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Short Communication

Camera-trap evidence of repeated ground-sunning by white-fronted nunbirds *Monasa morphoeus*

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Abstract

Terrestrial comfort behaviour is poorly documented in puffbirds. We examined 199 photographs of white-fronted nunbirds *Monasa morphoeus* obtained incidentally by an unbaited camera trap in lowland rainforest in Madre de Dios, Peru, between 2 August and 23 September 2016. Events were considered independent when more than 60 minutes had elapsed since the preceding photograph. The images formed 20 temporally separated events on 16 dates, with up to three birds visible together. In five events (104 photographs), birds repeatedly crouched or lay prone on exposed soil, sometimes spreading a wing or the tail and changing posture within a sunlit patch. No image showed an unequivocal dust cloud, a nest entrance, excavation, or transport of nest material. The posture and use of direct sunlight are most consistent with ground-sunning, although dust-bathing cannot be excluded from the photographs. To our knowledge, no previous account has described ground-sunning in *M. morphoeus* or another *Monasa*. The 53-day series indicates that the patch was used repeatedly for probable comfort behaviour rather than during a single chance visit.

Keywords Bucconidae, *Monasa morphoeus*, camera trap, comfort behaviour, rainforest, sunning

Sunning and dust-bathing are both commonly regarded as comfort or plumage-maintenance behaviours (Kruijt 1964; Kennedy 1969; Poulsen 1974), but they differ in posture and movement. Sunning postures vary among taxa, but a common high-intensity form involves crouching or lying with the back toward the sun, fluffing the body feathers, spreading one or both wings, and remaining relatively still (Kennedy 1969; Poulsen 1974;

Sazima 2015). Dust-bathing is more dynamic and typically involves crouching or lying in loose substrate, ruffling the plumage, and rapid, repeated movements of the body and wings that stir substrate into the feathers (Kruijt 1964). Proposed functions include feather maintenance, thermoregulation, and ectoparasite control, although the supporting evidence differs among behaviours, species, and mechanisms (Cade 1973; Clayton et al. 2010; Koop et al. 2012). Such behaviours can be difficult to observe in forest birds that spend most of their time above ground.

The white-fronted nunbird *Monasa morphoeus* (Bucconidae) inhabits tropical forest from Central America to South America and is usually encountered in the forest midstorey and subcanopy, often in pairs or groups (Rasmussen and Collar 2020). The species forages mainly by sallying from perches, but it also excavates nesting tunnels in level or sloping ground (Pérez Arrieta 2007; Rasmussen and Collar 2020). Because this terrestrial nesting habit could also produce repeated ground detections, we treated nesting-related activity as an alternative explanation. Sunning has been reported in Bucconidae (Rasmussen and Collar 2002), but we found no published description of this behaviour in *M. morphoeus* or any other species in the genus *Monasa*. Here we describe repeated terrestrial behaviour recorded by a camera trap in the Peruvian Amazon and assess whether the photographs support sunning, dust-bathing, nesting-related activity, or another interpretation.

All behavioural records analysed here came from camera station R17 in lowland Amazonian rainforest in Madre de Dios, southeastern Peru (12°56′51″S, 69°24′55″W; approximately 220 m a.s.l.). The station formed part of AmazonCam Tambopata, a mammal-focused survey that deployed 85 Bushnell Trophy Cam HD cameras across a 300-km² grid (Egna et al. 2020). At R17, the camera was installed approximately 50 cm above ground on an unbaited trail and operated continuously. It was programmed to record three photographs per trigger at normal sensor sensitivity (Egna et al. 2020). The trigger interval between consecutive trigger events was 10 min. The bird photographs were incidental records.

Across the catalogued avian bycatch, we found 209 photographs identified as *Monasa morphoeus* at four camera stations. Of these, 204 were from R17: 199 were taken between 2 August and 23 September 2016, and five were taken in February–March 2017. The remaining five photographs came from three other stations. We restricted the behavioural analysis to the 199-photograph series recorded at R17 in 2016. The ten additional photographs showed only upright birds, movement through the camera's field of view, or severe overexposure, and were therefore excluded from the behavioural series. We identified the birds from the diagnostic white forehead, red-orange bill and dark plumage visible in the clearest photographs, using the species description and colour plates in Birds of Peru (Schulenberg et al. 2010).

