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# New records of red brocket deer (*Mazama temama*) in cloud forests in northeastern Hidalgo, México

# Nuevos registros del venado temazate (*Mazama temama*) en bosques mesófilos del noreste de Hidalgo, México

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The red brocket deer (*Mazama temama*) is one of the least studied species of deer in Latin America. In México, little information is available on this species in mountainous regions, particularly in mountain cloud forests (MCF) in the state of Hidalgo. Since red brocket deer and MCF are threatened, mainly by anthropogenic activities, it is essential to carry out monitoring to corroborate the presence of this species in the MCF of Hidalgo. Here we report new records of this species in MCF of northeastern Hidalgo, in a forest management unit. The study was carried out in the 1302 Zacualtipán-Molango Forest Management Unit (UMAFOR) as part of the Strengthening of Social Organizations in the Forestry Sector project of the 2016 National Forestry Program. Monthly walks were carried out in different locations (sites) within the area between January 2016 and February 2019. The presence of red brocket deer was inferred from evidence of scats, tracks, direct sightings, and photographic records. For the latter, trap cameras were placed at sites identified as likely wildlife passes. We obtained 20 records (1 track, 2 scats, 1 sighting, 16 photographs) of red brocket deer. The sighting consisted of an adult individual being chased by seemingly feral dogs. These records provide up-to-date information on the distribution of red brocket deer in MCF in northeastern Hidalgo. To note, records were obtained in an area subjected to forest use under sustained anthropogenic impact. However, owners dedicate their premises to conservation, specifically those including MCF. Since red brocket deer thrives in conserved forests, the records reported here suggest positive effects of forest management on this UMAFOR. Biological monitoring in the area should be continued and extended, also covering areas subject to forest exploitation, as feral dogs may undermine red brocket deer populations. Finally, we recommend the development of research projects in the area, to contribute to management plans aiming to preserve red brocket deer populations.

**Key words:** Anthropogenic impact; cervid species; feral dogs; forest management.

El venado temazate (*Mazama temama*) es una de las especies de cérvidos menos estudiados en América Latina. En México, se tiene poca información de esta especie en regiones montañosas, particularmente en bosques mesófilos de montaña (BMM) del estado de Hidalgo. Dado que el venado temazate y los BMM se encuentran amenazados, principalmente por las actividades antropogénicas, es importante realizar monitoreos para corroborar la presencia de esta especie en los BMM de la entidad. Presentamos nuevos registros de esta especie en bosques mesófilos del noreste de Hidalgo, en una unidad de manejo forestal. El estudio se realizó en la Unidad de Manejo Forestal (UMAFOR) 1302 Zacualtipán-Molango, como parte del proyecto Fortalecimiento de las Organizaciones Sociales del Sector Forestal, del Programa Nacional Forestal 2016. Se llevaron a cabo recorridos mensuales en diferentes localidades (predios) de la zona, entre enero de 2016 a febrero de 2019. La presencia de venado temazate se verificó mediante el hallazgo de excretas, huellas, avistamientos directos y registros fotográficos. Para esto último, se colocaron cámaras trampa en sitios identificados como posibles pasos de fauna. Obtuvimos 20 registros (1 huella, 2 excretas, 1 avistamiento, 16 fotografías) de venado temazate. El avistamiento consistió en un individuo adulto que era perseguido por perros, aparentemente ferales. Estos registros aportan información actualizada acerca de la distribución del venado temazate en BMM del noreste de Hidalgo. Destacamos que los registros se obtuvieron en una zona de aprovechamiento forestal donde existe impacto antropogénico constante. Sin embargo, las personas destinan en sus predios áreas para conservación, específicamente los BMM. Dado que esta especie es considerada especialista de bosque conservado, los registros podrían indicar impactos positivos del manejo forestal en esta UMAFOR. Se deben continuar y extender los monitoreos biológicos en el área, abarcando también las zonas sujetas a aprovechamiento forestal ya que se observaron perros ferales que pueden vulnerar las poblaciones de venado temazate. Finalmente, exhortamos el desarrollo de proyectos de investigación en el área, para contribuir a los planes de manejo con el objetivo de la persistencia de las poblaciones de venado temazate.

