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Puma concolor: First photographic record in the El Jilguero Reserve Water Production Zone, Honduras

Puma concolor: Primer registro fotográfico en la Zona Productora de Agua Reserva El Jilguero, Honduras

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The puma (*Puma concolor*) is the second largest felid in Honduras, whose geographic distribution in the departments bordering El Salvador has been the subject of controversy. Two photographs of puma were captured in the El Jilguero Reserve Water Production Zone of the Guajiquiro-El Jilguero Biological Corridor on March 21, 2023 using camera traps installed in the mountain cloud forest at 2,092 m. The capture site of the puma is located 30.4 km northwest of the previous record at La Paz and 32.2 km northeast of the nearest record in the Sapo River Basin, El Salvador. The puma is a priority species for conservation since it is listed as Endangered in Honduras. Therefore, it is necessary to strengthen long-term monitoring programs and implement conservation actions to prevent and reduce its threats.

Key words: Biological corridor; Felidae; Guajiquiro; La Paz; Opatoro.

El puma (*Puma concolor*) es el segundo mayor félido en Honduras, cuya distribución geográfica en los departamentos fronterizos a El Salvador, había sido objeto de controversia. En la Zona Productora de Agua Reserva El Jilguero del Corredor Biológico Guajiquiro-El Jilguero, el 21 de marzo 2023, se obtuvieron 2 fotografías de puma en trampas cámara instaladas en el bosque mesófilo de montaña a 2,092 m. El sitio de ocurrencia del puma se encuentra ubicado a 30.4 km al noroeste del registro previo en La Paz y 32.2 km al noreste del registro más cercano en la Cuenca del Río Sapo, en El Salvador. El puma es una especie prioritaria para la conservación, dado que está categorizado en Peligro de extinción en Honduras. Por lo tanto, es necesario fortalecer los programas de monitoreo a largo plazo e implementar acciones de conservación con la finalidad de prevenir y reducir sus amenazas.

Palabras clave: Corredor biológico; Felidae; Guajiquiro; La Paz; Opatoro.

Felids have been reported in several regions of Honduras, including 5 species: jaguar (*Panthera onca*), puma (*Puma concolor*), jaguarundi (*Herpailurus yagouaroundi*), ocelot (*Leopardus pardalis*), and margay (*L. wiedii*; Reid 1997; Marineros and Martínez-Gallegos 1998). After the jaguar, the puma is the second largest feline living in the major biomes of América, from northern Canadá to southern Chile and Argentina, from sea level to above 5,800 m (Currier 1983; Nowell and Jackson 1996; Sunquist and Sunquist 2002; Beck *et al.* 2005). It lives in forests, rainforests, or near wetlands, plains, arid areas, sierras, and mountains (Currier 1983; Nowell and Jackson 1996). In addition, it adapts to altered environments and areas subjected to heavy anthropogenic pressure (Ernest *et al.* 2014; Meyer *et al.* 2020).

The puma is a priority species for conservation at the country level because it is listed as Endangered (EN) by the Wildlife Conservation Society (WCS 2021). In Honduras, as in the rest of its range in America, its populations are believed to be declining due to habitat loss and fragmentation, depletion of its prey, and conflicts with humans due

to livestock predation (Ernest *et al.* 2014; Nielsen *et al.* 2015; Meyer *et al.* 2020; WCS 2021).

