years suggest even lower figures (Pfeffer, 1993a, 1993b, 1995; Beudels *et al.*, 1994; Moksia and Reouyo, 1996).

2.4. Migration.

The Dama Gazelle undertakes movements of medium amplitude according to the availability of pastures. The cycle of these migrations, during which it could form herds of 100 or 200 head, sometimes up to 600 (Brouin, 1950), is, in the Sahel, similar to that of the Scimitar-horned Oryx (Brouin, 1950; Malbrant, 1952; Newby, 1974; Dragesco-Joffé, 1993). Its stay in the south of the range seems, however, longer than that of the latter species (Newby, 1974). In Chad, Newby (1974) observed a retreat towards the south as of January and February, an increasing concentration in the large wadis during the hot season, from March to May, a new progression towards the south, as for the Oryx, at the time of the first rains, at the end of May or the beginning of June, and migration towards the north in June and July.

The cyclic, seasonal, or interannual migrations of the Dama Gazelle have or had a cross-border character between Mauritania, the former Spanish Morocco, and Algeria (Valverde, 1957; Trotignon, 1975; Kowalski and Rzebik-Kowalska, 1991), between Mauritania and Mali (Trotignon, 1975), between Mali and Niger (Lhote, 1946), between Mali and Algeria (Lhote, 1946; Dupuy, 1967; Kowalski and Rzebik-Kowalska, 1991), between Niger and Algeria (Lhote, 1946), between Mali and Burkina Faso (Heringa, 1990; Heringa *et al.*, 1990), between Niger and Chad (Dragesco-Joffé, 1993), and between Chad and Sudan (Wilson, 1980).

3. Conservation status, by party

Morocco: extinct or on the edge of extinction

The largest part of the historical range of *Gazella dama mohrr* consists of an oceanic and sub-oceanic desert band about 200 kilometres wide, extending from the Oued Noun to the southern border of the former Spanish Sahara (Sclater and Thomas, 1898; Morales Agacino, 1950; Valverde, 1957; Trotignon, 1975; Loggers *et al.*, 1992). Observations exist outside of the Atlantic Sahara proper, in the Mediterraneo-Saharan zone immediately to the north of it, and in the adjacent Sahara in the Drâa basin, northwest to the region of Zagora (Loggers *et al.*, 1992). The species was already extremely rare in the 1940's (Valverde, 1957; Dupuy, 1967), then re-established itself locally in the 1950's (Valverde, 1957), before collapsing. Only one observation exists for the period 1960-1970, and one other for the period after 1980, both in the Drâa basin (Loggers *et al.*, 1992), so that the extinction of the Moroccan population and consequently that of *Gazella dama mohrr* are to be feared. It is possible, however, that the Mohr survives in very small numbers in the Drâa basin and in the Adrar Souttouf (Cuzin, 1996).

Algeria: extinct or on the edge of extinction

Gazella dama mohrr frequented, perhaps irregularly, the Tindouf hamada and the Drâa hamada in the extreme west of the country (Dupuy, 1967; De Smet, 1989; Kowalski and Rzebik-Kowalska, 1991). The last observations date back to the 1940's and 1950's. In addition, an area of regular presence of *Gazella dama dama* existed in the Hoggar massif and its surroundings (Dupuy, 1967; De Smet, 1989; Kowalski and Rzebik-Kowalska, 1991). This population was probably in contact with that of the Adrar des Iforas in Mali and perhaps with that of the Aïr in Niger (Lhote, 1946; Dupuy, 1967). The last data recorded by Kowalski and Rzebik-Kowalska (1991) for the complex of the Hoggar and the Tassili des Ajjers date back to the 1960's and the species has generally been considered extinct there (De Smet, 1989; Kowalski and Rzebik-Kowalska, 1991; Dragesco-Joffé, 1993), but Bousquet (1992) and De Smet and Mallon (1997) suggest possible survival.

