

# Fragmented forests and human disturbances create stress in Asian elephants

Shweta Yogi

1 Oct 2025 West Bengal Beyond Protected Areas

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- A new study shows elephants living in fragmented habitats in central India and facing frequent encounters with humans experience significantly higher physiological stress compared to those in more natural landscapes.
- Underlying physiological changes often drive behavioural alterations in elephants and understanding this connection helps interpret animal responses better.

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Driven by habitat loss, human activities and climate change, Asian elephants are increasingly forced to navigate human-dominated landscapes, often resorting to crop foraging to meet their nutritional needs. Elephants adjust their foraging behaviour, social interactions, and even vocal communication, to adapt to human presence. But how do these adjustments affect them internally? A [new study](#) published this year in *Scientific Reports* reveals that elephants facing frequent human interference exhibit significantly higher levels of physiological stress compared to those living in more natural habitats.

According to the corresponding author of the study, professor Raman Sukumar from the Centre for Ecological Sciences, Indian Institute of Science, elephant-human interactions vary significantly across different regions, ranging from passive and active deterrents to aggressive retaliation. "Elephants are already under stress from shrinking habitats. Aggressive human responses to crop-raiding can further amplify their stress, often more than human presence alone," he says.

## Monitoring physiological stress

Glucocorticoid hormones produced by the adrenal glands of elephants are crucial in stress response, making them key indicators of how they physiologically adjust to human disturbances. Similarly, thyroid hormones, particularly triiodothyronine (T3), reflect the metabolic state of animals facing nutritional stressors.

Sanjeeta Sharma Pokharel, Assistant Professor at Kyoto University's Hakubi Centre and lead author of the paper, has been [analysing elephant dung](#) to understand trends in the faecal levels of glucocorticoid metabolites and T3 (fGCM/ft3) in relation to regional habitat fragmentation, human responses, and dietary variations. She collected fresh dung samples after elephants defecated and moved on, during the peak crop-foraging period that coincides with crop harvest, allowing a more accurate evaluation of human-elephant interactions. "This non-invasive method allows me to monitor the health of elephants without disturbing them or altering their natural behaviours," she explains.



Researchers collect elephant dung samples in the Jalpaiguri plantation area to understand trends in the faecal biomarkers in relation to regional habitat fragmentation, human responses, and dietary variations. Image courtesy of Sanjeeta Sharma Pokharel.

## Regional stress variations and triggers

Pokharel and Sukumar's [previous study](#) showed that crop-foraging elephants in southern India show lower levels of fGCM compared to elephants in undisturbed natural habitats. According to Sukumar, the nutritional benefits of crops and the ease of foraging likely offset the stress caused by human exposure. He adds that the presence of contiguous forest stretches and comparatively non-aggressive human responses in southern India may also explain the lower stress levels.

On the other hand, Pokharel's recent fieldwork in South Bengal's Medinipur and Kharagpur districts — part of central India's highly fragmented elephant range — revealed significantly higher levels of fGCM (~2-fold) and lower ft3 (~2-fold), compared to samples from elephants in southern India and the relatively less fragmented habitats of North Bengal belonging to the Northeast population, including Jalpaiguri/Gorumara and Buxa/Jaldapara National Parks. The levels of fGCM did not vary significantly between samples obtained from elephants in southern and northeastern landscapes, likely due to lesser human disturbances and the presence of protected areas.

In contrast to southern India, central India is marked by highly fragmented habitats, sprawling agriculture, human disturbances, and a growing elephant population — factors that contribute to more frequent and often intense human-elephant conflicts. Furthermore, hostile human responses are more common in central India, where large groups of people chase elephants, pelt stones, and form '[hula parties](#)' or community groups that use flaming torches, fireballs, iron rods, or spears to drive elephants away from farms. According to Anukul Nath, from the Elephant Cell at the Wildlife Institute of India, such practices severely disrupt natural elephant movement, increase the risk of injury to both elephants and humans, undermine mitigation planning, and escalate conflict.

"[Forest department-coordinated hula parties](#) can drive elephants as far as 20 kilometres, often splitting herds and separating calves, further adding to their physiological distress," explains Honnavalli N. Kumara, Principal Scientist at the Salim Ali Center for Ornithology and Natural History, who has been studying [human-elephant conflicts in South Bengal](#). He adds that retaliatory killing — through poisoning or electrocution — has also been reported in response to human fatalities and economic losses.

Pokharel shares a disturbing encounter when hundreds of villagers in Kumarpada, North Bengal, chased a stranded sub-adult elephant that had separated from its herd, in a tea garden, before forest officials could intervene. In another instance, she also visited a home in Godapiasal, South Bengal, just hours after an elephant had chased the owner during the night and damaged the property. It was an experience that underscored how people living alongside elephants also face constant fear, just as elephants fear the hostile human crowds. “It feels like a delicate and ongoing tug of war, shaped by both ecological and socio-economic pressures,” Pokharel adds.



A home that has been damaged by crop-raiding elephants in south Bengal. Image by Human & Environment Alliance League.



A mob uses flaming torches and fireballs to drive away elephants from their farms in a hula drive in Jhargram district. Image by Human & Environment Alliance League.

### **Health consequences and risks**

While the risk associated with foraging was balanced by nutritional gains for elephants in the south, the diet of elephants in central India was poorer in quality. This was evident from a higher fecal carbon to nitrogen (C/N) ratio – indicating a diet rich in insoluble fiber with limited nutritive value, and low in proteins required for growth and health maintenance. Conversely, elephants in the southern and

northeastern landscapes had a lower fecal faecal C/N ratio, reflecting a more nutritious and protein-rich diet.

Pokharel further noted that elephants in central India were frequently chased from plantations and had little forest cover to seek refuge and rest. To avoid human encounters, they often resorted to brief foraging bouts during the late-night or early morning hours. This altered foraging behaviour, combined with harsh conflict management practices, may contribute to the observed increase in stress levels, reduced metabolism and poor nutrient absorption, posing long-term risks to their health, reproduction, and population dynamics. “Behavioural alterations are often driven by underlying physiological changes, and understanding this connection is key to interpreting animal responses more holistically,” she adds.

## Challenges and mitigation strategies

Expanding mining activities and energy projects forced elephants to migrate to South Bengal from Jharkhand and Odisha in the 1980s. However, vegetation in the region is dominated by sal trees, and the lack of suitable natural habitat and food has increased their dependency on crops, making these regions a hotspot for conflicts, explains Kumara.

According to Sukumar, about 150-200 elephants in South Bengal are responsible for almost the same number of human deaths as 5,000-6,000 elephants in the Mysore Elephant Reserve of Southern India, highlighting the disproportionate impact of human-elephant conflict .

While electric fencing and enclosed compounds can help protect crops, their broader impact on elephant behaviour and well-being must be carefully considered. He suggests that in regions like South Bengal, contraceptive strategies could be a viable approach to managing the growing elephant population.

Nath explains that effectively mitigating human-elephant conflicts in such regions, characterised by fragmented forests, growing elephant populations, and vulnerable rural livelihoods, requires both modern technology and strong local participation. “Real-time monitoring of elephants using radio collars and GPS tracking, AI-enabled camera traps, drones, thermal imaging, and early-warning systems — such as mobile apps or automated alerts — can help inform villagers of elephant movements and improve community vigilance,” he adds.

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Read more: [Expanding elephant range fuels human-wildlife conflict](#)

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**Banner image:** Elephants raid paddy fields at night in Jhargham district as farmers watch. Image by Human & Environment Alliance League.

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