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Filling the gap – Melanistic jaguars in Panamá

It has been postulated that in some jaguar *Panthera onca* populations, selective and geographical factors may influence the expression of melanism. Here, we report records of melanistic jaguars derived from a long-term camera trap study in the cloud forest of eastern Panamá. Our findings highlight the importance of Panamá in the distribution of melanistic jaguars and adds weight to the hypothesis of prevalence of this variant in areas of high humidity.

Gloger's original eco geographical rule is based on the assumption that melanin pigments confer fitness benefits for birds and mammals living in tropical and humid environments (Gloger 1833). The selective processes that explain melanin-based colouration patterns include camouflage, thermoregulation, aposematism, sexual selection, pathogens, and UV-radiation protection (Majerus 1998, Majerus & Mundy 2003, Roulin 2014). Moreover, genes involved in melanogenesis can pleiotropically regulate the behaviour and physiology of an organism (Roulin 2014). It has been hypothesised that selective ecological and geographical factors influence the expression of this variant in some jaguar populations (Silva 2017), but evidence for an adaptive role is lacking (Schneider et al. 2015).

The jaguar is one of 14 wildcat species (Schneider et al. 2015, González-Maya et al. 2018) that exhibit "wild-type" and melanic phenotype coat colour (Majerus & Mundy 2003, Silva et al. 2017). A 15-base-pair in-frame deletion [mutation] in the MC1R gene favours the production of dark melanin in jaguars (Eizirik et al. 2003). The fact that this variant has been strongly associated with particular environmental factors (e.g. moist and dense forests, temperature), suggests that the spatial distribution of melanism in jaguars throughout its geographic range is nonrandom (Silva 2017).

Data on the ecology of jaguars in the cloud forests of Panamá is scarce. Here we present, to the best of our knowledge, the first records of melanism in jaguars from Panamá. The study area encompasses sections of the Comarca Guna Yala and Chagres National Park (Fig. 1). The habitat is characterised by old growth and secondary forest. It also includes a portion of the Mamoní Valley Preserve, comprised of fragments of primary and secondary forest, cattle ranches, agricultural lands, and tree plantations. The study area (200 km^2) is within the narrowest stretch of Panamá and includes the Cordillera San Blas (9°19'35.5261" E / -79°08'47.8356" N). The altitude ranges from 300 to 1,000 m and rainfall is >3,000 mm annually.

This report was derived from a long-term camera trap study undertaken by Kaminando between 2016–2018. During the two-year period, trapping efforts accumulated 16,583 trap nights from 48 camera stations, the number of trap nights per station averaged 345.5 ± 23.3 SE (49–597). A total of 153 independent records of adult jaguars were registered, 135 (88.2 %) were wild-type, and 18 (11.7 %) were melanistic (Table 1). Melanistic individuals were identified by enhancing each image to extract rosette patterns for comparison (Fig. 2).

In light of the hypothesis that polymorphic individuals utilise resources by exploring different niche dimensions (Forsman et al. 2008, Silva et al. 2016), our limited observations open avenues for discussion. First, we found that melanistic jaguars used the same environments as the wild-types, as several stations registered both phenotypes in the same time and space. In two separate occasions (one at night, the other in daylight), one melanistic and one wild-type individual were observed on camera, the melanistic form was identified as a female on both occasions. Second, both phenotypes exhibited cathemeral activity patterns. However, wild-types showed a higher percentage (63.7%) of diurnal activity (06:00–18:00 h), while melanistic jaguars showed a higher percentage (61.1%) of nocturnal activity (18:01–05:59 h), implying that nocturnal activity may have adaptive relevance in the cloud forest (Gloger 1833, Silva 2017). Third, activity patterns and habitat use by melanistic jaguars did not exhibit a clear association with a particular forest structure (i.e., primary, secondary forest and/or forest edge; Table 1).