**Palabras clave**: Especies de cérvidos; impacto antropogénico; manejo forestal; perros ferales.

The red brocket deer, *Mazama temama* (Kerr 1792), is one of the least studied species of deer in Latin America in terms of biology, ecology, distribution, and other aspects (Weber and González 2003; Mandujano 2004; Gallina 2005; Gallina and Mandujano 2009; Mandujano 2011). As a result, the International Union for the Conservation of Nature (IUCN) lists this species as Data Deficient, indicating that it cannot be included in the red list of threatened species until its distribution range and other ecological aspects are better defined (Bello *et al.* 2016). Similarly, the limited information available for the species in México, particularly about its distribution, explains why it is currently not listed in any risk category (SEMARNAT 2010) despite being considered a conservation priority (SEMARNAT 2014). Its historical distribution includes southern México, Belize, Guatemala, El Salvador, Costa Rica, Nicaragua, Honduras, Panama, and western Colombia (Bello *et al.* 2010, 2016); in México, it is reported in the states of Tamaulipas, San Luis Potosi, Veracruz, Hidalgo, Oaxaca, Chiapas, Tabasco, Campeche, and Quintana Roo (Jones *et al.* 1983; Gallina 2005; Bello *et al.* 2016).

The red brocket deer inhabits mainly high evergreen and medium subdeciduous tropical forests, and mountain cloud forests (MCF); it has also been reported in temperate pine-oak forests (Bello *et al.* 2010). It commonly thrives in areas with dense vegetation coverage, high water availability, and low anthropogenic pressure (Weber 2008). Its presence has also been reported in patches of secondary vegetation near to more conserved MCF fragments (Lira-Torres and Naranjo 2003; Pérez-Solano *et al.* 2012, 2016).

MCF are recognized worldwide for their high biodiversity levels and the hydrological services provided. In México, these forests are considered one of the most threatened terrestrial ecosystems due to the small area covered (less than 1 %), and the constant anthropogenic impact associated with changes in land use (Challenger and Soberón 2008; CONABIO 2010; Ponce-Reyes *et al.* 2012; López-Arce *et al.* 2019).

Particularly, mountain cloud forests located in the state of Hidalgo are considered to be of high priority for conservation due to pressures related to extensive livestock, agriculture, and selective logging (CONABIO 2010). Of the two MCF subregions in the entity (CONABIO 2010), research work on red brocket deer has been carried out and published for the San Bartolo Tutotepec-Cuetzalan Cloud Forest subregion (Muñoz and Gallina 2014; Muñoz-Vazquez and Gallina-Tessaro 2016). In contrast, there are scarce research projects and little knowledge about biodiversity for MCFs in the other subregion, named Northeastern Hidalgo-Huayacocotla Cloud Forests (SERFORH 2017).

Since little is known about the current distribution of red brocket deer in mountainous regions of México (Ortíz-Garcia *et al.* 2012; Pérez-Solano *et al.* 2012; Ramírez-Bravo and Hernández-Santín 2012; Pérez-Solano and Mandujano 2013; Pérez-Solano *et al.* 2016), particularly in the state of Hidalgo (Muñoz and Gallina 2014; Muñoz-Vazquez and Gallina-Tessaro 2016), medium - and long - term monitoring in MCF of this state is deemed essential. In this note, we report new records of red brocket deer in Northeastern Hidalgo-Huayacocotla Cloud Forests, which supplement records reported for the San Bartolo Tutotepec MCF (Muñoz and Gallina 2014; Muñoz-Vazquez and Gallina-Tessaro 2016) and contribute with additional information on the current distribution of this species. Particularly relevant are the photographic records obtained in an area subjected to forest exploitation, which is poorly researched despite it represents an important site for biodiversity conservation.

The study was carried out in the 1302 Zacualtipán-Molango Forest Management Unit (UMAFOR), an area comprising 228,341.94 ha (SERFORH 2011; Figure 1). It is located to the northeast of the state of Hidalgo (20º 58′ 34″-20º 23′ 15″ N, 98º 57′ 56″-98º 25′ 12″W) and encompasses 8 municipalities: Calnali, Juárez Hidalgo, Metztitlán, Molango de Escamilla, San Agustín Metzquititlán, Tianguistengo, Xochicoatlán, and Zacualtipán de Ángeles.