A new event began when more than 60 min had elapsed since the preceding photograph. This rule produced temporally separated sampling units. For each event, we calculated a minimum detection window as the elapsed time between the first and last photograph.

Because photographs were recorded discontinuously, these windows do not represent continuous attendance or behavioural duration. We therefore treated the number of photographs only as a sampling descriptor rather than as a measure of behavioural intensity or duration. For each event, we also recorded the maximum number of birds visible and scored five features from the full sequence: low or prone posture, wing or tail extension, apparent movement of the substrate, visible airborne dust and image quality. We looked additionally for pecking, a tunnel entrance, excavation and transport of nest material. The photograph-level catalogue and event-level dataset are provided in Online Resource 1, and the complete set of 199 photographs is provided in Online Resource 2.

Representative photographs from the focal series are shown in Fig. 1. The photographs were taken between 2 August and 23 September 2016 and formed 20 events on 16 calendar dates. Intervals between successive events ranged from 69 min to 11 days; detections occurred between 09:49 and 16:35 h (Fig. 2). In seven events, one bird was visible; in six events, two birds were visible; and in seven events, three birds were visible.

Five events, comprising 104 photographs, provided the clearest evidence of comfort behaviour. These occurred on 3 August (two events), 12 August, 14 August and 16 August. In chronological order, their minimum detection windows were 60 min 25 s, 37 min 49 s, 9 min 53 s, 37 min 27 s and 15 min 5 s, respectively. Birds repeatedly crouched or lay prone in the same patch of exposed soil and changed orientation between photographs (Fig. 1). In several sequences, the body feathers were loose, and a wing or the tail was partly spread. Up to three birds occupied the patch together. Five additional events contained low postures but lacked wing or tail extension or another diagnostic feature. Eight events showed only ground presence, and two could not be interpreted because of overexposure.

The repeated prone postures and extended flight feathers resemble descriptions of sunning, and the birds usually occupied the sunlit portion of the patch. The sequences also appear more static than the rapid, alternating movements of the body sides and wings described during dust-bathing (Kruijt 1964). However, the camera recorded discontinuous bursts of still photographs rather than video, so rapid movements could have occurred between frames. Consequently, the absence of unequivocal dust clouds or visible dust on the plumage cannot by itself exclude dust-bathing. We therefore interpret the clearest events as probable ground-sunning, while recognising that the photographs do not permit a definitive behavioural classification.

Nesting-related activity is unlikely to explain the recorded postures. Although *M. morphoeus* excavates ground tunnels and may attend nests socially (Pérez Arrieta 2007), no tunnel entrance was visible within the photographed patch, and none of the sequences showed excavation or transport of nest material. Instead, in the clearest events the birds crouched or lay on the exposed surface, sometimes with a wing or the tail partly spread, which is more consistent with comfort behaviour than with excavation or nest attendance. Some nondiagnostic events may nevertheless represent foraging, resting or simple movement along the trail.

Although the available avian bycatch contained records of *M. morphoeus* at four camera stations, repeated low or prone behaviour was observed only at R17. The photographs show exposed, apparently dry soil illuminated by discrete patches of direct sunlight against a largely shaded forest floor (Fig. 1), consistent with sunflecks produced when predominantly direct-beam radiation passes through canopy openings (Chazdon 1988). The overall 09:49–16:35 h detection period overlaps the middle-of-day interval in which sunflecks commonly reach tropical forest floors (Chazdon 1988); however, because irradiance was not measured and this range includes nondiagnostic events, event timing alone does not demonstrate the use of sunflecks. Canopy structure can nevertheless strongly influence the duration and frequency of sunflecks (Chazdon 1988; Reis et al. 2021). The local light environment may therefore have made R17 suitable for terrestrial comfort behaviour. However, canopy openness, irradiance, soil properties, microtopography and the availability of comparable patches at other stations were not measured, and the minimum detection windows do not estimate sunfleck duration. In addition, the incomplete bycatch catalogue and absence of marked individuals prevent a formal test of site selection or population-level behavioural frequency. The series therefore demonstrates repeated use of this particular forest-floor patch over 53 days, rather than selection of R17 relative to other stations. These observations illustrate how avian bycatch from mammal-focused camera-trap surveys can fill persistent natural-history gaps for hard-to-study Neotropical birds, as also shown by Arana et al. (2024) for high-intensity sunning in five Accipitridae species in Madre de Dios.