Libya: probably extinct

The Dama Gazelle was present in the first half of the 20th century in the periphery of the Tibesti in Chad (Dalloni, 1936; Malbrant, 1952), and Hufnagl (1972) suggests that it reached the south of Libya. A relict population could still survive in the Tibesti region near the Chadian border (Essghaier, com. pers., 2005)

Mauritania: probably extinct

Northwestern Mauritania is part of the Atlantic Saharan range of *Gazella dama mohrr*, while the southeast is part of the Sahelian range of *Gazella dama dama*. These ranges were perhaps in contact but the data gathered by Trotignon (1975) indicate a gap. In the Atlantic zone, the data are limited to the immediate surroundings of the eastern border of the former Spanish Sahara, especially in the region of Bir Moghreim (Fort Trinquet) at 25° 30' N, and to a coastal band about 200 kilometres wide extending from the southern border of the former Spanish Sahara to the Inchiri in the south. The gazelle was noted particularly in the Taziezet, the region of Chami, the Tijirit, and the Inchiri. The last observations there date back to 1967-1968 (Trotignon, 1975). In the eastern Sahelian range, the species was distributed in the 1930's to the 1960's as far as the Adafer, the region of Tidjika, the Tagant, the Aoukar, and the region of Kiffa. It was more common in the southeast, in the Semi-Aklé, the region of Oualata, the Achemine, the Irrigi, the region of Néma, and the region of Bassikounou (Trotignon, 1975). The last observations cited by Trotignon (1975) are in the extreme east and date from the middle of the 1960's. The Dama Gazelle could have persisted there somewhat late, until about 1980, particularly in the Akle Aouana, near the Malian border (Sournia and Verschuren, 1990).

Mali: endangered

The Sahelian range of the Dama Gazelle crosses Mali from the Irrigi in the west to Azouak in the east, between 18° and 15° N., with an extension as far as 20°N., and to the Algerian border in the periphery of the sub-Saharan massif of the Adrar des Iforas (Lhote, 1946; Dupuy, 1967; Trotignon, 1975; Sayer, 1977; Newby, 1988; Heringa, 1990; Sidiyene and Trainer, 1990). Lhote (1946) notes its presence in the entire Sahelian steppe zone, including in the loop of the Niger river, in particular, in the region of Hombori, in the immediate vicinity of the present Elephant Reserve and at the latitude of the Ansongo-Menaka Reserve. The species survived, at the end of the 1970's and in the beginning of the 1980's, in the southern Sahelian regions of Gourma and Ansongo, to the west of the Adrar des Iforas, in the region of Araouane and near the Mauritanian border (Heringa, 1990), as well as perhaps in the Azaouak at the border with Niger (Grettenberger and Newby, 1990; Millington *et al.*, 1991). The numbers were estimated at more than one thousand in the beginning of the 1980's, at much lower figures, in decline, at the end of the 1980's (Heringa, 1990). Duvall *et al.* (1997), however, estimated the population to be several hundred strong and suggested a possible recent increase. A recent survey, conducted within the CMS/FFEM project, shows that circa 250 individuals are present in South Tamesna divided in two sub-populations (eastern and western) (Lamarque, 2005).

Niger: endangered

The Sahelian range of the Dama Gazelle crosses Niger from the Azaouak to the south of the Ténéré, between the 15th and 17th parallels (Lhote, 1946; Brouin, 1950; Grettenberger and Newby, 1986, 1990; Millington *et al.*, 1991; Dragesco-Joffé, 1993; Poilecot, 1996a, 1996b). In the 1940's, the principal concentrations were noted south of the Air (Lhote, 1946; Brouin, 1950). Brouin (1950) qualified the "very wooded" region of the Tadéras, between 15° 30' and 16° 30' latitude, and between 6° 30' and 9° longitude, as the preferred habitat of *Gazella dama*. The distribution has contracted considerably, and, in the 1980's, residual populations occupied a range, around the Air and the Termit on the one hand, around the Azaouak on the other hand (Grettenberger and Newby, 1990; Millington *et al.*, 1991). The population in Niger was estimated at less than 1000 individuals by Grettenberger and Newby (1990) and Millington *et al.* (1991) of which 150-250 were in the Air and



200-400 were in the Termit (Grettenberger and Newby, 1986, 1990; Millington *et al.*, 1991). Dragesco-Joffé (1993) evaluates a population of Niger reduced to 400 animals. Surveys conducted since 2000, indicate that Dama's population is mostly concentrated in the Termit (Claro, 2004, Wacher *et al.*, 2004) and could count ca 300 individuals (Wacher *et al.*, 2004).

