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PRESS RELEASE

White owls becoming invisible in moonlight: new study looks into their nocturnal camouflage

- The striking white colour of the barn owl (*Tyto alba*) might be an adaptation that makes it harder for its prey to spot when it flies against the night sky.
- This seemingly paradoxical claim is the conclusion of an interdisciplinary scientific study led by the Doñana Biological Station – CSIC recently published in the journal *PNAS*.



Barn owl in full flight / Istock



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Seville, 16th December 2024. Animals need to blend into their surroundings to avoid detection, whether they are prey or predators. However, camouflage is generally considered a daytime phenomenon, relying primarily on light and shadow. But can an animal camouflage itself at night, beyond the cover of darkness?

A new study published in the journal PNAS and led by the Doñana Biological Station – CSIC, addresses this question by investigating the paradox of the barn owl's coloration. The barn owl, with its striking white plumage, stands out from other nocturnal raptors, which have complex feather patterns that clearly camouflage them in their environment. While the barn owl's flight is as silent as any other owl's, its white ventral plumage, far from being discreet, could alert its prey. According to the new study, however, this is not necessarily the case.

"We worked with the hypothesis that the barn owl's plumage could represent a new form of nocturnal camouflage," explains Juan J. Negro, a specialist in behavioral ecology and researcher at the Doñana Biological Station – CSIC. "The owl's concealment during hunting flight would be achieved when its contrast against the sky is below the threshold of detection of objects in the sky by its prey, typically rodents searching for food on the ground."

The condition of near "invisibility" for an unsuspecting mouse, as proposed by the researchers, generally does not hold true on completely overcast or moonless nights, known as isotropic skies. However, on clear nights, the isotropy of the sky's glow disrupted by the presence of the moon. This creates a balance between the light of the celestial dome behind the owl and the light reflected by the owl towards the ground where its prey is located. In this way, the owl can become nearly undetectable to the mouse, which is often too late to escape by the time it sees the owl.

The coloration of the owl's ventral plumage naturally varies from snowy white to orange. These findings align with previous observations in other studies suggesting that on full moon nights, the whitest owls manage to catch more prey than the darker ones.

"We examined the effectiveness of the owls' white plumage as a means of camouflage while hunting, taking into account the radiometric properties of the sky, the ground, and the owls themselves, as well as the visual system of the mouse, which differs from that of humans," says astrophysicist David Galadí, a researcher at the University of Córdoba and co-author of the study. "Our model shows that as long as the moon is above the horizon in any of its phases, an owl in flight can approach rodents from wide regions of the night sky, always remaining below the detection threshold of the mouse's particular visual system."

Specifically, this study shows that white plumage of owls acts as effective camouflage adapted to a moonlit sky background, providing a new foundation for understanding nocturnal camouflage in other species.

The implications of this multidisciplinary work go beyond camouflage itself, as explained by Carlos Camacho, a specialist in the study of nocturnal species and researcher at the Doñana Biological Station: "Lighter and darker owls in a population might choose different times to hunt, aligning with lunar conditions that maximize the hunting efficiency of each. This temporal mismatch could make it harder for owls of different colors to pair up, even though they share the same space."

The study also suggests that increasing light pollution could interfere with the natural functioning of ecosystems in unexpected ways, as it enhances the brightness of the night sky in a way that counters the camouflage provided by the white plumage of owls, making the predator more visible to its prey.

The study involved the participation of both biologists from the Doñana Biological Station and physicists from other institutions. For example, the radiometric studies of the owl's white plumage were conducted using sophisticated measurement systems in CSIC laboratories in Madrid and at the University of Granada. The

radiometry and photometry of the moonlit sky were estimated using a calculator that provides various indicators of sky brightness based on the moon's height above the horizon, in phase, atmospheric aerosol content, and soil albedo. This calculator was developed by Eduard Masana from the Institute of Cosmos Sciences at the University of Barcelona (ICCUB) and the Institute of Space Studies of Catalonia (IEEC), along with Salvador Bará, an independent researcher, in collaboration with Carmen Bao-Valera from the University of Santiago de Compostela.

Reference:

Juan J. Negro, Salvador Bará, David Galadí-Enríquez, Juan Luis Nieves, Miguel A. Martínez, Alejandro Ferrero, Joaquín Campos, Carmen Bao-Varela, Eduard Masana¹, and Carlos Camacho. Nocturnal camouflage through background matching against moonlight. *PNAS*.
<https://doi.org/10.1073/pnas.2406808121>