According to the Global Biodiversity Information Facility (GBIF 2023), in 1946, a female puma was collected in the department of Lempira, municipality of San Francisco, in western Honduras adjacent to El Salvador. This specimen was deposited in the Museum of Comparative Zoology at Harvard University (MCZ 43013). Marineros and Martínez-Gallegos (1998) reported the observation of a skull in Guajiquiro and a limb in Opatoro, both municipalities of the department of La Paz (Figure 1); however, this evidence is not available in a scientific collection for review and verification. Later, Portillo-Reyes and Elvir-Valle (2022) reported one indirect photographic record collected at the municipality of Aguanqueterique in La Paz, western Honduras, and mentioned another record supported by an unverified television news from Colomoncagua, Intibucá. Separately, the puma has been recently recorded at localities in El Salvador near Honduras through camera traps (Morales-Rivas *et al.* 2020). There are no systematic studies aimed at obtaining specific records, *i.e.*, supported by photographs or skulls of specimens deposited in scientific collections and available for consultation. For this reason, the inclusion of the western region of Honduras in the geographic range of puma has been the subject of controversy, specifically in the departments bordering El Salvador (Table 1). It was believed that the puma could be highly restricted to some protected areas in the central and eastern regions, mainly on the northern coast and the Honduran Moskitia (Gonthier and Castañeda 2013; Midence 2019; Portillo- Reyes and Elvir-Valle 2018, 2022; Castañeda *et al.* 2023). This study documents the first photographic record of puma in the El Jilguero Reserve Water Production Zone (ZPARJ, in Spanish), consisting of 2 photographs captured with a camera trap as recent evidence of their presence in this protected area. This evidence suggests that the forested areas of this region probably function as corridors for Felidae.

The Guajiquiro-Jilguero Biological Corridor (CBGJ, in Spanish) comprises 3 protected areas (Figure 1): ZPARJ, Guajiquiro Biological Reserve (RBG), and Montecillos Biological Reserve, in addition to other protected forest areas, such as microbasins, based on the delimitation of the corridors of southwestern Honduras of the Secretariat of State's Office of Natural Resources and Environment (SERNA 2023). The ZPARJ

