# Distribution Update

## First camera trap record of crab-eating fox on Auyan Tepui, Venezuela

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Keywords: Auyan Tepui, camera-trapping, faunal distribution, Pantepui, mesopredator, tepui.

## Abstract

The crab-eating fox *Cerdocyon thous* was first recorded in the vicinity of Auyan Tepui, Venezuela by G.H.H. Tate during the 1937-38 Phelps Expedition to the region. However, Tate did not record the altitude of the sighting and no subsequent observations of *C. thous* on a tepui summit or slope have been documented. Though the tepuis are considered depauperate of mammals larger than 5kg, a crab-eating fox was photographed on the slopes of Auyan Tepui at Campo Guayaraca in 2012 at an altitude of 1,010m during a short expedition to the region. This evidence verifies Tate's observations in 1938, providing the first photographic evidence of this canid on the talus slopes in the tepuis of Venezuela.

## Introduction

The crab-eating fox *Cerdocyon thous* is a widely distributed medium-sized (4-7kg) Neotropical canid, first observed in the vicinity of Auyan Tepui by G.H.H. Tate during the 1937-38 Phelps Expedition (Tate 1939). Auyan Tepui and the eastern district tepuis (defined in Huber 1988) were included in Canaima National Park, Venezuela, in 1975 due to their unique biodiversity and natural beauty (Gutman 2002). The Venezuelan subspecies *C. thous thous* is found primarily in open savanna and woodlands (Brady 1979, Bisbal 1988) and was listed by the IUCN as Least Concern (LC) in Venezuela, and Information Deficient (IC) in Canaima National Park (Señaris et al. 2009). Although no collection altitude was given for the specimen Tate recorded, it can be inferred from his work that this fox was found between 450 and 2,200m in altitude (Tate 1938, 1939).

The tepuis of Venezuela comprise a biogeographical province known as Pantepui (Huber, 1987), and are host to a high level of endemic vascular plants (Berry et al. 1995, Rull 2005, Nogue et al. 2009, Vegas-Villarrubia et al. 2012) and herpetofauna (McDiarmid and Donnell 2005, Rödder et al. 2010), though they are considered depauperate of mammals less than 5kg in weight (Huber 1988, Ochoa et al. 1993, Lim et al. 2005). Recently, the brown-nosed coati *Nasua nasua vittata* was verified to occur on Roraima (Havelkova et al. 2006) and the Chimanta Massif (Robivinsky et al. 2007) indicating that medium-sized omnivorous lowland mesopredators can range into the tepui summits. Other mammals such as South American tapir *Tapirus terrestris* and jaguar *Panthera onca* have been reported from the summit of Auyan; however these sightings have not been verified with photographic or physical evidence (Huber 1988, Havelkova 2006). The extent to which larger mammals, including carnivores, are present on the tepui summits and talus slopes has not been adequately assessed due to a lack of long term field studies on the fauna in the tepui ecosystem. The Pantepui region is under conservation regimes and considered pristine but has not been fully surveyed (McDiarmid and Donnelly 2005). The lack of long-term expeditionary work has resulted in incomplete knowledge of the total biodiversity in the tepui ecosystem (Myers 2000, McDiarmid and Donnelly 2005, Nogue et al. 2009). In an effort to close this knowledge gap, a pilot camera trapping study was conducted. The study surveyed the slopes and the summit of Auyan Tepui and occurred from 6 January to 13 January 2012.

## Survey area

Auyan Tepui (N 5°55' W 62°32') is the largest tepui in the Eastern Pantepui District in terms of continuous area with a summit area of 700km$^2$ and a talus slope area of 200km$^2$ (Huber 1988). The summit is topographically connected to the lowlands by a series of escarpments on the southern and eastern sides of the plateau (McDiarmid and Donnelly 2005). Auyan Tepui has a comparatively rich faunal diversity (Jaffe et al. 1993, McDiarmid and Donnelly 2005). Floral assemblages on Auyan Tepui are divided into four broad types and vary according to elevation and substrate: 1) transitional broad leaf evergreen forests on the talus slopes and midlands (800-2,000m), 2) mosaic summit communities of herbaceous assemblages, paramoid shrub lands, and pioneer plants, 3) summit meadows dominated by *Stegolepis* (Rapateaceae), and 4) riparian gallery forests composed of *Bonnetia* (Bonnetiaceae) and bromeliads along perennial river systems (McDiarmid and Donnelly, 2005). Auyan experiences high levels of precipitation (2,500-4,000mm per annum), a consistent temperature (14 to 21°C), 80% humidity, and a 0.6°C average temperature drop per 100m (Sanhueza et al. 1999). We surveyed three sites, including Campo Guayaraca, Peñón, and Naranja (Figure 1). Both Peñón and Naranja vegetation assemblages are composed of shrublands and tepui meadows dominated by *Bonnettia* and *Stegolepis* along eroded rock surfaces. Campo Guayaraca is located on the southern talus slopes dominated by floristically diverse forested areas (Figure 1).

