

Barbary Macaque Presence in the Rif Mountains, North Morocco

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Abstract: The Endangered Barbary macaque (*Macaca sylvanus*) is endemic to Morocco and Algeria. The species occurs in three main areas of Morocco, one of them the Rif Mountain range in the far north of the country. Over two years, we undertook extensive surveys of potential Barbary macaque habitat throughout the Rif Mountains. Here, we report on the presence of Barbary macaques in the Rif but excluding Bouhachem forest. Our study shows that, while some populations are very isolated and small, there is a thriving and currently contiguous population inhabiting the diverse, but connected, canyon habitats between two mountain chains of the Rif Mountains. We identify threats to both the fragmented and contiguous populations.

Keywords: Barbary macaques, conservation, contiguous populations, Morocco, Talessemtane National Park

Introduction

The Barbary macaque (*Macaca sylvanus*) is found in Morocco and Algeria and is Endangered (Wallis *et al.* 2020). In Morocco, it is found in the High and Middle Atlas Mountains and in the Rif mountains (hereafter Rif). The difficult mountainous topography of the region and the often very cryptic behavior of the macaques in their forest habitat mean that conventional primate survey methods cannot be applied. The species has been the focus of two short population surveys in the Rif (each less than three months). The surveys resulted in estimates of very low numbers—383 (Fa 1984) and 300 (Waters *et al.* 2007)—in fragmented groups and populations. The highest concentrations according to both surveys were seen in the fir and cedar forest of Talessemtane National Park. There, Fa (1984) recorded 121 individuals with group sizes of 7–28 and Waters *et al.* (2004) 58 individuals in groups of 3–19. A two-year study in this area reported six groups ranging from 12–59 individuals (median 24) (Mehlman 1989).

The authors all work or volunteer for the Moroccan NGO Barbary Macaque Awareness and Conservation (BMAC). Formed in 2010, it is a community-based conservation project based in the mixed oak forest of Bouhachem (see Fig. 1), which has the largest population of Barbary macaques in the Rif (Waters *et al.* in prep). Part of our NGO's remit is to survey and monitor Barbary macaques in the region. Here, we report Barbary macaque presence covering the Rif but excluding Bouhachem. The survey was conducted from

2016–2018 and, while confirming the presence of a few fragmented populations of the species, we found macaque numbers in the largest survey area (which includes a number of protected areas) to be much higher than previously reported. However, the contiguity of this area is threatened by forest fires and the expansion of cannabis cultivation.

Methods

Study site

The survey area encompasses different habitats of the Rif. The limestone massif is visible at Jbel Moussa at the northern tip of the region (protected as a site of biological and ecological interest). The international port of Tangier Med lies to the west of Jbel Moussa, with the Spanish enclave of Ceuta directly to the east. The steep cliffs of the limestone massif can be seen intermittently above ground in areas such as Bou Jmeel and Fahss Lemhar. The massif then emerges above the city of Tetouan, to continue without interruption down the Mediterranean coast of the peninsula, culminating in the steep canyons of the River Lao. The area is characterized by steep rocky cliffs, Mediterranean scrub vegetation and very small forests of holm oak (*Quercus ilex*). The largest peak of the massif is Jbel Kelti at 1,928 m. It is forested with Atlas cedars (*Cedrus atlantica*) and is protected. The unprotected areas of the massif and its outliers have been exploited for limestone and, in some areas, quarrying has destroyed entire rock formations. Historically, villagers relied on subsistence agriculture in the