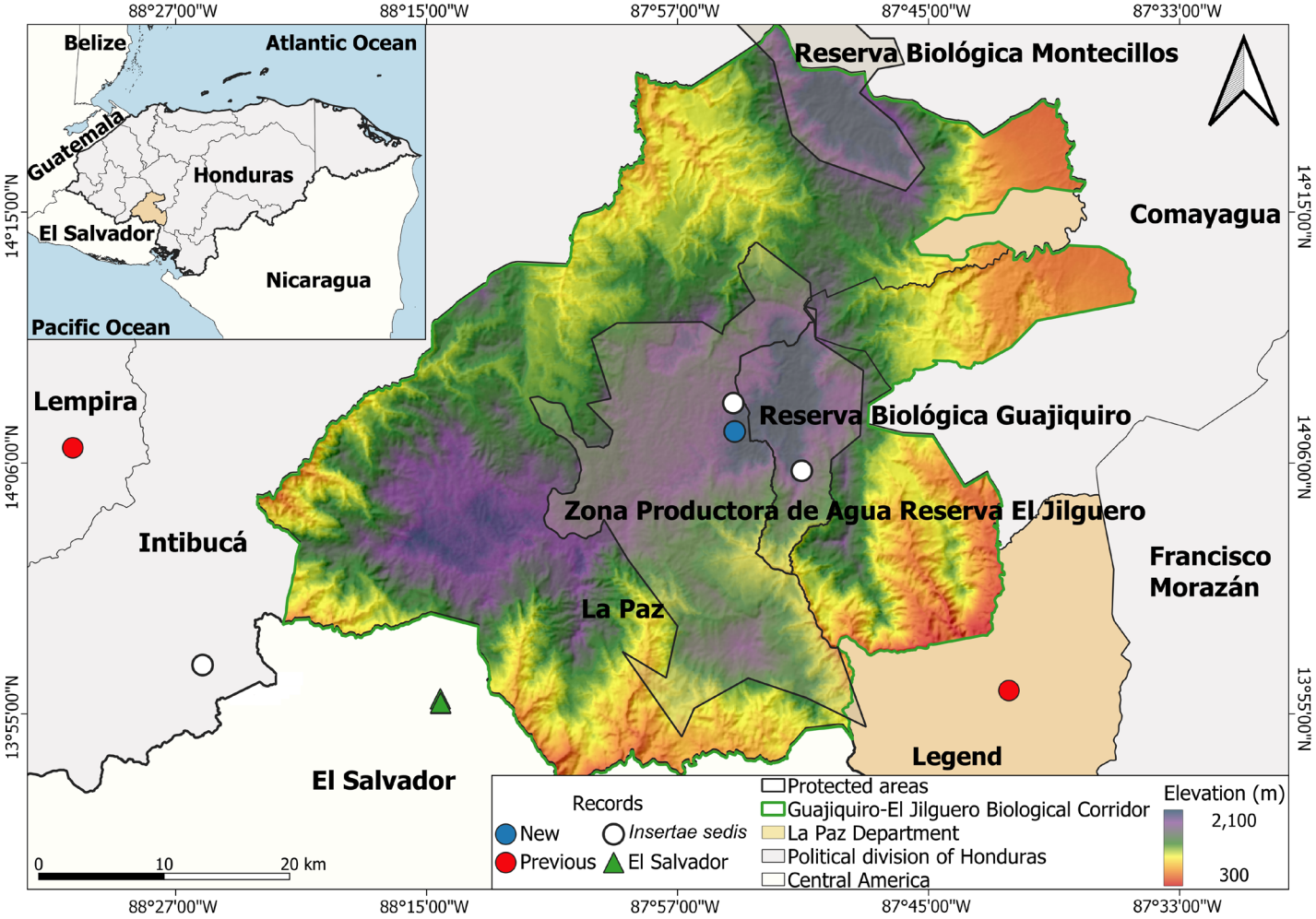

Figure 1. Geographic location of the sites of occurrence of puma (*Puma concolor*) in the Guajiquiro-El Jilguero Biological Corridor and adjacent areas. In addition, records in the Honduras-El Salvador border are indicated. Geographic coordinates and other details are included in Table 1.

stretches across 44,108.01 ha, with jurisdiction in 8 municipalities in the department of La Paz. According to the National Institute for Forest Conservation and Development, Protected Areas, and Wildlife (ICF 2016), 93.72 % of the area corresponds to subtropical humid forests and 6.28 % to low mountain cloud forests. Besides, 11.97 % of the area comprises the core zone and 88.03 % the buffer zone, which, in turn, includes 5 sub-zones: sustainable natural resource management, recovery, urban, restricted use, and protected forests. In ZPARJ, the main issues affecting biodiversity are associated with deforestation from different anthropogenic activities, especially migratory agriculture of basic grains (maize and beans), monoculture coffee plantations, and forest fires. These have led to the decline of forest areas; for example, 18 ha were lost between 2018 and 2020 (SERNA 2023).

On March 20, 2023, the mammal monitoring program was launched at ZPARJ, installing 5 camera traps (Moultrie®), 1 per station, separated by 400 m. On May 2, 2023, 2 additional camera traps (Stealth Cam®) were installed following the same protocol. To maximize the probability of capture, we sought evidence of the presence of mammals, *e.g.*, footprints, feces, and burrows. The cameras were set at a distance not less than 2 m (ideally 3 to 4 m) from the expected trajectory of the animal, either perpendicular or at 45°, and at between 30 cm and 80 cm from the ground, depending on the local topography and slope. These traps were set to operate for 24 hr; 1 camera trap was set to capture 3 photographs, and 6 camera traps to capture 15-sec videos (Appendix Video). The field sampling effort at the time of the review was 170 camera trap-days.

We deposited the photographs and videos in the mammalian photographic collection of the Natural History Museum at Universidad Nacional Autónoma de Honduras (National Autonomous University of Honduras; MUVS-V; see collection numbers in Figure 2). Capture sites were georeferenced with a manual geopositioner (Garmin eTrex®). The map (Figure 1) was produced in the Geographic Information System v3.26.3 (QGIS 2023). All coordinates are in the datum WGS84.

On March 21, 2023, 2 photographs of puma (*Puma concolor*) were captured during the night (20:17 hr) at 2,092 m in the ZPARJ broadleaf forest (14° 8' 16.19" N, 87° 52' 58.40" W), municipality of Opatoro, CBGJ, La Paz (Figures 1, 2a, 2b). This site is located 30.4 km northwest of the record at Aguanqueterique, La Paz (Portillo-Reyes and Elvir-Valle 2022) and 32.2 km northeast of the nearest camera trap record on the Sapo River Basin, department of Morazán, El Salvador (Morales-Rivas *et al.* 2020; Table 1).

