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Cover: Oil painting of Humpback Whale *Megaptera novaeangliae*. © R. Mahesh.



Preliminary observations on the breeding ecology and potential threats to Bonelli's Eagle *Aquila fasciata* in Sithagiri Malai, Tamil Nadu, India

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Abstract: Bonelli's Eagle (மொசலடிக்கி; meaning hare hunter) *Aquila fasciata* is a top predator experiencing population declines across its range. This study presents preliminary findings from a periodic survey (April 2024–May 2025) in Sithagiri Malai, a rocky outcrop in Tamil Nadu, India. We document the presence of breeding territory, potential prey species, and discuss imminent threats, particularly from windmills, emphasising the ecological value of rocky outcrops for the species in this landscape.

Keywords: Accipitridae, Accipitriformes, bioindicators, power line collisions, raptors, rock outcrop, wind turbines.

Raptors are indicators of environmental health and are keystone species (Kitowski et al. 2017), vital for maintaining ecosystem balance. As apex predators, they help regulate prey populations, preventing overgrazing, and agricultural damage (Donázar et al. 2016). Globally, 18% of raptors are threatened with extinction and 52% exhibit declining populations (McClure et al. 2018), making demographic studies crucial for their conservation (Byju et al. 2023).

The Bonelli's Eagle *Aquila fasciata* is an uncommon resident throughout the Indian subcontinent from plains to 2,600 m (Ali & Ripley 1987; Rasmussen & Anderton 2012). It is a cliff-nesting raptor with fragmented distribution across the Palearctic, Indo-Malayan, and marginally Afrotropical regions (Di Vittorio et al. 2017;

Birdlife International 2020). Breeding period varied in the western range (January–July); Indo-Malayan region (November–September) (Ferguson-Lees & Christie 2001), and Indian region (December–May) (Ali & Ripley 1987; Ontiveros 1999; Rasmussen & Anderton 2012). Bonelli's Eagle is a long-lived, territorial, and monogamous species. The nest is a massive platform built on cliffs or on tall trees and reused in successive years (Hernández-Matías et al. 2011). Rocky outcrops provide critical nesting habitat for this species, offering inaccessible cliff faces that protect nests from mammalian predators (Fitzsimons & Michael 2017).

The population is declining drastically throughout its range owing to over-use of pesticides, habitat degradation, loss of prey species, collision with power lines, and persecution by hunters & pigeon fanciers (Ferguson-Lees & Christie 2001; Bharos & Pare 2023). This study reports initial observations on Bonelli's Eagle breeding in Sithagiri Malai, focusing on its potential threats. This study emphasizes the conservation significance of this rocky hillock as a potential breeding area for birds, despite growing anthropogenic pressures, including rock mining in the vicinity.

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OBSERVATIONS

Breeding was recorded in Sithagiri Malai, Kuppanavalasu, Tamil Nadu (approx. 10.45° N, 77.72° E), a rocky outcrop with elevations ranging from 287–376 m (Image 1). This hill supports moderate dry-deciduous scrub vegetation. Sithagiri Malai comprises at least three sacred temples, one of which is a cave temple that hosts a bat population. Natural water holes locally called ‘Paali’ and ‘Sonai’ are present here; the former has served as a water source for people and cattle, and the latter is used as a sacred water to treat illness until the mid-20th Century. The area is surrounded by grasslands either with bio-fences or fenced with granite poles, agricultural lands, and villages. The region receives the north-east monsoon from October–December, and summers last from March–June with occasional summer showers. Geographically, it lies ~100 km east of the Palakkad Gap, leading to strong westerly winds during the south-west

monsoon season (June–September).

Field visits were carried out from April 2024 to May 2025, at fortnightly intervals, every month. The bird’s behaviour was recorded from 0700–0900 h and 1600–1800 h. Observation was carried out at a distance of at least 250 m to avoid disturbance through a Nikon Aculon binocular (8 × 42). Photographic documentation was done using a Nikon P950 camera.

With information from local villagers, the activity of Bonelli’s Eagle was followed. We confirmed the first breeding record of this species from the area, and the breeding season is from December–March (Bharos & Pare 2023). A detailed chronological follow-up of some field observations of nesting details is given separately in Table 1. Sithagiri Malai breeding territory is consistent with the species’ preference for rocky, arid to semi-moist habitats (Ferguson-Lees & Christie 2001). A nest, composed of sticks and approximately 1.5 m in