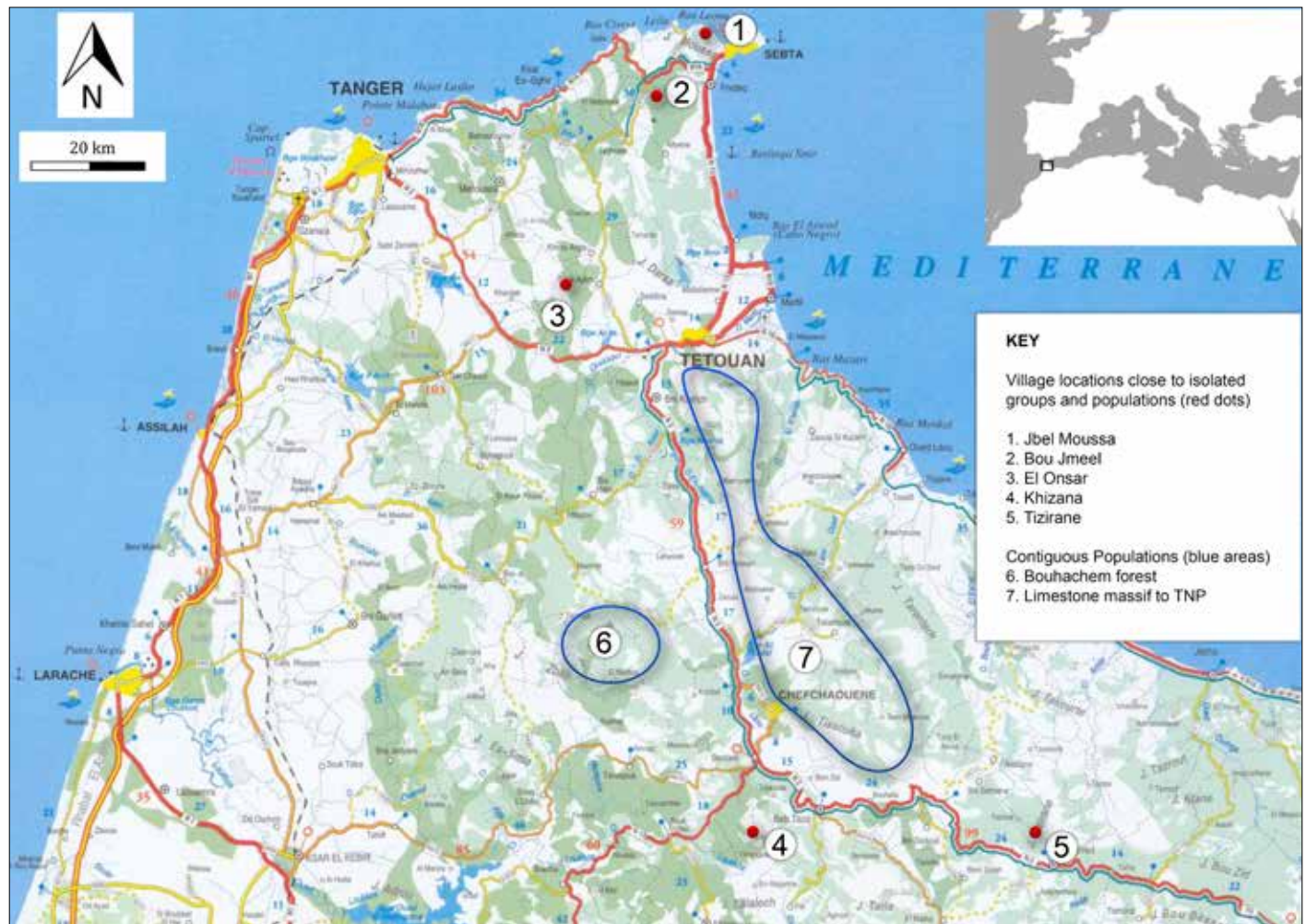


Figure 1. Study area with the locations of isolated groups and populations of Barbary macaques in the Rif Mountains.

form of agro-pastoralism centered on goats. Many villagers cultivate cannabis (*Cannabis sativa*), enabling them to be less dependent on subsistence agriculture.

A number of rivers run northeastwards into the River Lao forming a network of canyons between steep cliffs. Isolated trees or clumps dominate the shrub midstory running between the massif and the Chefchaouen mountains on their north side. The Chefchaouen mountain range includes the Talessemtane National Park created in 2004. The park's mountains are mostly forested with Atlas cedars, Moroccan fir (*Abies marocana*) and black pine (*Pinus nigra*). It consists of 58,000 ha split into two zones (hereafter referred to as Tazaout and TNP) with elevations of 1,600–2,170 m.

Data collection and analysis

The surveys were carried out in both protected and unprotected areas of potential Barbary macaque habitat over three years during eight weeks in Spring (April–May) and Autumn (mid-September–mid-November) 2016–2018, with sites visited once in Spring or Autumn (a total of 126 days of survey effort). We chose these months because our previous observations indicated that macaque groups are more likely to stay in their core areas as food is plentiful and

females are either giving birth (Spring) or reproductively active (Autumn). Barbary macaques in Algeria have been observed to move less in Spring and Autumn due to high food availability in those seasons (Menard and Vallet 1997). The steep, rocky topography of the area makes it difficult to undertake systematic surveys. We followed footpaths when first ascending to potential macaque habitat and after the initial ascent, three teams separated for 3–4 hours, walking at 7–8 km/hour and maintaining a minimum distance of 1,000 m between them. We walked an irregular network of tracks, but we also did recce walks, i.e., taking the way of least resistance when no tracks existed. We also continuously scanned rocky outcrops for macaques. The steep canyons were challenging to survey and where possible, two team members followed the river and other team members followed tracks above the canyons scanning with binoculars. We also recorded the presence of macaque scat. All records of macaque sightings and sign were recorded with a handheld GPS and the groups counted if and while they were visible.