As the first results of the ZPARJ monitoring, records of other mammal species (Figure 2c-l) were obtained: margay (*L. wiedii*), coyote (*Canis latrans*), white-tailed deer (*Odocoileus virginianus*), white-nosed coati (*Nasua narica*), rabbit (*Sylvilagus gabbi*), Central American agouti (*Dasyprocta punctata*), armadillo (*Dasypus novemcinctus*), opossum (*Didelphis marsupialis*); the birds captured include Highland guan (*Penelopina nigra*) and white-faced quail-dove (*Zentrygon albifacies*).

Previous records, the potential distribution, and comments from local inhabitants on puma sightings partially supported the hypothesis of its presence in ZPARJ (Reid 1997; Marineros and Martínez-Gallegos 1998; Portillo-Reyes and Elvir-Valle 2022), which was confirmed by this first photographic record using camera traps. Despite likely being present in the area, the species had not been previously recorded due to the limited or absent sampling effort in the western Honduras protected areas. On the other hand, Castañeda *et al.* (2023) have carried out sampling in some protected areas of western Honduras, as well as the Mancomunidad Mapance monitoring program in the Montaña de Celaque National Park, without having recorded

Table 1. Records of puma (*Puma concolor*) indicated in Figure 1, including unverified *incertae sedis* observations, because of lack of evidence such as a photograph record, or voucher specimen deposited in a museum or collection. Museum of Comparative Zoology, Harvard University (MCZ). Elevation in m. Coordinates and elevation data provided by H. Portillo-Reyes, May 16, 2023 (indicated with superscripts[1,2]).

Locality	Latitude (N)	Longitude (W)	m	Evidence	Reference
San Francisco, Lempira	14° 7' 4.78"	88° 22' 22.10"	790	MCZ 43013	GBIF (2023)
Aguanqueterique, La Paz[1]	13° 56' 45.58"	87° 40' 52.69"	320	Photograph record	Portillo-Reyes and Elvir-Valle (2022)
ZPARJ, Opatoro, La Paz	14° 7' 55.37"	87° 53' 3.49"	2,092	Photograph/Camera trap	This study
	13° 56' 06.70"	88° 06' 01.62"	705		
Sapo River Basin, Morazán, El Salvador	13° 56' 18.94"	88° 06' 02.42"	716	Photograph/Camera trap	Morales-Rivas *et al*. (2020)
	13° 56' 08.71"	88° 06' 01.61"	706		
Incertae sedis					
Altamira, Guajiquiro, La Paz					Marineros and Martinez-Gallegos (1998)
Las Trancas, Opatoro, La Paz					Marineros and Martinez-Gallegos (1998)
Colomoncagua, Intibucá[2]	13° 57' 43.19"	88° 16' 34.33"	860		Portillo-Reyes and Elvir-Valle (2022)

