

Examining the intersection of thrush nightingales, territoriality and testosterone

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Scientist Léna de Framond during field research in Tanzania: With a large microphone and binoculars, she studies the behavior and song of thrushes. Credit: Max Planck Institute for Biological Intelligence / Henrik Brumm

Under the Tanzanian skies, some thrush nightingale males reside in close proximity to each other, a striking contrast to their territorial behavior during breeding season in temperate zones. With the end of winter, a dual transformation unfolds in the birds: the emergence of full songs and territorial behavior.

Over five years, researchers from the Max Planck Institute for Biological Intelligence decoded their connection in the birds' winter quarters. They could show that the annual melodious development of [song](#) intertwines with territoriality, both triggered by surging testosterone levels at the nearing end of winter. The work is published in the journal *Proceedings of the Royal Society B: Biological Sciences*.

Asserting control over geographic areas is a universal phenomenon that reverberates through the natural world. Yet, physical aggression is only one way to fight for a territory. While most of our favorite pets mark their territory with scent marks, other species defend territory with visual display or vocal signals. Perching birds for example establish and defend their territories with singing!

One such bird is the thrush nightingale, which migrates from temperate zones during breeding season to the tropics in winter. Whereas all-year resident tropical songbirds usually display [territorial behavior](#) throughout the year, little is known about the role of territoriality of migrating birds in their winter quarters. Henrik Brumm and his team conducted an extensive field study in Southern Tanzania, the winter quarters of many thrush nightingales, to find out if and how territoriality comes to play here.

Observing the thrush nightingales in Africa, the scientists were captivated by the proximity of some males, settling very close to each other. This behavior sharply contrasts the birds' highly territorial behavior during breeding season, where they never settle as close to

other males. The team was thus spurred to investigate: are thrush nightingales actually territorial in their winter habitat, and how does this relate to song development during this time?

Thrush nightingales, like many other birds, annually embark on a melodious development of song—progressing from subsong to plastic song and finally to the crystallized full song for the season. The males cycle through this development every year, with their final song emerging with the start of the breeding season. Subsong does not contain any memorized materials and is soft and highly variable. During the plastic song phase, the birds elaborate the note structure and syntax of their song over a course of time until the crystallization of the final song.

Through extensive experiments, such as measuring the distances between males or playback experiments, the team studied the interrelation of song development and territorial behavior.

The presence of full song increased from none at the start of winter to about half of the observed population at the time of departure to their [breeding grounds](#). Interestingly, the full songsters were never found to settle close to each other. Plastic songsters in contrast settled close to each other as well as close to full songsters. Notably, territorial behaviors were observed among full songsters but not towards or among plastic songsters, indicating a connection between song and territoriality.

A pivotal factor known from other studies that may bridge song development and territorial behavior is the hormone testosterone. As the wintering season nears its end, testosterone levels surge and the birds transition into the breeding stage. Henrik Brumm explains, "Rising testosterone levels trigger full song development and, in parallel, territorial behavior. If a male reaches such high testosterone levels even before he departs to his breeding grounds, then this will make him become territorial also in his winter quarters."

The team suggests that age might be a vital factor, letting some birds reach the full song stage faster. "Although all males undergo the annual development of song," team member Léna de Framond explains, "young birds are most likely slower in developing their final song than older ones. Because they are still in their plastic song phase, they can settle closer to full songsters which may allow them to learn new songs from their older neighbors."

The study suggests that the territorial behavior of some of the wintering thrush nightingales is a by-product of rising [testosterone levels](#) and the ensuing song development. As some birds already show territorial behavior before they depart, the question of whether territoriality also has an adaptive purpose in the [birds' winter](#) habitat could be studied next.

Ultimately, the study highlights the dynamic shifts in territorial and non-territorial behaviors within bird populations, offering a window into the intricate tapestry of settlement patterns. Last author Wolfgang Goymann concludes, "Our findings open up a new avenue of understanding in bird [behavior](#), underscoring the interplay between song, hormones, and territoriality. The wintering grounds, once thought to be a season of respite, now reveal themselves as a theater of intricate behaviors."

More information: Henrik Brumm et al, Territorial behaviour of thrush nightingales outside the breeding season, *Proceedings of the Royal Society B: Biological Sciences* (2023). [DOI: 10.1098/rspb.2023.0496](https://doi.org/10.1098/rspb.2023.0496)

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