Chad: endangered

The Dama Gazelle was distributed in Chad in the whole Sahelian belt, mainly between the 14th and 17th parallels, from the border with Niger in the west to the massifs of the Ouaddaï, the Kapka, the Ennedi, and the depression of the Mourdi along the eastern border (Malbrant, 1952; Newby, 1974; Thomassey and Newby, 1990). In the 1970's and 1980's, the species seems to have survived in its entire range, in reduced numbers however (Thomassey and Newby, 1990). The Ouadi Rimé-Ouadi Achim Reserve was one of the bastions of the species with a population estimated, in the middle of the 1970's, at 10,000 to 12,000 individuals (Newby, 1974). Currently, the species has become very rare in the Ouadi Rimé-Ouadi Achim Reserve (Pfeffer, 1993a, 1993b, 1995; Beudels *et al.*, 1994; Tubiana, 1996a, 1996b; Moksia and Reouyo, 1996) and throughout the Chadian Sahel. Nevertheless, a population of 50 to 100 individuals survives in the Manga region (Monfort *et al.*, 2004).

Sudan: extinct or on the edge of extinction

The Dama Gazelle was distributed at the beginning of this century in the entire Sahelian zone and the sub-desert valleys of the Darfur, the Kordofan, and the south of the Northern Province, between 13° and 20° N (Sclater and Thomas, 1898; Audas, 1951; Wilson, 1980; Hillman and Fryxell, 1988). In the 1940's, it survived in all the regions where the Oryx did, north of 13° N, especially in the eastern Kordofan (Audas, 1951). In the 1960's and 1970's, small, very mobile groups of Dama Gazelles persisted in a large part of the north of the Darfur, from the Chadian border to the edge of the Kordofan, particularly in the region of the Wadi Howar at 16° 30' N and further south, towards 15° N (Wilson, 1980). The last precise observations date from the years 1975-1977. Two animals killed in January 1989 between Omdurman and the western Darfur by Middle Eastern hunting tourism are noted by Cloudsley-Thompson (1992). Today, the species is considered in danger of extinction if not extinct in the country, but precise information on its possible survival is lacking (Hillman and Fryxell, 1988; Hashim, 1996).

Senegal: extinct

The Dama Gazelle has been known since at least the 18th century in the Sahelian zone of Senegal (Sclater and Thomas, 1898). Sournia and Dupuy (1990) suppose, however, that it was only a dry season visitor. It seems to have been especially frequent in the zone of the Ferlo at the time of the Sahelian droughts of the 1970's (Sournia and Dupuy, 1990). There are no more recent data.

Burkina Faso: extinct or on the edge of extinction

Northern Burkina Faso, north of 14°, is in the southern Sahelian belt of deciduous shrubs or thickets (White, 1983). The Dama Gazelle was still present recently, though in reduced numbers (Heringa *et al.*, 1990). It could have survived in particular in the Seno-Mango area which is part in the Sahel Reserve (Heringa *et al.*, 1990).

Nigeria: probably extinct

Extreme northeastern Nigeria, in the region of Lake Chad and the Jawa, is situated in the southern Sahelian belt of deciduous shrubs or thickets (White, 1983; Anadu and Green, 1990). The Dama Gazelle was apparently rare there. There are no recent indications of presence (Anadu and Green, 1990).

4. Actual and potential threats

Like that of the Scimitar-horned Oryx, the decline of the Dama Gazelle has happened under the combined effect of several factors acting simultaneously: the anthropogenic degradation of habitats, arid-land environmental stochasticity, taking, and loss of habitat as a consequence of human pressure. These factors, which are still active today, do not differ in their overall description for the two species, whose principal ranges coincide.