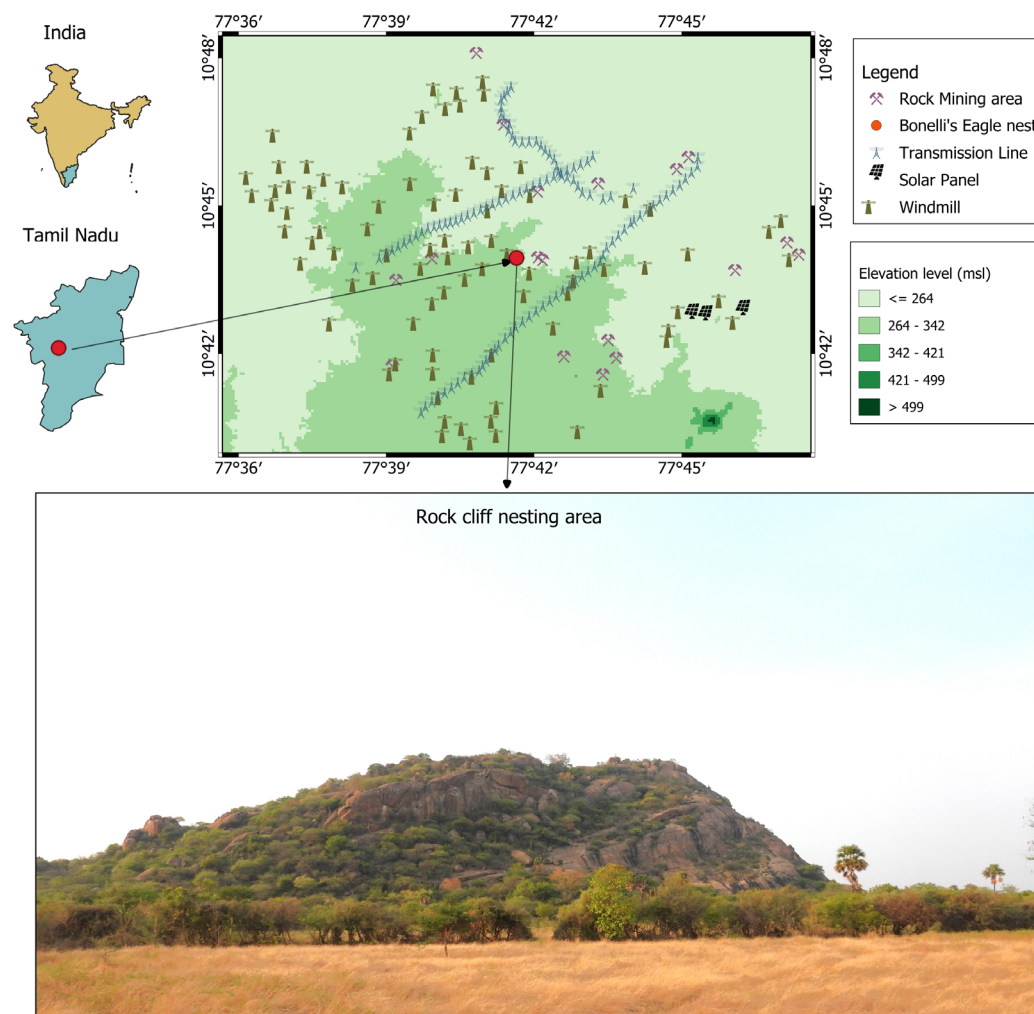


Image 1. Map showing the nesting area of Bonelli’s Eagle surrounded by windmills, electric lines, solar panels, and mining areas.

Table 1. Summary of observations on the nesting Bonelli's Eagle.

Date of observation	Time of observation	Activities and behaviour
09.iv.2024	0700–0900 h	Two adult birds were taking advantage of the thermal current upwind and actively scanning for prey. Then the female bird perched on the rocks looking for food.
18.viii.2024	0700–0900 h	Observed both male and female roosting on a single tree. Remnants of an old nest are observed on the rock cliff.
29.xii.2024	0700–0900 h	One adult was observed roosting in a tree and grooming.
16.i.2025	0700–0900 h	Nest looks in good shape with a reinforced base on an inaccessible cliff face. Approximately 1.5 m in diameter.
22.ii.2025	0700–0900 h	The male was perched on the rock in the vicinity of the nest. The female was seen inside the nest; chicks or eggs were not visible.
27.iii.2025	1600–1800 h	Two fledglings were seen inside the nest with dropped wings. A male was seen guarding the nest from the rock situated above it.
28.iii.2025	0700–0900 h	The female was feeding two chicks inside the nest. Prey was recorded from the bottom of the cliff.
26.iv.2025	0700–0900, 1600–1800 h	Initially, the fledglings, which have become juveniles, were seen with adults in flight. Then, one juvenile was seen roosting in a tree. The juveniles were seen soaring very close to the adults. On the ground, the juveniles were still dependent on the adult for food.
15.v.2025	0700–0900 h	Two of the juveniles were flying together and engaged in aerial combat a couple of times. One was trying to catch an Asian Palm Swift. At previous night, the nearest temple had crackers for the festival.