MCF is the most widely distributed vegetation type in this UMAFOR, stretching across an area of 62,177.51 ha (SERFORH 2011; Figure 1). On the other hand, the dominant vegetation types in the localities studied within the UMAFOR (sites) are pine-oak and oak-pine forests subjected to forestry management (SERFORH 2011). It is worth mentioning that the sites studied have been under this forest management scheme since the 1980s, and their forest zoning programs consider MCFs as conservation and non-use zones (SERFORH 2011). The mammal species recorded in MCFs include lion mountain (*Puma concolor*), margay (*Leopardus wiedii*), tayra (*Eira barbara*), white-tailed deer (*Odocoileus virginianus*), and collared peccary (*Pecari tajacu*; SERFORH 2017). Some sites are currently managed under the pay-for-environmental-services scheme, involving monitoring brigades to prevent poaching; however, subsistence hunting is practiced in forestry areas (SERFORH 2011, 2017).

As part of the field work of the Strengthening of Social Organizations in the Forestry Sector project, 2016 National

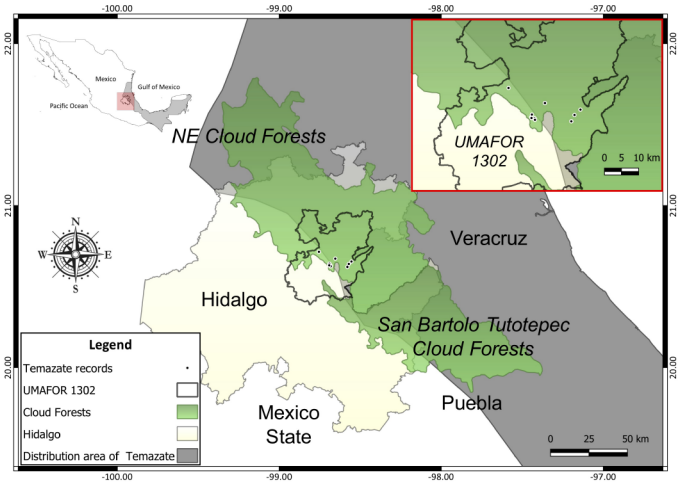


**Figure 1.** Study area and location of records of red brocket deer (*Mazama temama*) in mountain cloud forests in northeastern Hidalgo, México. Known distribution of *Mazama temama* (IUCN 2016), the two mountain cloud forest regions of Hidalgo: Northeastern (NE)-Huayacocotla Cloud Forest and San Bartolo Tutotepec-Cuetzalan Cloud Forest (CONABIO 2010), as well as the 1302 Zacualtipán-Molango Forest Management Unit (UMAFOR) polygon are shown.

Forestry Program, monthly walks across different sites were conducted for 3 years (January 2016 to February 2019). The distance covered in each walk was 1 km minimum, depending on the orography of the site studied, with 2 walks per month. Walks were carried out in the morning (8 am to 3 pm); the presence of red brocket deer was inferred from indirect evidence, mainly scats and tracks, using illustrated field guides to support each determination (Aranda-Sánchez 2012). The accuracy of records was further confirmed by placing 7 camera traps model Bushnell® Trophy® Cam HD (Bushnell©) at sites previously identified as wildlife passes. Camera traps were spaced about 500 m to 1 km apart, and were set to capture 3 images per detection event; traps operated 24 hours a day for 30 days in each location. The camera-trap sampling period covered the dry and rainy seasons of the year, with a total of 90 days trap per year. Finally, the sampling effort was calculated by multiplying the total number of camera traps by the total number of sampling days (trap nights), as reported for medium- and large - sized mammals (Hernández-Pérez *et al.* 2015).

Camera traps were placed in forest trails, firewall gaps, adjacent to streams, forestry areas, and conservation areas (Table 1). From the photographic records obtained, red brocket deers were identified based on the physical characters described for the species and applying quality filters to photographs (Reid 1997; Gallina 2005; Lara-Díaz *et al.* 2011; Aranda-Sánchez 2012).

We obtained 20 records of red brocket deer over the 3 years of sampling (2016: $n = 5$, 2017: $n = 3$, 2018: $n = 7$, 2019: $n = 5$), which correspond to scats ($n = 2$), tracks ($n = 1$), sightings ($n = 1$), and photographic records ($n = 16$; Table 1). The total sampling effort over the 3 years was at least 48 linear kilometers (walks) and 1,890 trap-nights (camera traps).