4.1. Degradation and decline of habitats

Catastrophic droughts. In the context of aridity which has prevailed in the Sahara for 3,000 to 4,000 years (Le Houérou, 1986; Newby, 1988), years of increased drought, especially affecting the Sahel, occur at more or less long intervals (Monod, 1986). During the 20th century, severe Sahelian droughts happened in 1913-1914 (Monod, 1986), in 1940-1945 (Monod, 1986; Newby, 1988), then, with a particularly high frequency, in 1968-1973, 1976-1980, and 1983-1984 (Monod, 1986; Newby, 1988; Hassaballa and Nimir, 1991). These periods of drought necessarily have a catastrophic effect on the fauna of arid regions. The damage caused by recent episodes to palaeartic migratory birds wintering in the Sahel has been abundantly documented and commented upon. The effects of these natural catastrophes were deeply worsened by their occurrence in combination with anthropogenic factors. They indeed hit populations of Sahelian antelopes which had already been pushed by human pressure towards sub-desert zones at the limit of their tolerance for aridity. They forced them to re-shift southwards, to areas where the pressure of pastoralists and farmers is much stronger (Newby, 1988) and the risks of taking much higher (Newby, 1982). Moreover, the level of human occupation of the land compromises the prospects for reconstitution of the vegetation after periods of drought (Millington *et al.*, 1991).

Degradation of pastures by overgrazing. The capacity of the excellent livestock-raising areas in the sub-desert steppe to support an enormous primary production of gramineous and other perennial plants, combined with relatively weak competition and predation, explain the past abundance of ungulates (Newby, 1974). Sharp increases in domestic livestock and the possibility of permanent use of pastureland located in regions without water thanks to deep-well drilling, have led to the generalisation of intense overgrazing (Newby and Sayer, 1976; Newby, 1978a; Newby, 1988). For the entire northwestern Saharan and sub-Saharan regions, Le Houérou (1986) evaluates grazing pressure to be twice the carrying capacity, and notes among its effects the elimination of perennial grasses and browsable shrubs, trampling and compaction of soils, their denudation and consequent eolian erosion. For the Sahel, Monod (1986) indicates grazing pressures of 0.8 to 1 sheep-equivalent per hectare, for a carrying capacity of 0.25 sheep-equivalent per hectare, a load four times too high, leading to severe and generalised overgrazing. The effects of such overexploitation are well described for the Sudan by Bari (1991) who documents the transformation of rich pastures of short grasses and perennials into absolute desert, and by Hassaballa and Nimir (1991) who note a 5 to 6 kilometres progression of the desert per year. The destruction of pastures, especially of formations of *Cornulaca*, by grazing has also been observed in Chad (Newby, 1974).



Felling of ligneous species. Ligneous species are essential for the Dama Gazelle, as much as or more than for the Oryx, both for the shade and the food. The Dama Gazelle is in fact a mixed user, more a foliage browser than a grazer on gramineous plants. The systematic destruction of trees and shrubs in the Sahelo-Saharan zone is a historical constant (Le Houérou, 1986). It has strongly increased recently in the southern fringe regions of the Sahara, under the combined effects of drought and needs for firewood and charcoal (Grettenberger and Newby, 1986; Newby, 1988; Bari, 1991; Hassaballa and Nimir, 1991; Millington *et al.*, 1991). In Sudan, for example, Bari (1991) documents the total disappearance of *Acacia tortilis*, *Acacia raddiana*, *Acacia senegal*, and *Maerua crassifolia* woodlands, and their replacement by absolute desert.

Gazella dama in the wild. Chad. 2002. Mission SSIG-SCF.
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4.2. Direct exploitation.

Traditional hunting. Traditional modes of capture, either hunting (Brouin, 1950; Newby, 1974; Grettenberger and Newby, 1986; Dragesco-Joffé, 1993), or trapping, exercised by nomads in particular, certainly played a role in reducing the species, especially when it was done in conjunction with other factors and was practised at the expense of ecologically weakened populations.

Motorized hunting. Much more than forms of traditional capture, it is the development of taking using modern firearms and vehicles, including 4x4 vehicles, which was an essential proximal factor in the reduction or local extinction of the species. It

was mainly perpetrated by military, mining, oil, or administrative personnel, expatriate or African (Grettenberger and Newby, 1986; Hassaballa and Nimir, 1991; Dragesco-Joffé, 1993).

