

Research/Technical Note

New Data on the Current Distribution of Barbary Macaque *Macaca sylvanus* (Mammalia: Cercopithecidae) in Algeria

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Abstract: The Barbary macaque, *Macaca sylvanus* (Linnaeus, 1758), is the only species of non-human primate living in Morocco and Algeria, North Africa. It is classified as Endangered on the IUCN Red List and listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 2018). Algeria is a country with a singularly complex topography, the vegetation falls into three zones which correspond to the three major physical zones: the forested Tell Atlas Mountains, the Highlands, and the Saharan Atlas. The Barbary macaque was only found on the northeastern part of the forested Tell Atlas Mountains a massive area extensively dissected into mountains, plains, and basins. Its population was fragmented to nine small subpopulations in three regions (Chiffa, Grande Kabylie and Petite Kabylie) but disappeared from six localities. The geographical distribution of the three remaining three subpopulation established in 1984 shows that the numbers vary from 3400 to 5100 individuals but these later years, few studies on population dynamics and the distribution of the species have been conducted in Algeria. Here we present the updated data that which show that the monkey tends to move from West to East (probably depending on food availability, or repeated fires) from Chiffa (36°44'9680"N 2°74'0872"E) in Chrea national park to Salah Bouchaour locality (36°59'8668"N-6°85'3913"E) in the wilaya of Skikda, with an estimated population of individuals varying from 3229 to 3888 in the national parks and from 186 to 200 individuals in the new localities studied. Better monitoring of the populations of this emblematic species and especially the monitoring of its movements is strongly recommended because by occupying new regions they could be victims of attacks from residents, especially since the monkey feeds on their crops and orchards.

Keywords: Barbary Macaque, *Macaca sylvanus*, Geographical Distribution, Algeria, Conservation

1. Introduction

The Barbary macaque (*Macaca sylvanus*) is a non-human primate endemic to North Africa. This species belongs to the family *Cercopithecidae* (Figure 1). It is the single species of the genus *Macaca* found outside Asia [1] The current distribution of this primate is limited to relict habitat patches in Morocco [31]. and Algeria (Figure 1). The species was introduced centuries ago to the rock of Gibraltar [2, 3]. It is classified as Endangered on the IUCN Red List [4] and listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 2018).

The Barbary macaque is a protected species in Algeria where it lives only in the coastal zone and the Atlas Mountains. The occupied habitat patches in Algeria are characterized as forests and scrub [3, 5-7]. In 2016, an action plan was initiated by the IUCN and the Algerian General Directorate of Forests to conserve this endangered primate species.

The range of Barbary macaque has been reduced over time. During the Holocene, the species have been extirpated from many localities. For example, in the 16th century, monkeys were imported from Barbary for the royal menagerie in France

[8]. In the 18th century, the presence of numerous monkeys was recorded in Algeria [9 37. Later, the Algerian Barbary macaque population fragmented to nine small subpopulations [10, 11]. The subpopulations survive today in three regions: Chiffa, Grande Kabylie and Petite Kabylie (Figure 2) [3, 30] but disappeared from six localities in Algeria [12, 13]. The geographical distribution of the three subpopulation established. [3, 34, 35]. The Barbary macaque shows a distribution in three regions of Algeria, namely Chiffa, Grande Kabylie and Petite Kabylie. The description of the habitats and estimated population size are summarized in the table 1.



Figure 1. Specimen of Barbary Macaque (Photo: Ahmim).