The time and direction of the group's travel was recorded. To avoid the possibility of double-counting groups, teams discussed and compared their results after the completion of

each walk. Based on group sighting times, and if the groups observed were travelling in a similar direction, we assumed them to be two (or more) observations of the same group. If relying on sign, we considered a group of macaques to be independent of previously observed groups if macaque scat was found a minimum of 5 km from those observed groups.

Results

Our survey in Jbel Moussa contrasts positively with the low number of sightings by Fa (1982) and Waters *et al.* (2007) (see Table 1 and Fig. 1). We also observed a group of macaques above the village of Bou Jmeel that has been isolated because of quarrying around the surrounding limestone outcrops. A very small group of macaques apparently still survives on the southern end of the mountain of Fahss Lemhar. It was reported to us by the villagers of El Onsar, but we were unable to confirm it. Villagers at the opposite end of Fahss Lemhar told us that the macaques had been subjected to organized hunting parties because of their crop foraging. No macaques have been seen in the mountains of the northern side of the plateau for over five years, suggesting they have been extirpated from that area.

In the area encompassed by the limestone massif, the connecting canyons, Tazaout and TNP (an area of about 383 km²), we directly observed 865 Barbary macaques in 49 groups and we estimate a further 31 groups (about 565 individuals) from sign (see Table 2). In an effort to obtain a more realistic population estimate, we multiplied the number of estimated groups from sign (N = 31) by the mean group size for each habitat. This calculation resulted in a minimum population of 1430 individuals (density of 3.7

individuals per km²) in the area comprising the limestone massif (see Fig. 2), the canyons (see Fig. 3) and Tazaout and TNP (see Fig. 1).

Discussion

Our results demonstrate that there are five locations where macaque groups survive in the Rif, but they are isolated from other populations by insurmountable distances due to human activities. These results demonstrate that Barbary macaques persist in mountainous areas with suitable habitat unless there has been serious human impact, such as organized hunting as reported by Fahss Lemhar villagers. The single groups reported from El Onsar and Bou Jmeel must be in danger of extirpation due to anthropogenic activity. In fact, three individuals from the Bou Jmeel group were shot and killed in 2017 (the person was fined for the offence). The largest isolated population in the Rif appears to be that of Jbel Moussa. In 2004, this population was exploited by villagers who were capturing infants to sell in the Spanish enclave of Ceuta. The increased employment brought to the area by the construction of an international port appears, however, to have brought an end to that.

This is the first study to report that macaques are present throughout the limestone massif. Crossing open areas, rivers and roads present no obstacle to the macaques in these areas and we have twice observed one group crossing around 1,500 m of open space, including Oued Lao and a busy road, to travel from the edge of the limestone massif to the edge of the Chefchaouen mountain range. The presence of macaque groups throughout the length of all the canyons is hard to ascertain due to the difficult working conditions and the lack of observation points above some parts of the canyons. However, we observed and counted 15 groups, suggesting these areas are very important for the macaques probably due to the security this habitat provides from anthropogenic disturbance and the possibility of moving undisturbed above or below village fields depending on the topography. The canyons which are part of the natural nature reserve are very attractive to Moroccan tourists in Spring and Autumn and we have received and acted upon reports from the public about illegally held, locally caught infant macaques offered for sale. We have been told by local vendors that

Table 1. Isolated groups and populations of Barbary macaque in the Rif Mountains.

Location	No. of groups observed	Group size (individuals)	Total individuals observed
Jbel Moussa	3	8–23	52
Bou Jmeel	1	11	11
Jbel Khizana	1	2	2
Jbel Tiziran	1	-	1

Table 2. Continuous Barbary macaque population grouped according to habitat in the Rif Mountains (excluding Bouhachem).