Hunting tourism. As for all the Sahelo-Saharan antelopes, the massacres perpetrated by hunting tourism, in particular Middle-Eastern, which is well documented, especially for Sudan (Cloudsley-Thompson, 1992), Niger, and Mali (Newby, 1990; Bousquet, 1992), represent a major potential threat.

4.3. Other threats.

All the indirect human pressures likely to affect the species, such as the increase of ovine and caprine livestock, the increase in the number of wells, and the invasion of available habitats, are exerted through the deterioration or regression of habitats and the increase in susceptibility to taking. They have been treated under these points.

5. Regulatory provisions

5.1. International.

Bonn Convention: Appendix I, resolution 3.2, paragraph 4.
Washington Convention (CITES): Appendix I

5.2. National.

The Dama Gazelle is completely protected in Mali, Senegal, Morocco, Algeria, Niger, Tunisia, and partially in Sudan.



6. Conservation measures, by party

6.1. Ban on takings.

Morocco:	protected
Algeria:	protected
Mali:	protected
Niger:	protected
Senegal:	protected

6.2. Habitat conservation.

Morocco

The proposed protected areas in the lower Drâa basin and in the Dakhla region (AEFCS 1995) appear to be appropriate for the reintroduction of the species. In both sites, the species is extinct. In the case of Dakhla, the protected area must extend sufficiently far into the interior, and in the region of the Adrar Souttouf, it must include a substantial representation of steppes and woodlands with a Sahelian physiognomy which characterised the range of *Gazella dama mohrr* (Valverde, 1957). It is possible however that *Gazella dama mohrr* still survives in a few isolated pockets in parts of its historical area of distribution Cuzin (1998), in particular along the Mauritanian border. If this is the case, efforts to protect the species, accompanied by restoration of its habitat, should of course be a priority.

Algeria

The National Park of the Tassili des Ajjers and the Hoggar National Park offer, by their exceptional dimensions and their environmental diversity (Bousquet, 1992), unquestionable possibilities of redeployment of the Dama Gazelle. Here also, the possibility that the species still occurs in the wild must obviously be evaluated before launching any project of reintroduction.

Mauritania

Gazella dama mhorr was present until the end of the 1960's in the Banc d'Arguin National Park.



Mali

The Elephant Reserve and the Ansongo-Menaka Reserve are situated in the zone of distribution of the Dama Gazelle (Lhote, 1946). In both reserves, populations of the species occurred until recently (Heringa, 1990; Pavy, 1996). Unfortunately, they are under considerable agricultural, pastoral, residential, and hunting pressures (Heringa, 1990). The establishment of the protected areas of Tamesna, North Azawagh and West Zdjaret, where *Gazella dama* still occurs, could be an important contribution to the conservation of the species in Mali.

Niger

The Termit massif, which, at least recently, harboured the largest populations of the Dama Gazelle, is one of the best preserved regions of the Sahel in Niger, with the environment in relatively good condition (Newby, 1982, 1988; Grettenberger and Newby, 1986, 1990; Millington *et al.*, 1991). The national park planned there is essential for the species. The Air-Ténéré National Park also shelters substantial populations; the implementation of conservation measures runs up against difficult practical problems but its effective protection remains an essential element of a network of protected areas (Newby and Jones, 1986; Grettenberger and Newby, 1986, 1990; Millington *et al.*, 1991). The Gadabedji Reserve, created for the protection of Sahelo-Saharan antelopes, mainly the Scimitar-horned Oryx, had Dama Gazelles at the time of its creation. Unfortunately, human pressures have never been sufficiently controlled there (Newby, 1982; 1988; Dixon and Newby, 1989; Grettenberger and Newby, 1990; Millington *et al.*, 1991). It is a potential site of reintroduction if these pressures can be held in check and if the programme of habitat rehabilitation which was undertaken in 1989 (Millington *et al.*, 1991) is successful.

Chad

The Dama Gazelle might still survive in the Ouadi-Rimé-Ouadi Achim Reserve where its population in the mid-1970's totalled 10,000-12,000 individuals (Newby, 1974). However, its situation has sharply deteriorated since the end of the 1970's (Thomassey and Newby, 1990; Dragesco-Joffé, 1993; Pfeffer, 1993a, 1995; Moksia and Reouyo, 1996).