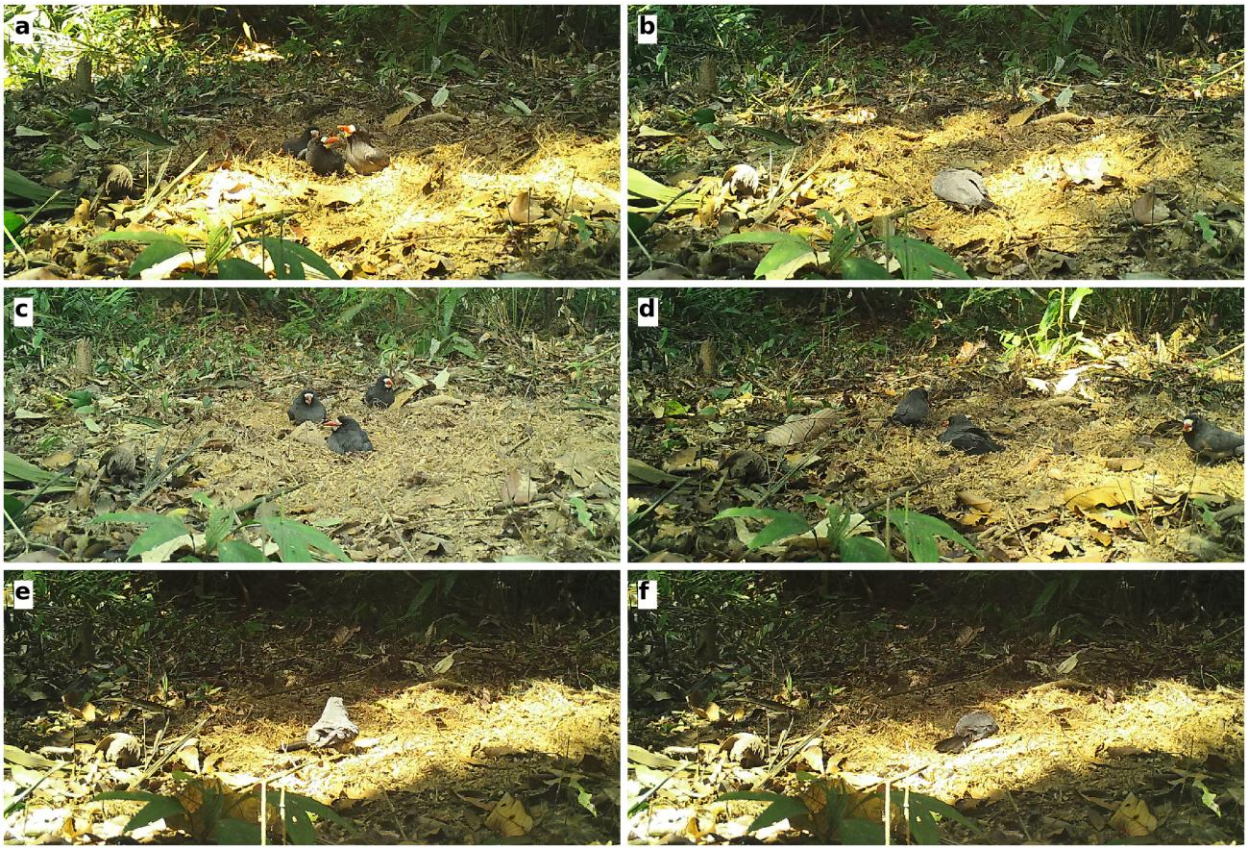


Fig. 1 Representative camera-trap photographs of white-fronted nunbirds *Monasa morphoeus* at station R17 in Madre de Dios, Peru. (a, b) Birds crouched in a sunlit patch; (c) three birds at the same patch; (d) prone and upright birds; and (e, f) a bird with the body lowered and flight feathers exposed. Images were cropped from camera-trap originals