One of the scats records was found in a trail within the area dedicated to conservation in Ejido Olotla, municipality of Metztitlán. The second scat was found in a forest trail along the protection strip within the Apaxtitla site, which is under forest management. The record corresponding to the track was found in a trail within the Tetenatipa site, which is under forest management, located 2 km from the

**Table 1.** Location of records of red brocket deer (*Mazama temama*) in mountain cloud forests located in the 1302 Zacualtipán-Molango Forest Management Unit, Hidalgo, México. *n*: number of records.

| Record | Location | Municipality | Latitude | Longitude | n | Age | Observations | Month, year |
|---|---|---|---|---|---|---|---|---|
| Scat | Predio Apaxtitla | Zacualtipán de Ángeles | 20 °38′ 21.52″ | 98° 34′ 17.57″ | 1 | Undefined | In a forest trail within a conservation area, Apaxtitla private premises. | February, 2016 |
| Scat | Ejido Olotla | Metztitlán | 20° 37′ 48.40″ | 98° 40′ 59.04″ | 1 | Undefined | In a trail by a stream, within the conservation area 5 km from Olotla. | March, 2016 |
| Sighting | Predio Cruxtitla | Zacualtipán de Ángeles | 20° 39′ 15.87″ | 98° 33′ 17.45″ | 1 | Adult | Cruxtitla, land under forest use. Specimen chased by feral dogs observed during a transect review. | August, 2016 |
| Photo-record-4 | Ejido Olotla | Metztitlán | 20° 37′ 32.8″ | 98° 40′ 54.5″ | 2 | Adults (female and male) | 10 m from a stream, within the conservation area. | August, 2016 |
| Photo-record-3 | Ejido Olotla | Metztitlán | 20° 38′ 25.88″ | 98° 41′ 25.95″ | 2 | Fawn and yearling | On a firewall gap, within the areas under forest management, delimiting the area under recovery. | January and February, 2017 |
| Photo-record-6 | Ejido Santo Domingo | Zacualtipán de Ángeles | 20° 37′ 17.03″ | 98° 34′ 48.36″ | 1 | Adult (male) | On a forest gap, within the areas under forest management. | August, 2017 |
| Photo-record-5 | Ejido Olotla | Metztitlán | 20° 37′ 34.5″ | 98° 40′ 57.5″ | 3 | Adult (females) | 10 m from a stream running across the conservation area. | March, 2018 |
| Photo-record-7 | Ejido San Agustín | Eloxochitlán | 20° 42′ 53.46″ | 98° 45′ 20.96″ | 1 | Adult (male) | In a gap adjacent to the stream in San Agustín Eloxochitlán, within the conservation area. | August, 2018 |
| Photo-record-1 | Bienes Comunales Olotla | Metztitlán | 20° 37′ 58.83″ | 98° 41′ 34.11″ | 3 | Adults (1 female and 2 males) | On a firewall gap delimiting Olotla and Bienes Comunales Olotla. | November, 2018 |
| Photo-record-2 | Bienes Comunales Olotla | Metztitlán | 20° 37′ 51.0″ | 98° 41.3′ 30.0″ | 4 | Adults (3 females and 1 male) | On a firewall gap, within the areas under forest management. | February, 2019 |
| Track | Predio Tetenatipa | Zacualtipán de Ángeles | 20° 40′ 20.37″ | 98° 39′ 14.80″ | 1 | Undefined | On a gap, in the Tetenatipa private premises subjected to forest management, 2 km from Zacualtipán de Ángeles. | July, 2019 |

urban area in the municipality of Zacualtipán de Angeles. The sighting occurred within the Cruxtitla site, also under forest management. During a survey walk of transects across this site, an adult red brocket deer was observed being chased by a pack of dogs (apparently unguarded by people), which were after it until leaving the area.

The rest of records were photographic evidence. Two adult individuals were recorded in August 2016, 1 female and 1 male. In 2017, 3 specimens were recorded, corresponding to one fawn, one yearling, and one adult, in January, February and August, respectively (Figure 2). In 2018, 7 records were obtained: 3 adult females in March, one adult male in August, and 2 adult males plus one adult female in November. Finally, 4 records were obtained in February 2019, corresponding to 3 adult females and 1 adult male. Of the photographic records, 11 were captured during the night (between 6:45 pm and 1 am) and 5 during the day (between 8 am and 3 pm).