Sudan

The proposal to create a national park in the Wadi Howar in the northern Darfur could offer good possibilities of conservation or recolonisation for the Dama Gazelle (Hashim, 1996).

Senegal

The North Ferlo Reserve (Bille *et al.*, 1972; Bille and Poupon, 1972; Sournia and Dupuy, 1990) offer possibilities of recolonisation or reintroduction for Sahelian antelopes. The designation as national parks is under consideration (Diop *et al.*, 1996). A programme to reintroduce the Dama Gazelle is going on (Sournia and Dupuy, 1990; Diop *et al.*, 1996). Its success depends mainly, as for all the southern Sahelian localisations, on the chances of limiting human pressure so as to ensure the protection of the animals and the rehabilitation of the vegetation (Diop *et al.*, 1996). In October 2005, there are 6 Dama in the Ferlo North with only one birth in 2005 (Jebali, October 2005. comm.pers.).

Burkina Faso

Dama Gazelles may survive in the partial fauna reserve of the Sahel, in particular in the Seno-Mango area. The reserve has suffered much from grazing, wood cutting and drought (Heringa *et al.*, 1990).



6.3. Attenuation of obstacles for migratory animals.

The creation of a network of sufficiently close protected areas, numerous and large enough, and particularly of crossborder reserves, can, in the medium term, ensure adequate movement security for this relatively small and discreet species. Among the priorities would appear to be the creation of a reserve in Mali in the Adrar des Iforas, in relation with the parks in southern Algeria and in Tamesna in continuity with the Niger Tamesna and the rehabilitation of western Algerian acacia woodlands in the zone of possible population expansion of *Gazella dama mohrr* in the Drâa basin.

6.4. Regulations concerning other detrimental factors.

These possible regulations only have meaning within a framework of management plans for protected areas. This point consequently merges with point 6.2.

6.5. Other measures.

Morocco

Animals from Almeria (Spain) were introduced within the fenced R'mila protected area (Marrakech region), where there are now several dozen individuals, as well as within the fenced Rokkeïn protected area (Souss-Massa National Park), where there are about 10 individuals (2005). These semi-captive animals could be part of a reintroduction programme in the Saharan region in the future.

Tunisia

A programme to introduce the species exists (Kacem *et al.*, 1994).

Senegal

A reintroduction programme in North Ferlo Reserve is underway. Six dama gazelles were introduced in the 600 ha enclosure within North Ferlo Reserve in January 2003. (Sournia and Dupuy, 1990; Diop *et al.*, 1996; Jebali, 2005).



Training. Mali. 2004
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Gazella dama. Guembeul Reserve. Senegal.
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Outside range of distribution

The species is raised in captivity or semi-captivity in North Africa, the Middle East, Europe, and North America. Stocks include specimens of *Gazella dama mohrr*, originating from the ex-Spanish Sahara then from the Almeria animal husbandry center.



7. Research activities

7.1. Public authorities.

7.2. N.G.O.s

8. Needs and recommended measures

Recommended measures are detailed in ASS-CMS Action Plans (Beudels *et al.*, 1998). The principal needs that they meet are listed below.

8.1. Total protection of the species.

Necessary in all the countries of the present and historical range so as to preserve the surviving populations and prepare for a possible redeployment.

8.2. Conservation measures.

Establishment of a network of protected areas in all the parts of the historical range, with absolute priority to the areas where the species survives or may survive in the wild. Adequate management of these areas to re-establish favourable ecological conditions.

8.3. Localization and monitoring of residual populations, and definition of their ecological requirements.

Determined search for possible residual populations of *Gazella dama mohrr*. Study of the principal surviving Sahelian populations, mainly in Niger, Mali, Chad; evaluation of their current status and the ecological conditions they encounter.

8.4. Reinforcement of populations and reintroduction into the potential range.

Assistance to the Senegalese reintroduction programme. Possible preparation of programmes in other regions of the historical range, after evaluation of the chances of natural survival without reinforcement, and the chances of success of reinforcement or reintroduction efforts. It is principally in the Atlantic range of *Gazella dama mohrr* that this type of measure could be applied.



Niger. Gazella dama. Engraving, tracks and habitat. © John Newby