**Image 2. Nest of Bonelli's Eagle on the rock cliff: A—juveniles | B—adults. © S. Naveen Kumar.**

diameter, was located on a remote cliff ledge (Image 2). The surrounding landscape, including grasslands and agricultural fields, likely serves as foraging areas, as eagles often hunt several kilometers from the nest.

Adult male is dark brown above with a capped head and a white patch on the back. The tail is grey, obscurely barred, with a broad sub-terminal band; white below with thin streaks, broader on breast/flanks, bars on belly/crissum. During flight, below the white body, a black band on the linings; obscure dark trailing edges to greyish remiges; a subterminal band on paler tail. Above white on back; grey tail, dark band. Adult female—flight below smaller; quills more clearly barred; belly/thighs/crissum more boldly marked (Ferguson-Lees & Christie 2001).

From both our field observations and local villagers' accounts, the potential prey species identified included

Indian Hare *Lepus nigricollis*, Bonnet Macaque *Macaca radiata*, Grey Francolin *Ortygornis pondicerianus*, Rock Bush Quail *Perdica argoondah*, and domestic poultry. The presence of the Grey Slender Loris *Loris lydekkerianus* and Bengal Monitor Lizard *Varanus bengalensis* suggests a diverse prey base (Image 3). Potential predators of the eagle chicks include Indian Golden Jackal *Canis aureus*, Jungle Cat *Felis Chaus*, and Rock Eagle-Owl *Bubo bengalensis*, the latter being a known predator of Bonelli's Eagle chicks in other regions (Image 4).

POTENTIAL CONSERVATION THREATS

The primary threats identified are linked to energy infrastructure and habitat modification.

Bonelli's Eagle nesting area is in proximity to windmills, and the birds are often observed flying around



Image 3. A few prey species observed near the Bonelli's Eagle nest: A—Bonnet Macaque | B—Indian Hare | C—Grey Slender Loris. © S. Naveen Kumar.

it for foraging. The region's high wind potential, ideal for energy development, poses collision risks for raptors like Bonelli's Eagle, which engage in kiting and stooping while hunting (Smallwood & Thelander 2008; Skarabal et al. 2025), limiting maneuverability, and increasing collision risk (De Lucas et al. 2008), as they might lose track of



Image 4. A few predators observed around the Bonelli's Eagle nest: A—Indian Golden Jackal | B—Rock Eagle-owl. © S. Naveen Kumar.

their wind turbine position (Krijgsveld et al. 2009). While the present study focuses on nesting ecology rather than mortality assessment, the proximity of active wind turbines to known nesting and flight corridors warrants caution. Incorporating bird flight height data and seasonal activity patterns could help avert future bird and bat collision risk assessments, which would be essential for accurately quantifying turbine-related threats to Bonelli's Eagle populations in the Dindigul landscape. In the Western Ghats (Karnataka and Maharashtra), most victims of this collision were land birds such as Bonelli's Eagle, Changeable Hawk Eagle *Nisaetus cirrhatus*, and Black Kite *Milvus migrans* (Kumar et al. 2019, 2022).

Electrocution on poorly designed power pylons and collision with power lines are leading causes of mortality for Bonelli's Eagles globally (Hernández-Matías et al. 2015). Even though we did not observe any electrocution of the species, the existing and expanding network of electric pylons in the landscape poses a potential risk, as electrocution of raptors is

increasingly reported (Manigandan et al. 2022). The conversion of traditional bio-fences to impermeable granite stone walls reduces microhabitats for prey species. The sacred and cultural significance of Sithagiri Malai (e.g., cave temples, water holes) may offer some protection, but rising anthropogenic pressure remains a concern. The emerging threat to this rocky outcrop is the potential impact of climate change, as species inhabiting mountain regions are predicted to be adversely affected by rising temperatures and reductions in bioavailable water (Fitzsimons & Michael 2017). Cattle grazing and firewood collection are not observed, but bird poaching is still reported by locals, along with honey gathering. Presently, there is no mining, but we observed that the sounds created by nearby rock mines created panic for peafowls. This is not impacting the nesting of eagles, at present. The bio-fence of the grassland patch, which is being converted to a metal fence with granite stone, is reducing hiding spots for several reptile, mammal, and bird species. Currently, no conservation outreach, either by villagers or NGOs, is active. Hence, immediate conservation measures are warranted.

CONCLUSION

Sithagiri Malai provides a critical breeding habitat for the Bonelli's Eagle in Tamil Nadu. The confirmed nesting site and diverse prey base highlight this rocky outcrop ecosystem's high conservation value.

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