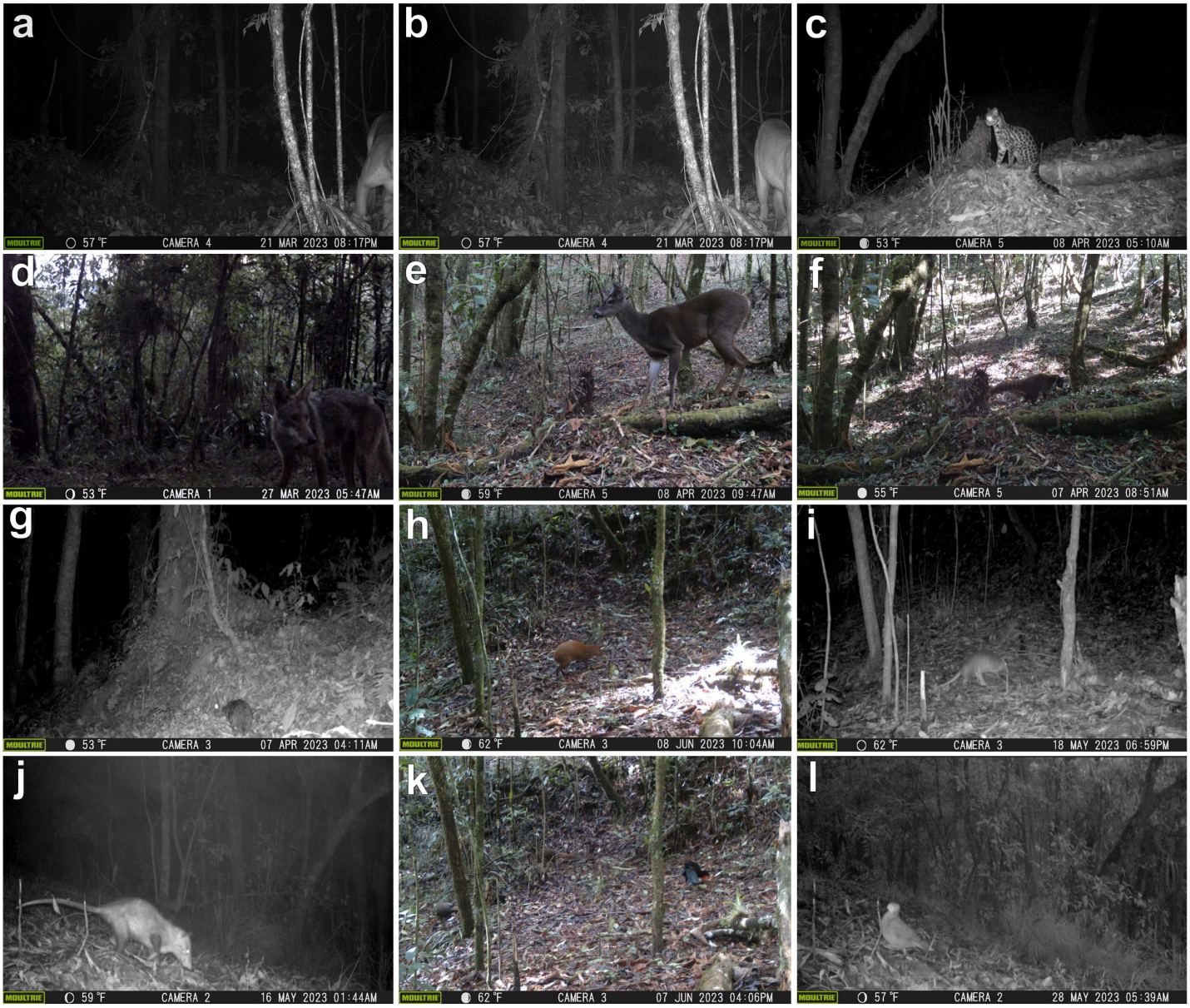

Figure 2. Fauna recorded during the monitoring with camera traps in the El Jilguero Reserve Water Production Zone, Guajiquiro-El Jilguero Biological Corridor, Honduras, Central America. Mammals: a, b) *Puma concolor* (MUVS-F-0001); c) *Leopardus wiedii* (MUVS-V-0001); d) *Canis latrans* (MUVS-F-0002); e) *Odocoileus virginianus* (MUVS-V-0002); f) *Nasua narica* (MUVS-V-0003); g) *Sylvilagus gabbi* (MUVS-F-0003); h) *Dasyprocta punctata* (MUVS-V-0004); i) *Dasypus novemcinctus* (MUVS-V-0005); j) *Didelphis marsupialis* (MUVS-F-0004). Birds: k) *Penelopina nigra* (MUVS-V-0006); l) *Zentrygon albifacies* (MUVS-V-0007).

pumas (H. Vega, pers. comm., July 20, 2023). Besides, the puma photograph we report probably corresponds to a dispersed individual from nearby regions, *e.g.*, Sapo River basin in El Salvador, as the puma requires extensive areas to move, generally greater than 100 km^2, with notable records exceeding 450 km^2 (Ruiz-García *et al.* 2009). Puma dispersal movements usually occur through preserved habitats; however, they can also move through landscapes dominated by anthropic activities, *e.g.*, crops and grasslands (Hornocker and Negri 2010).