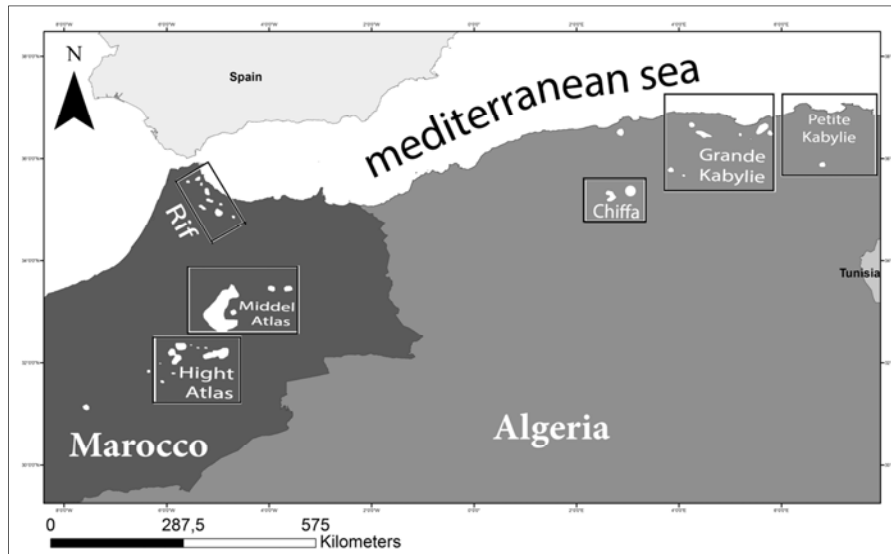


Figure 2. Geographical distribution of *Macaca sylvanus*.

Table 1. Location, habitat types and sub-population size of the Barbary macaque in three regions of Algeria [3].

Region	Location	Description	Number of individuals
CHIFFA	Chiffa	rocky shrub-covered gully slopes	300 individuals
	Brook of Monkeys	years in the vicinity of a hotel	> 100 individuals
	Peak of Monkeys in the Gouraya Mts	Shrubs, pine and oakforest	> 50 individuals
GRANDE KABYLIE	Djurdjura Mts	Shrubs, pine-oak forests in the lower parts, cedar forests in the upper part	500 individuals
	Akfadou forest between Azazga, Yakouren and El Kseur	forest-covered area dominated by oaks.	1000 to 2000 individuals
PETITE KABYLIE	Chabet el Akhra canyon near Kherrata	rocky gully slopes covered with shrubs	> 200 individuals
	Babor Mts	a mountain range covered with cedars and the endemic <i>Abies numidica</i>	< 300 individuals
	Jijilian cornich and Guerrouche forest	Sea coast SSW of Jijel and forest oak	1000 to 1500 individuals

2. Materials and Methods

2.1. Topography and Climate of Algeria

Algeria is a country with a singularly complex topography [14] situating in North West Africa. The vegetation falls into three zones which correspond to the three major physical zones [14]: the forested Tell Atlas Mountains, the Highlands (a region characterized by bare steppe or flight brushwood cover), and the Saharan Atlas (the Sahara with its Hoggar and Tassili mountains). The Barbary macaque is only found on the northeastern part of the country—a massive area extensively dissected into mountains, plains, and basins. Near the northern coast, the Petite Kabylie Mountains are separated from the

Grande Kabylie range at the eastward limits of the Tell by the Soummam River. The coast is predominantly mountainous in the far eastern part of the country, but limited plains provide hinterlands for the port cities of Bejaïa, Skikda, and Annaba. In the interior of the region, extensive high plains mark the region around Sétif and Constantine; these plains are the principal centers of grain cultivation. Northern Algeria, also called the Tell, is in the temperate zone and has a mild, Mediterranean climate. Temperatures in summer average between 21°C and 42°C (70° F and 108 °F) and in winter drop to 10°C to 12°C (50°F to 54 °F). In eastern Algeria, the average temperatures are somewhat lower, and on the steppe of the High Plateaus winter temperatures hover only a few degrees above freezing. A prominent feature of the climate in this region is the Sirocco, a dusty, choking south wind blowing

off the desert, sometimes at gale force. This wind also occasionally reaches into the coastal Tell. Rainfall is abundant along the coastal part of the Tell, ranging from forty to sixty-seven centimeters per m² annually, the amount of precipitation increases from west to east. Precipitation is heaviest in the northern part of eastern Algeria, where it reaches as much as 100 centimeters in some years. Prevailing winds that are easterly and northeasterly in summer and change to westerly and northerly in winter and carry with them a general increase in precipitation from September to December, a decrease in the late winter and spring months, and a near absence of rainfall during the summer months.

2.2. Methods

Data are derived from the previous studies [3, 6, 15-17, 27-29, 33, 34] as well as records based on direct observations and presence indices and from local people. In addition, we collected data from other sources, such as national park action plans, which monitor monkey populations. We also have new data since 2013 on the monkey's presence in areas where it has not been reported before based on direct observations and calculation of the individuals forming the troops. Outside the national parks, the approximate population size has been estimated from counts made by ourselves and from the observations of the people living near the sites occupied by the monkey groups.