The following is the established format for referencing this article:
Barkoczy, L. 2013. First camera trap record of crab-eating fox on Auyan Tepui, Venezuela. Canid Biology & Conservation 16(4): 12-15. URL: http://www.canids.org/CBC/16/crab_eating_fox_in_Venezuela.pdf


Figure 1. Satellite image of Auyan Tepui with yellow pins indicating the three camera trapping locations in the southern portion of Auyan Tepui. Pin #1 is Campo Guayaraca at an altitude of 1,010m, where the reported photo was captured. Pin #2 is the summit of Peñón at an altitude of 1,838m and Pin #3 marks the summit of Naranja at an altitude of 2,161m. Image obtained courtesy of Google Earth © (Google 2012) with satellite image taken by U.S. Geological Survey on 31 December 1969. Inset shows location of the study area relative to Venezuela country boundary.

## Methods

The survey area was confined to the southern talus slopes and summit of Auyan, an area identical to the trail used by the Phelps Expedition (Tate 1938). Two camera traps (D55 IR Game Spy, Moultrie, Alabaster, Alabama, USA) were placed on the tepui talus slopes and summit at the three different locations, and were moved as the team proceeded north toward the centre of the plateau. The two cameras were positioned in close proximity to each other (between one to two metres), 60cm above the ground, between ten and 50m from the expedition camp sites, and affixed to trees in forested areas or placed on rocks when active in herbaceous summit assemblages (Figure 2). The camera traps were configured for still shots and short video segments, and then baited with leftover food scraps. At Campo Guayaraca on the high talus slope, (1,010m altitude, N 5º 41.084' & W 62º 31.483) the traps were active from 6 January to 7 January for 14 hours. On the summit the cameras were set up at Peñón (1,838m altitude, N 5º 44.665' & W 62º 32.452) from 7 January to 8 January for ten hours, and at Naranja (2,161m altitude, N 5º 46.415' & W 62º 31.969') from 10 January to 13 January for 60 hours. The expedition team also performed an *ad hoc* fauna survey south of Auyan Tepui and conducted reconnaissance for future camera trapping locations.

## Results

Cameras were operational for 84 hours in the field, producing a combined total of 168 camera hours (approximately seven camera days). At Campo Guayaraca, the cameras captured photographs and video of the crab-eating fox (Figure 3, Video 1) *C. thous thous* 50m from the camp in upland mountain forests. From the images recorded in the camera trap video sequences it seems as though the fox is startled by the infra-red flash of the cameras, but is not engaged in trap avoidance behaviour; a concern in camera trap studies (Séquin et al. 2003). While determining the sex from photographs is difficult because the species does not exhibit sexual dimorphism, analyses of the video and images indicated that the animal was a male (N. Songsasen, Smithsonian Institution, pers. comm.).

No useful photographs were obtained from the camera traps set at the summit camps (Peñón and Naranja). The transect surveys documented sightings of herpetofauna from 1,010 to 2,161m and a few small opossums (species undetermined) at Naranja. The latter was not captured in the camera traps (A. Pomares, pers. comm.).


Figure 2. Camera trap arrangement in mountain forest at Campo Guayaraca at an altitude of 1,010m, Auyan Tepui. We recorded crab-eating fox at this location.


Figure 3. Nocturnal photograph of a male crab-eating fox, taken in the mountain forest at Campo Guayaraca, Auyan Tepui.

## Discussion

No general study of the population dynamics of crab-eating foxes in the Guiana Highlands exists; the total population of *C. thous* across South America can only be inferred from studies on localized populations (Berta 1987, Tchaicka et al. 2006). Tate (1938) was the first to mention the presence of the crab-eating fox on Auyan Tepui. Subsequent expeditions have not reported this fox on the slopes or summit of any tepui. This is the first instance in which a crab-eating fox has been photographically verified as being present in the mid-mountain forests of the Pantepui, and the first instance of camera trapping on any tepui summit. Camera trapping studies across South America indicate that crab-eating fox has a low capture rate (Maffei et al. 2007, Jacomo et al. 2004). It is not possible to compare sampling efforts from Auyan Tepui to other studies at this time. Additional camera trapping studies will be required to determine the differences in mammal distribution between tepui summit/slope environments and other areas of the Guiana Shield. A longer study or series of short-term studies in the Pantepui region has the potential to produce enough data for useful comparisons to other studies. Future camera trapping and field studies on the summit of Auyan Tepui may provide more data if they are designed specifically for the climatic and vegetation realities of tepui environments.