The records of red brocket deer reported in this note provide relevant information about its current distribution in the state of Hidalgo, México, and contribute to the information available on the conservation status of this cervid species (SEMARNAT 2010; Bello *et al.* 2016). Our work is a contribution to the few studies carried out on this species in the MCF of Hidalgo (Muñoz and Gallina 2014; Muñoz-Vazquez and Gallina-Tessaro 2016), being among the early works covering Northeastern Hidalgo-Huayacocotla Cloud Forest subregion.

The records were obtained in the UMAFOR's MCF, a managed forest where the main anthropogenic impact is the land use change for forest activities, including selective logging (CONABIO 2010; SERFORH 2011). Regarding this, habitat fragmentation and human presence have been reported to adversely impact red brocket deer populations; hence, this species is considered to be an inner-forest specialist in different regions of México (Reyna-Hurtado and Tanner 2005; Ortiz-Garcia *et al.* 2012; Ramírez-Bravo and Hernández-Santín 2012; García-Marmolejo *et al.* 2015; Contreras-Moreno *et al.* 2016; Pérez-Irineo and Santos-Moreno 2016), particularly in San Bartolo Tutotepec Mountain Cloud Forest, Hidalgo (Muñoz and Gallina 2014; Muñoz-Vazquez and Gallina-Tessaro 2016). In our study, carried out on some MCF sites in the Northeastern Hidalgo-Huayacocotla subregion, community companies classify these forests as conservation areas exempted from any sort of forest use (SERFORH 2011), resulting in areas of dense vegetation cover surrounding disturbed sites. Thus, the presence of