Monkeys like all other large mammals (Artiodactyla, Carnivora, Pinnipeds and Cetacean) seem to be, because of their size, the easiest to count of all the Vertebrates. We soon realized that certain environments and certain behavioral characteristics posed a number of problems. To address this, we used the technique of sampling by counting on fixed routes (line transects or strip-censuses), proposed by [18] which remains the only one to give results having some value as soon as the animal is of size medium or that the environment begins to "close" (shrubby savannah, "bush", etc.).

The principle of the method is based on the random

establishment of fixed routes in the center of the habitat or the region to be surveyed, avoiding the edge effect along which the observer will move at regular intervals counting all the animals seen, on each side of its walking axis while minimizing the width of the counting's trip.

For better results, it was supplemented for certain difficult stations by a counting in two stages by identification and counting of more or less closed social groups and distributed in a non-uniform way because this method was used with success by primatologists like [19, 32, 20, 21] for the population of howler monkeys (*Alouatta palliata*) living in the forest of Barro Colorado (Panama); [22] to count the Virunga mountain gorillas in Albert Park to study the baboons (*Papio daguera*) in Nairobi Park. [36]

Following [23] we have conducted a survey of *Macaca sylvanus* semi-tame colonies near human habitations. During the survey, population size and composition, ranging behavior, amount of provisioning by humans, and attitudes of local people were assessed.

3. Results

3.1. Estimated Population Size Within the National Parks

Data on groups living in national parks are derived from management plans. Numbers of troops and individuals in the national parks are detailed in Table 2. At the Djurdjura National Park, the management plan reported that in 2013 there were 102 troops with a total of 1441 individuals [24]. These troops were spread over five localities. The management plan of the Chrea National Park reported 14 troops in 3 localities [25]. In 2004, the management plan of the Gouraya National Park mentioned the presence of 10 troops with a total of 367 individuals [26] in 8 locations. In Taza National Park, 29 troops were mentioned as living in forest and the Jijilian cornich near the sea.

Table 2. Location, geographical coordinate, number of troops and individuals of the Barbary macaques in the national parks.

National Park	Sites	Geographical coordinates	Number of troops	Mean of individuals by troop	Number of Individuals
Djurdjura	AitOuabane	36°48'4736"N 4°29'7414"E	41	26 to 27	1441
	Tala Guilef	36°55'9609"N 3°96'5561"E	25		
	Tala Rana	36°41'5688"N 4°17'4950"E	17		
	Tikjda	36°40'6147"N 4°07'1293"E	16		
	Tirourda	36°47'3965"N 4°34'6863"E	3		
Chrea	Chiffa	36°44'9680"N 2°74'0872"E	3	367	Min = 476 Max = 630
	Tamezguida	36°33'3548"N 2°66'5383"E	11		
	Oued el Merdja	36°33'3548"N 2°66'5383"E			
	Tunnel SidiYahia	36°75'8516"N 5°09'3719"E			
	Cap Carbon	36°57'4888"N 5°10'5054"E			
Gouraya	SidiBouali	36°56'2401"N 5°08'7684"E		10	Min = 1015 Max = 1450 Min = 3299 Max = 3888
	Aiguades	36°56'4782"N 5°10'2779"E			
	Les Oliviers	36°55'6591"N 5°08'9127"E			
	Mcid el Bab	36°57'9074"N 5°04'6619"E			
	Boulimat	36°41'1790"N 4°98'2246"E			
Taza		36°48'3733"N 5°58'5164"E	29	35 to 50	
TOTAL	15		155		

These results show that during 2004 to 2016 there were 155 troops of monkeys in the national parks, resulting in a total

number between 3229 and 3888 individuals. They also show that in 2016 the Barbary macaque was present in 15 localities.

This includes 6 new localities (Table 2) including 3 localities which appear to have been recolonized, as there were no recent observations of the Macaque in these areas yet. They are known to have existed there during the Holocene according to the literature (Chrea, Babor, Kabylie of Collo) and 155 troops.

3.2. Data of the New Locations Outside National Parks

Outside the national parks there are approximately 186 individuals, living in seven locations (Table 3). New sites, where the presence of the Barbary Macaque has been reported in 2016, are represented in the figure 3.

The latest observation was on June 16, 2017, when we observed a troop of 13 Barbary macaque near the metal bridge of Sidi Marouf in the Wilaya of Jijel on the borders of the Wilaya of Mila. The troop consisted of 4 females, 2 juveniles and 7 males including a mature adult. It has been observed that they tried to reach the river to drink but they could not cross the road. We conclude that the road prevented monkeys to access into the river. This group is distant from the nearest known troop by at least 70 km. This observation supports our hypothesis that the range of the Barbary macaque in Algeria is spreading mainly towards the East of the Country.