Location	Groups observed	Group size range (Individuals)	Total individuals	Mean group size	Macaque group presence detected by sign
Limestone massif	13	5–26	192	15 ±5.73	5 (+ 75 individuals)
Canyons of River Lao, its catchments and Tazaout NP	13	1–48	216	17 ±14.4	10 (+170 individuals)
Talessemtane NP	23	2–57	457	20 ±15.1	16 (+ 320 individuals)
Totals	49		865		31 (+ estimated 565 individuals)



Figure 2. Macaques of the limestone massif. Photograph by Ahmed El Harrad.



Figure 3. Macaques in the canyon of a catchment of the River Lao. Photograph by Ahmed El Harrad.

our confiscation activities prevent more individuals attempting to sell macaques due to their fear of the significant fine imposed on offenders.

The Rif region in general is at great risk from fires—around 62% of forest fires occur in the north of Morocco (Taiqui 1997). A substantial fire in 2002 affected 200 ha of Tazaout fir forest and the site still shows little sign of regeneration. Lower rainfall due to climate change also poses a threat to these forests (Esteban *et al.* 2010). Fire is used to claim land for cannabis cultivation in unprotected areas of extant forest and scrub vegetation in the limestone massif and in wider river canyons. The macaques feed on this vegetation and the habitat contributes to keeping this population contiguous. The recent introduction of a strain of cannabis which requires increased water for propagation is leading to serious water shortages outside the prolonged droughts of the Summer. Such droughts leave macaques vulnerable to predation by dogs and people when accessing a shrinking number of water sources. More positively, villagers told us that they no longer undertook the arduous work of herding goats into TNP's forests for grazing as it was easier and more profitable to cultivate cannabis for a living. This has the advantage of increasing available resources for the macaques of TNP.

While our survey demonstrates that Barbary macaque numbers are much higher than those in previous surveys, we also acknowledge that we have undercounted groups due to the complicated terrain and frequent limited observations of five or fewer macaques resting on rocks in a canyon revealing the presence of a group but giving us little opportunity to gain a meaningful count. Undercounting has been a problem elsewhere (see, for example, Menard *et al.* 1985). The increased numbers in this survey compared to those of Fa (1984) and Waters *et al.* (2007) may be explained by the larger area surveyed. Increased vehicular access allowed us to get much closer to the survey areas much more quickly than was the case for the previous survey teams. The areas covered by previous surveys were not then protected and were heavily used by subsistence agro-pastoralists (Fa 1984) suggesting that the protected area status has improved the species' conservation prospects. These results demonstrate that there is a sustainable population of Barbary macaques in the diverse montane habitats of the Rif but the connectivity of this population relies on the canyons of the River Lao and its catchments some of which occur outside protected areas. If these connections are lost, these populations will be separated by insurmountable distances. All the canyons connecting this population should be protected to ensure that connectivity remains unbroken.

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Literature Cited

- Esteban, L. G., P. de Palacios and L.R.-L. Aguado. 2010. *Abies pinsapo* forests in Spain and Morocco: threats and conservation *Oryx* 44: 276–284.
- Fa, J. E. 1984. A survey of population and habitat of the Barbary macaque *Macaca sylvanus* L. in north Morocco *Biol. Conserv.* 24: 45–606.
- Mehlman, P. T. 1989. Comparative demography, density and ranging behaviour of Barbary macaques (*Macaca sylvanus*) in marginal and primate conifer habitats. *Int. J. Primatol.* 10: 269–291.
- Menard, N., D. Vallet and A. Gautier-Hion. 1985. Demography and reproduction of *Macaca sylvanus* in different habitats in Algeria. *Folia Primatol.* 44: 65–81.
- Menard N. and D. Vallet, 1997. Behavioural responses of Barbary macaques (*Macaca sylvanus*) to variations in environmental conditions in Algeria. *Am. J. Primatol.* 43: 285–304.
- Taiqui, L. 1997. La dégradation écologique au Rif marocain: Nécessités d'une nouvelle approche. *Mediterranea: Serie de Estudios Biológicos* (1997): 5–17.
- Wallis, J., M. E. Benrabah, M. Pilot, B. Majolo and S. Waters. 2020. *Macaca sylvanus*. The IUCN Red List of Threatened Species 2020: e.T12561A50043570.
- Waters, S., M. A. Aksissou, A. El Harrad, M.-E. Hobbelink and J. E. Fa. 2007. Holding on in the Djebela: Barbary macaque *Macaca sylvanus* in northern Morocco. *Oryx* 41: 106–108.
- Waters, S., A. El Harrad, M. Chetuan and Z. Amhaouch. 2015. Barbary macaque group size and composition in Bouhachem forest, north Morocco. *Afr. Primates* 10: 53–56.

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