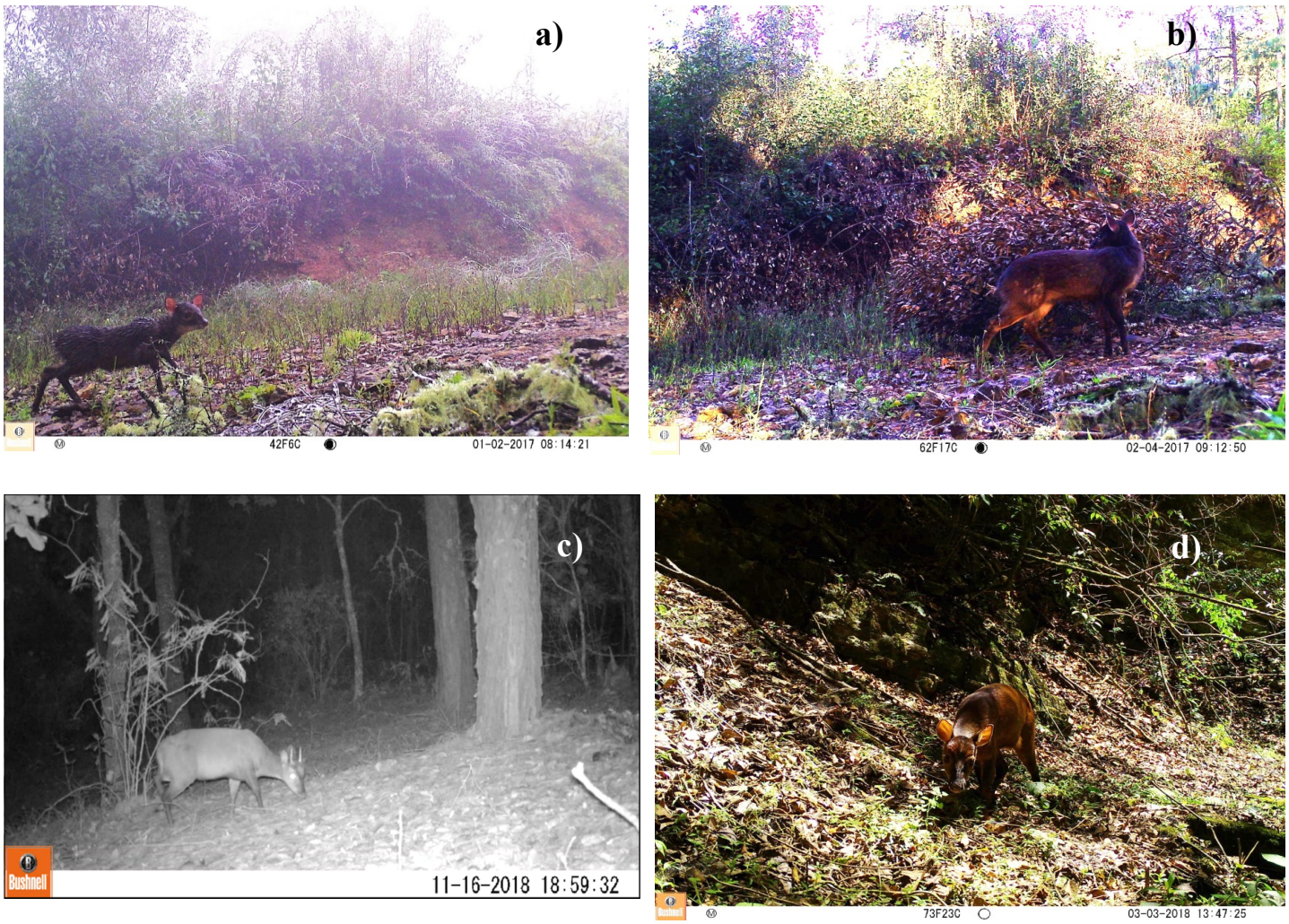


**Figure 2.** Photographic records of red brocket deer (*Mazama temama*) in the 1302 Zacualtipán-Molango Forest Management Unit, Hidalgo, México: a) fawn (small size, presence of white spots along the back), b) yearling or adult female, c) male (small, unbranched antlers), d) yearling or adult female.

red brocket deer in this UMAFOR could be associated with the existence of MCF, as reported elsewhere (Lira-Torres and Naranjo 2003; Reyna-Hurtado and Tanner 2007). Given the above, MCFs in northeastern Hidalgo may represent the northernmost shelters for red brocket deer populations, which could be connected with San Bartolo Tutotepec MCFs (Muñoz-Vazquez and Gallina-Tessaro 2016).

In this regard, community forests in México have been documented as high species richness sites because owners set limits on deforestation and degradation of the forest cover, hence promoting biodiversity conservation (Bray *et al.* 2007; CONAFOR 2016). Similarly, the adoption of a socio-ecological approach where the use of natural resources considers the interactions between the social and natural environments, has been proposed as a successful management approach for the conservation of wildlife species in fragmented environments, particularly the red brocket deer (García-Marmolejo *et al.* 2015). Therefore, our results suggest positive impacts of forest management on this UMAFOR. This finding may be further confirmed through additional monitoring in areas under forest exploitation, using specific methods to estimate population abundance and density (see Lara-Díaz *et al.* 2011), coupled with more accurate assessments of the impact of forest management on red brocket deer populations (Muñoz-Vazquez and Gallina-Tessaro 2016). It is worth stressing that this forest management scheme has contributed to reducing the negative impacts on mammalian diversity (Hernández-Rodríguez *et al.* 2019); therefore, this UMAFOR may be considered a management scheme that is compatible with the conservation of priority species.

On the other hand, the presence of seemingly feral dogs in the study area demonstrates the importance of continuing the monitoring efforts in this and other management units, since red brocket deer are preyed upon by them (Weber and González 2003; Mandujano 2011). UMAFOR units are areas with little published information about the species they harbor, especially mammals (SERFORH 2017). Additionally, our photographic records suggest that red brocket deer is particularly active at night in the MCF located at this UMAFOR, which could be interpreted as a strategy to evade humans and its activities, including poaching (Reyna-Hurtado and Tanner 2005).

Our results suggest that UMAFORs may supplement the protection provided by natural areas of high conservation priority, including MCFs (Challenger and Soberón 2008; CONABIO 2010), which harbor priority species such as red brocket deer (SEMARNAT 2014). Finally, we encourage the development of research projects at this UMAFOR specifically addressing the red brocket deer. These will contribute to a better understanding on its ecology, ethnoecology, ethology, and genetics (Weber and González 2003; Mandujano 2004; Reyna-Hurtado and Tanner 2005; Gallina and Mandujano 2009; Escobedo-Morales *et al.* 2016), and will set the groundwork for the development of management and conservation plans for this species populations.

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