Table 3. Location, geographical coordinate, number of individuals of the Barbary macaques outside the national parks.

Sites	Geographical coordinates	Number of individuals
Matera (Salah Bouchaour-Skikda)	36°59'8668"N-6°85'3913"E	15
Oued Zhou (Skikda)	37°02'0201"N-6°31'1581"E	11
Zitouna in the region of Collo	37°18'5621"N-6°45'9023"E	07
Tamanart (Skikda)	37°25'3157"N-6°51'7875"E	10
Sidi Maarouf (Jijel)	36°43'4761"N-6°27'1155"E	13
Ain Lehmane (Jijel)	36°44'1890"N-6°27'3215"E	100
Bourbatache-El Kseur (Bejaia)	36°49'1857"N-4°81'5649"E	Approx. 30

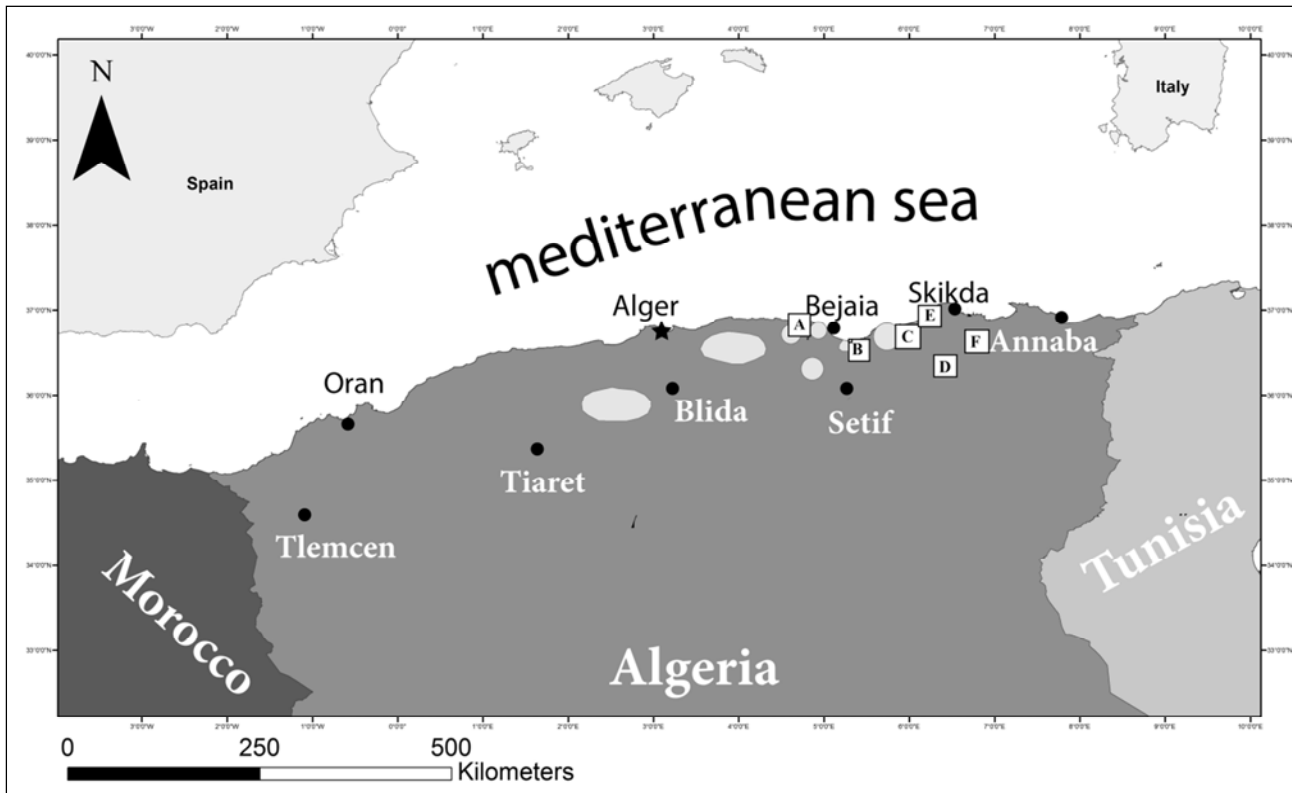


Figure 3. New sites where the presence of the Barbary Macaque was reported in 2016.