Although we present the first report of melanistic jaguars in Panamá, anecdotal observations of this phenotypic variant have been known for decades by the Indigenous Guna Yala, local hunters, and/or there has been a lack of reporting by other studies. Nonetheless, the incidence of melanism in eastern Panamá fills the gap of records for the presence of black jaguars in the Americas. More importantly, it adds weight to the hypothesis of the prevalence of melanism in areas of high humidity, as originally proposed by Gloger (1833), and later by Silva (2017). Yet, begets more questions on how melanistic forms might use their environments differently from

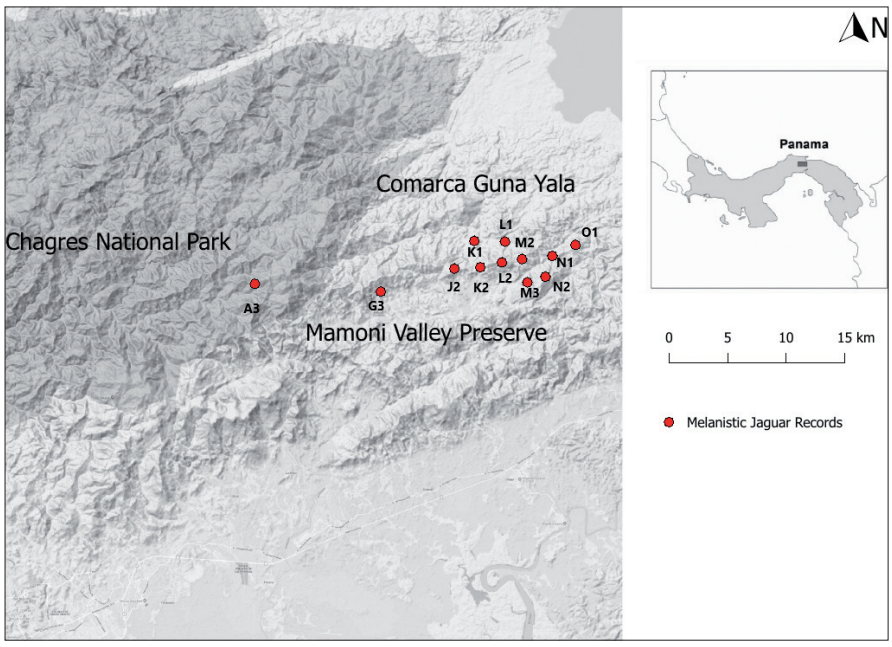

Fig. 1. Map of Panamá illustrating the study area and the distribution of camera-stations where melanistic jaguars were recorded during the 2016–2018 study period.

Table 1. Records of melanistic jaguars registered during a two-year monitoring programme (2016–2018) in eastern Panamá.

Record	Ind. ID	Station ID	Sex*	Date	Time	Season	Forest Type‡
1	12	K2	F	12/01/16	19:39:00	Dry	FE
2	13	K2	F	12/02/16	0:15:00	Dry	FE
3	37	M3	Unk	04/12/17	16:16:00	Dry	PF
4	40	N2	F	05/02/17	0:30:00	Wet	PF
5	49	M2	F	06/23/17	1:15:00	Wet	PF
6	152	G3	F	07/21/17	11:04:00	Wet	SF
7	51	N1	Unk	07/26/17	7:49:00	Wet	PF
8	41	A3	Unk	08/10/17	18:07:00	Wet	PF
9	153	G3	F	08/22/17	16:15:00	Wet	SF
10	83	L2	Unk	10/20/17	8:06:00	Wet	PF
11	61	A3	Unk	11/01/17	5:40:00	Wet	PF
12	77	K1	Unk	11/08/17	0:00:00	Wet	PF
13	78	K1	F	11/14/17	17:09:00	Wet	PF
14	148	O1	F	01/09/18	1:49:00	Dry	PF
15	139	J2	F	02/13/18	18:58:00	Dry	FE
16	140	J2	F	02/13/18	20:39:00	Dry	FE
17	107	L1	F	08/27/18	20:46:00	Wet	PF
18	108	L1	Unk	08/29/18	7:47:00	Wet	PF

* = Female - F; Unknown - Unk

‡ = Forest edge - FE; Primary forest - PF; Secondary forest - SF

wild-types (Allen 2010). Thus, our report emphasises the need for reporting, and calls for further investigation into jaguar ecology in this region, as the presence of melanism may be more common than suspected.

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Fig. 2. Melanistic jaguars (ID 13 and 37; Table 1) taken by remote cameras in the study area (Photos Kaminando Habitat Connectivity Initiative).

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