The presence of carnivores such as *P. concolor*, *C. latrans,* and *L. wiedii* at the top of the ecological pyramid may indicate that CBGJ forested areas such as ZPARJ, RBG, and the micro-basins of Quebrada Honda, Río León, and Cimarrón still maintain a good state of conservation, connectivity, and ecological integrity. In turn, the present report is one of the few records of puma in mountain cloud forests in Honduras. This is a positive indication of efforts focused on conservation to address the effects of habitat fragmentation pressures on Felidae populations. ZPARJ also yielded photographic records of *O. virginianus, N. narica, S. gabbi, D. punctata, D. novemcinctus, D. marsupialis,* and *P. nigra*, all of which are potential prey of puma (Branch *et al.* 1996; Beck *et al.* 2005; Novack *et al.* 2005; Cascelli de Acevedo 2008; Monroy-Vilchis *et al.* 2009). The records of species such as *P. nigra*, *O. virginianus*, *L. wiedii*, *N. narica*, and *P. concolor* are relevant because they are a warning call for conservation actions, given that all of them are on the Red List of Endangered Species in Honduras, with the first 4 species in the Vulnerable category (VU; WCS 2021).

CBGJ is a priority area for conservation due to its location, rugged topography, and altitudinal strata, ideal to function as a potential corridor for puma dispersal as it borders El Salvador (Morales-Rivas *et al.* 2020; SERNA 2023). In this sense, the conservation of puma and its prey poses numerous challenges and opportunities to focus actions based on strengthening the connectivity of protected areas of the CBGJ with Honduras and El Salvador. The ZPARJ is contemplated in collaborative efforts between different actors for the management and governance of forest areas (*e.g.*, ASOMAINCUPACO, Conecta+/SERNA, International Union for Conservation of Nature, IUCN, water councils and boards, civil organizations) involving the participation of the Lenca indigenous people. The Lenca communities are essential to preserving the natural heritage of the CBGJ, as they have a good knowledge of biodiversity. Values such as respect and admiration for nature are part of their culture and worldview, thus providing opportunities to boost protection actions involving key species such as the puma. A close relationship has been demonstrated between indigenous territories and areas of high biological diversity, where deforestation is generally lower because native communities manage their lands sustainably (McElwee *et al.* 2020). Undoubtedly, the RBG adjacent to ZPARJ (Figure 1) is fundamental for connectivity. Therefore, the Conecta+ project initiatives include developing the first management and conservation plan for the protected area; besides, it is being strengthened at the local organizational level to assume shared management of the reserve.

Given that a network of forested areas is needed in the CBGJ, micro-basins are being decreed, agroforestry coffee systems implemented, and degraded areas reforested (SERNA 2023). Protected under decree 98-2007 of the Protected Areas and Wildlife Forestry Act, Opatoro government authorities recently (2023) issued an ordinance prohibiting the use of fire in agriculture. Monitoring efforts are carried out under an inclusive governance approach, with the participation of indigenous people and the local community as the key players in conservation. It is necessary to continue environmental education and long-term monitoring, in addition to implementing payment for environmental services and training community monitoring committees on livestock predation conflicts that may occur in ZPARJ and CBGJ.

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Appendix

Mammal and bird species recorded by video during the monitoring with camera traps in the El Jilguero Reserve Water Production Zone, Guajiquiro-El Jilguero Biological Corridor, Honduras, Central America.

https://drive.google.com/file/d/1KkBPaSndApj0DMcxowg-suZB4jr4wyeX/view?usp=sharing

In order of appearance: Margay (*Leopardus wiedii*), white-tailed deer (*Odocoileus virginianus*), white-nosed coati (*Nasua narica*), central American agouti (*Dasyprocta punctata*), armadillo (*Dasypus novemcinctus*), highland guan (*Penelopina nigra*), and white-faced quail-dove (*Zentrygon albifacies*).