(A-Bourabatache El Kseur; B-Aokas; C-Corniche jijelienne; D-Sidi Maarouf and Ain Lehman; E-Oued Zhou and Tamanart; F-Salah Bouchaour; Circles - Old known territories occupied by monkeys)

4. Discussion

Previous data on the distribution of the Barbary Macaque in Algeria showed that the easternmost distribution was in the Taza National Park at the Jijilian Cornich and the Guerrouche

Forest. However, in this report, the distribution expanded eastwardly to Sidi Marouf and Ain Lehman in the Wilaya of Jijel, (Tamanart, Zitouna, Oued Zhou) in the peninsula of Collo, and Matera and Salah Bouchaour in the Wilaya of Skikda. Straight-line distances between these five new troops and the previously known most eastern locality reported

(Ziama Mansouria) (Figure 4) are 140 to 190 km to Tamanart, 195 to 212 km to Salah Bouchaour, 110 to 134 km to Oued Zhour and 123 to 135 km to Sidi Marouf. The maximum extension eastwards is therefore 212 km. These extensions are likely to have resulted from migration of monkeys in search

for food because of the vegetation deterioration following repeated fires in the Algerian forest massifs, especially in the oak forests which are their favorite habitat because they find acorns there.

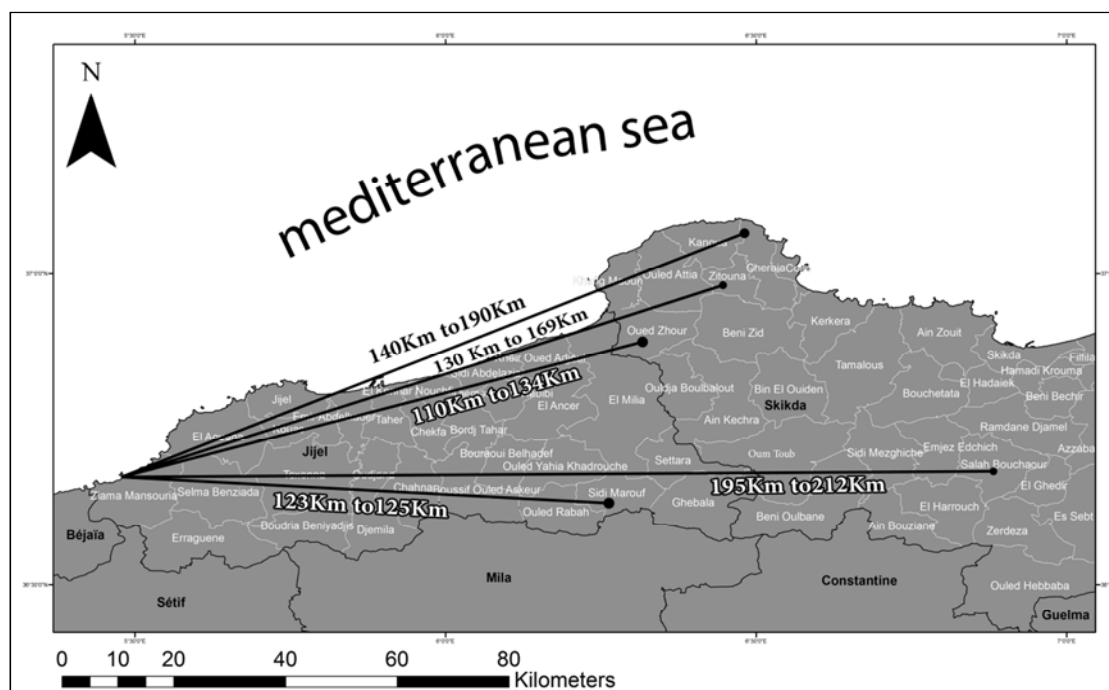


Figure 4. Distance between current locations and the most easterly point previously reported.

5. Conclusion

The Barbary Macaque *Macaca sylvanus* is the only species of non-human primate in Algeria. We showed that in 2016 the Barbary macaque was present in 22 localities including 3 localities which have been recolonized. We also show that troops of the monkeys are now found up to 212 km east of their formerly known range. We suspect that this eastern expansion may be due to movement of groups away from fire affected areas further west.

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