

Consecutive breeding failures by Black-chested Buzzard-Eagle *Geranoaetus melanoleucus* in southeastern Brazil

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Received 15 March 2025; final revision accepted 29 January 2026

Cotinga 48 (2026): 23–30

published online 20 March 2026

A águia-serrana *Geranoaetus melanoleucus* é o predador de topo nos céus de Belo Horizonte, Minas Gerais, Brasil. Doze anos após o último registro documentado de sua reprodução na Serra do Curral, novos dados sobre sua nidificação na localidade são apresentados e discutidos. Três diferentes ninhos foram monitorados durante as temporadas reprodutivas de 2018–20. Não eclosão dos ovos e morte prematura dos filhotes ocasionaram o fracasso reprodutivo ao longo dos três anos investigados. Além de analisadas as possíveis causas de falha na reprodução, são sugeridas propostas para a conservação da espécie na área de estudo e seu entorno.

Apex predators are species that feed at or near the top of the food web and are relatively free from predation once they reach their adult size^{47,54}. Many of the most iconic and charismatic species in the natural world, including some large raptors, fall into this category. Due to their fundamental roles in ecosystem functioning^{27,54}, apex predators' declines may severely impact landscapes and their biological communities¹⁵.

Black-chested Buzzard-Eagle *Geranoaetus melanoleucus* is a large South American accipitrid associated with rugged, open-country landscapes^{5,16}. The species is usually divided in two subspecies: *G. m. australis*, ranging from Venezuela to Tierra del Fuego, including the Andes and Patagonia; and *G. m. melanoleucus*, occurring in south, east and northeast Brazil, east Bolivia, Paraguay, Uruguay and northeast Argentina^{5,16,37}.

Geranoaetus m. australis is well known to science, mostly due to studies carried out in Chile and Argentina, with several aspects of its breeding biology already reported in the literature^{3,9,10,19,38}. On the other hand, little is known about the life history of *G. melanoleucus* beyond the Andean and Patagonian domains^{6,43,48,56}, with only two studies concerning nesting productivity reported in Brazil^{6,43}. Aiming to improve knowledge and provide new data on the breeding biology of *G. m. melanoleucus*, the present study reports three consecutive years of breeding failure on the Serra do Curral mountain ridge, which is contiguous with the city of Belo Horizonte, Minas Gerais, Brazil.

Study area

Belo Horizonte is the capital of the state of Minas Gerais, located in southeastern Brazil²¹ (Fig. 1A). Its metropolitan region, composed of 34 municipalities²¹, encompasses the transitional zone between the Atlantic Forest and Cerrado biomes, both considered global hotspots of biodiversity³⁴.

With more than 5 million inhabitants, it is the third most populated conurbation in Brazil²¹. Due to its geographic location, Belo Horizonte is influenced by mid-latitude and tropical climates, with two well-defined climatic seasons: a dry season from April to September, during the austral autumn and winter, and a rainy season from October to March, encompassing the austral spring and summer²⁸.

The Serra do Curral (Fig. 1B) is the official symbol of Belo Horizonte^{43,51}. It reaches 1,400 m in elevation, and is part of the meridional portion of the Espinhaço mountain range⁵¹. It is aligned northeast–southwest and represents the northern limit of the Quadrilátero Ferrífero mineral province¹². After nearly one century of mining exploitation⁴, parts of its slopes are definitively lost, leading to the extirpation of cliffs, rocky outcrops and stretches once covered by Cerrado, Atlantic rainforest and *campos rupestres* (rupestrian grasslands)⁵¹.

Data collection

Data were collected during the 2018, 2019 and 2020 nesting seasons of *G. melanoleucus* in the Serra do Curral. Monitoring was carried out from 26 May to 11 November 2018, from 6 August to 10 November 2019, and from 30 May to 2 November 2020. In total, 132 field surveys were completed, totalling 452 hours of monitoring nesting sites and their surroundings. Field surveys ranged from 30–420 min (mean = 205 ± 81 min) per day and were scheduled to ensure that at least two visits to the nest sites were carried out per week. On 71 occasions, both authors visited the study area together, whereas the remaining 61 surveys were carried out by one author, sometimes accompanied by field assistants.