Video 1. Video segment recorded by a camera trap at Campo Guayaraca, Auyan Tepui (video available through author's blog http://biokryptos.blogspot.com/2012/05/camera-trapping-of-auyan-tepui-january.html). The fox is engaged in consuming bait left in the capture zone. Based on the behaviour of the animal, it may be aware of the camera trap. Video encoder can be downloaded for free at http://www.videolan.org/.

Tepui topography is highly discontinuous; therefore the locations for faunal encounters will correspond to suitable habitats, such as mixed vegetation assemblages near perennial streams and lagoons. In the tepui meadow environment, suitable trees to attach the camera traps were not found. Future efforts will require pre-built structures to mount the traps in tepui meadows. The high annual precipitation can be counteracted by encasing the camera traps in a waterproof housing to prevent moisture accumulation and subsequent camera malfunction.

Although the known altitudinal distribution of *C. t. thous* extends beyond 1,000m (Bisbal 1988), recording this carnivore on the talus slopes of Auyan Tepui provides the first photographic evidence to verify Tate's 1937-1938 observations of the faunal composition of Auyan Tepui, which also included extensive observations of *N. n. vittata* up to 2,200m (Tate 1939). *N. n. vittata* has recently been observed, filmed and photographed on the summit of Auyan Tepui (Barkoczy 2009, A. Pomares, pers. comm.) and other Eastern District tepuis (Havelkova et al. 2006, Robovsky et al. 2007). *C. t .thous* and *N. n. vittata* share similar feeding strategies (both are hypocarnivorous, frugivorous and highly opportunistic); their ecological interactions and place in tepui ecology are unknown at this time.

Establishing the range, population dynamics and niche of *C. t. thous* on the tepui talus slopes and summits is necessary for understanding the current ecosystem dynamics of the Pantepui and predicting future changes. The digestive system of *C. t. thous* may encourage the germination of certain plant seeds making it a primary seed disperser; a phenomenon observed in *N. nasua* (Alves-Costa 2007, Vasconcellos-Neto et al. 2009, Cazetta et al. 2009.). Seed dispersal mechanisms are not well known in the Guiana Highlands and tepui floral dispersal capabilities are considered to be minimal (Rull 2010). Understanding the dispersal mechanisms of tepui plants is important given the dramatic effects climate change will have on the distributions of future tepui ecosystems. Global warming is predicted to produce an approximately 80% extinction rate in summit vascular plants, and a lowland upward ecosystem displacement of 500-700m by 2100 (Rull 2010, Nogue et al. 2012, Vegas-Villarrubia et al. 2012). *C. t. thous* may influence the distribution of current and future floral assemblages on the tepui summits, by dispersing seeds of both endemic and non-endemic plant species (Nathan et al. 2008, Thuiller et al. 2008).

## Conclusion

Though limited in scope and duration, this camera trapping pilot study verifies Tate (1938)'s observations of *C. t. thous* on Auyan Tepui, and demonstrates that lowland carnivores are in contact with tepui ecosystems. The results also indicate that camera trapping surveillance is a viable methodology for studying the distribution of fauna in the remote and difficult to access Pantepui region. At this time the dynamics of lowland and highland biotic interactions such as seed dispersal mechanisms remains poorly understood, as does the status of large bodied lowland vertebrates on the tepui slopes and summits. In order to determine the distribution and ecological dynamics of *C. t. thous* and other carnivores such as *N. n. vittata* in the tepui environments, further fieldwork and camera trapping will be necessary. Camera trapping and survey gap analysis in combination with GIS analysis of the Pantepui would make future research and expeditionary work more cost efficient, and would help to identify and catalogue Pantepui fauna which may otherwise prove elusive using standard survey methods. Based on the results of this study, I recommend camera trap surveys of the larger Eastern District tepuis to obtain additional evidence for the presence of *C. thous* and other large-bodied animals which have been reported but not confirmed on the tepui summits.

## Acknowledgements

I am deeply indebted to the entire expedition crew for the realization of my pilot study; Alberto Pomares, Vittorio Assandria, Daniel Abgrall, Cedrig Abgrall, Dr. Douglas Olivares, Nelson Gonzalez, Richard Dittmar, Ana Cristina Fernandez, Dr. Carlos Acevedo, and Paul Stanley. I would also like to especially thank the Pemon guides who assisted with the completion of the camera trap survey: Santos Ugarte (the principle guide), Arturo Berti (guide and camera trap assistant) and Nixson (camera trap assistant). I would like to acknowledge Dr. Nucharin Songsasen at the Smithsonian Institution for assistance in determining the sex of the crab-eating fox from camera trap images.

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## Biographical sketches

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