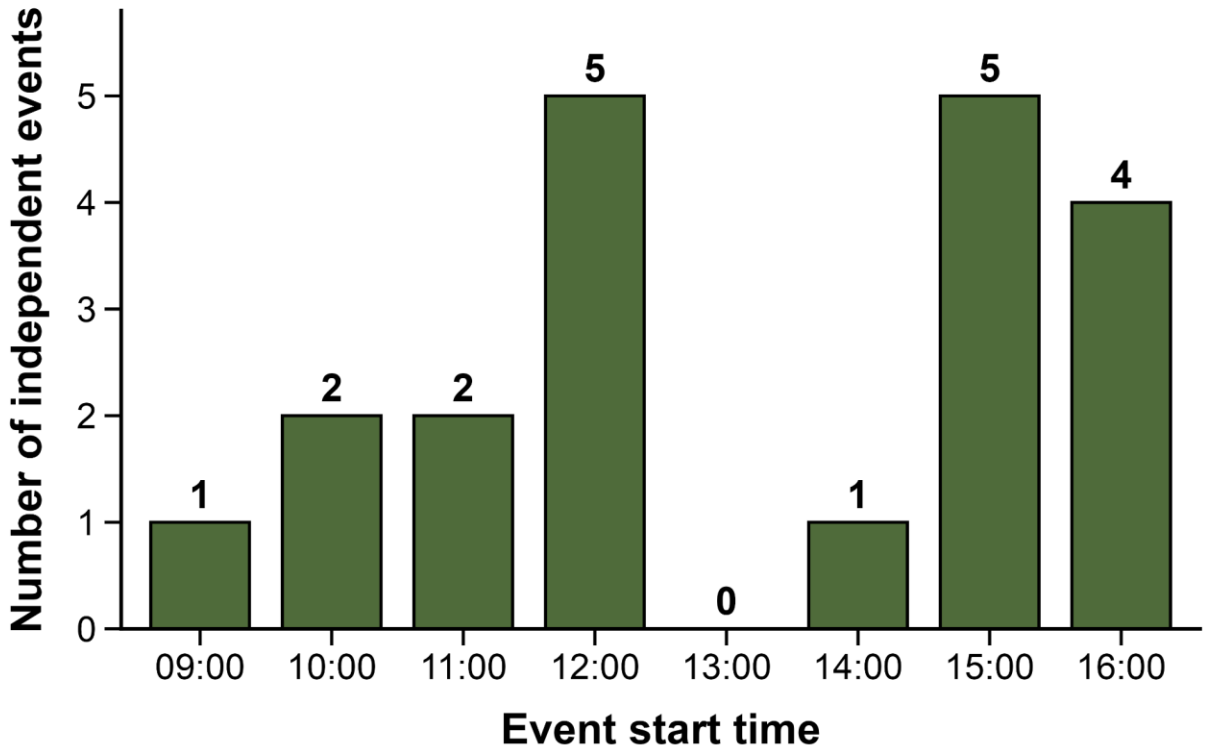


Fig. 2 Hourly distribution of the start times of 20 independent camera-trap events of white-fronted nunbirds *Monasa morphoeus* at station R17, Madre de Dios, Peru, between 2 August and 23 September 2016. Bars show the number of events beginning in each 1-h interval; numbers above the bars indicate event counts. Events were considered independent when more than 60 minutes had elapsed since the preceding photograph.

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Author contributions: Conceptualization: Juan Esteves and Letty Salinas; Methodology: Juan Esteves, Samia Carrillo-Percastegui, Mark Bowler and Mathias W. Tobler; Investigation: Juan Esteves, Alejandra Arana, Samia Carrillo-Percastegui, Mark

Bowler and Mathias W. Tobler; Data curation: Juan Esteves, Alejandra Arana and Mathias W. Tobler; Formal analysis: Juan Esteves and Alejandra Arana; Visualization: Juan Esteves; Writing – original draft: Juan Esteves; Writing – review and editing: Juan Esteves, Alejandra Arana, César Arana and Letty Salinas; Resources: Mark Bowler, Mathias W. Tobler and Letty Salinas; Project administration: Mark Bowler, Mathias W. Tobler and Letty Salinas; Funding acquisition: Mark Bowler and Mathias W. Tobler; Supervision: César Arana, Mathias W. Tobler and Letty Salinas.

Data availability: Online Resource 1: Photograph-level catalogue and event-level dataset for the 199 focal photographs analysed in this study. Online Resource 2: Complete set of 199 camera-trap photographs of *Monasa morphoeus* recorded at station R17 between 2 August and 23 September 2016

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