To avoid possible risks to the breeding process^{18,42}, all observations of the nests and their occupants were carried out at 100 m distance using binoculars (10x50) and digital cameras (70x

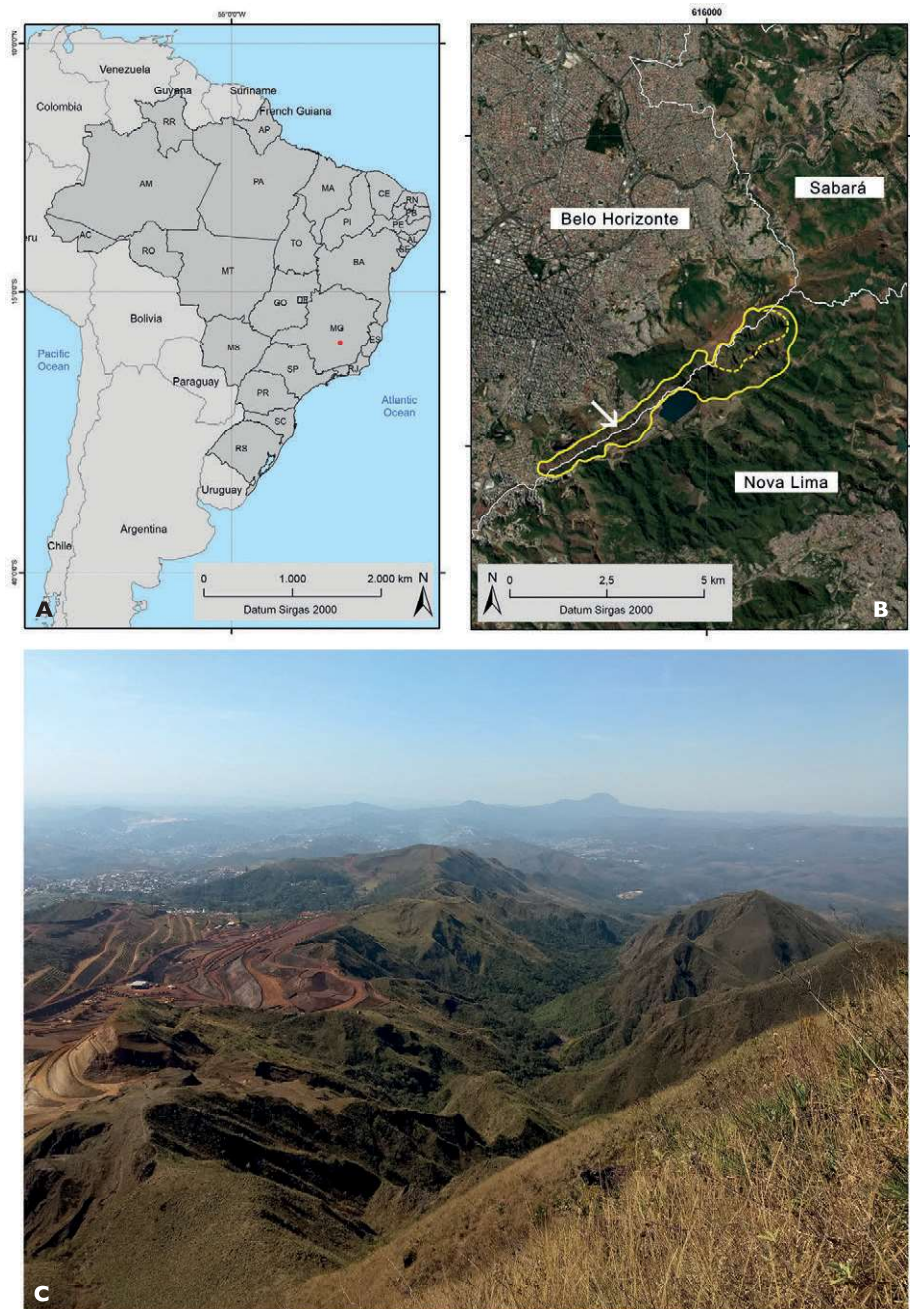


Figure 1. Study area at different spatial scales: **A** Municipality of Belo Horizonte (red dot), Minas Gerais, Brazil. Source data from Instituto Brasileiro de Geografia e Estatística (2020)²⁰; **B** Serra do Curral, Belo Horizonte, Minas Gerais, Brazil, with the estimated delimitation of its remaining slopes circled in yellow; the white arrow indicates the location of the Black-chested Buzzard-Eagle *Geranoaetus melanoleucus* nest-site investigated during the 1997, 2000, 2004 and 2005 breeding seasons; the yellow dashed line indicates the approximate limits of the valley sheltering the nests monitored in the present study. Source data from Prefeitura de Belo Horizonte (2020)³⁹; **C** View of valley at the east end of the Serra do Curral, showing the open-pit mine on the left, which is advancing towards the cliffs that shelter the nests monitored from 2018–20, on the right (Luiz Fernando Salvador-Jr.). Map produced by Leticia Oliveira Freitas, using free-to-use QGIS software (<http://www.qgis.org>) with an ESRI basemap. Satellite image © Esri. (Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.)