

# Departure of migratory birds from stopover sites is hormone-controlled

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Migratory birds like the garden warbler are hormone-controlled. Credit: Wolfgang Goymann

Migratory birds often stop along their long journeys to replenish their fat stores. The purpose of these stopovers – rest and refuelling – is clear. To date, however, it had been unclear which physiological signals triggered the birds' decision to continue their flight. A team led by researchers from Vetmeduni Vienna has now identified, for the first time, the hormone ghrelin as a signal for the birds' brains. Ghrelin, which is known to be an appetite-regulating hormone in humans, was measured at high levels in satiated garden warblers. Moreover, birds injected with additional ghrelin exhibited decreased appetite and increased the highly active state of migratory restlessness. The results, which were published in the journal *PNAS*, confirm the hormonal influence on avian migratory behaviour and could even lead to an improved understanding of eating disorders among humans.

Every year, billions of [migratory birds](#) make their way back to Europe from their wintering quarters. Since their energy reserves are not enough for a non-stop flight, they put in stopovers along the way to rest and replenish their fat stores. That migratory birds must stop on their long journey is clear. But how long they rest and what signals tell the birds to continue on their way has so far been unclear.

A research team led by Leonida Fusani of the Konrad Lorenz Institute of Ethology at Vetmeduni Vienna and the Department of Cognitive Biology at the University of Vienna, together with Wolfgang Goymann of the Max Plank Institute for Ornithology in Seewiesen, could now demonstrate, for the first time, that the hormone ghrelin controls [migratory behaviour](#). They were also able to show that a form of ghrelin that had been considered to be an [inactive form](#) of the hormone is in fact much more influential than had previously been assumed.

## **Appetite-regulating hormone identified as departure**

## signal

A network of hormones regulates the appetite in mammals. The hormones signal how much food we eat and when we have had enough. Besides leptin and cortisol, ghrelin has been identified as an especially important factor in appetite regulation. "The hormone was recently identified in birds as well. We therefore investigated whether it might also play a role in the behaviour of migratory birds," explains Fusani. Through two experimental studies with the garden warbler *Sylvia borin*, the researchers found evidence that ghrelin functions as an indicator and a signal for the birds to continue their migratory journey.

On their stopover in the island of Ponza, Italy, the researchers first measured the fat stores and the ghrelin concentrations in the birds. The analysis revealed that concentrations of ghrelin circulating in the bloodstream of "fat" garden warblers were higher than in thinner birds. "The concentration of the hormone correlated very well with the birds' body mass index," says Goymann. The birds' circulating hormone concentrations thus reflected their physical condition. Additionally, garden warblers in good physiological condition and with high ghrelin levels also were in a state of migratory restlessness. Even captive birds exhibit this urge to migrate at the appropriate time.

## **Inactive form of ghrelin also an active influential factor**

Migratory restlessness also indicated the influence of ghrelin in the second experiment conducted by the research team. This behaviour, however, was triggered in the warblers by a form of ghrelin that had previously been considered to be inactive. "Two forms of ghrelin exist in the bloodstream: an acylated and an unacylated form. The latter had previously been considered to be the inactive form of the hormone," says

Fusani. The acylated form, which was considered to be the active form of the hormone, differs from the unacylated form in that it has an additional acyl group.

In a second experiment, the researchers injected the birds with different concentrations of the hormone. The acylated form of ghrelin had little effects on the animals; the unacylated form did, however, especially among animals who had not yet sufficiently replenished their energy reserves. Injections of "inactive" ghrelin decreased the appetite in the garden warblers but increased their activity, i.e. it triggered migratory restlessness.

## **Hormonal control of bird migration as food for thought for mammal research**

The research results clearly demonstrated a hormonal trigger behind the decision of migratory birds to continue their journey. "We have thus identified an important factor behind migratory behaviour in addition to natural influences such as the weather and food availability," says Goymann. But the results of the study could also contribute to a better understanding of the hormone's function among mammals.

The evidence that the "inactive" form of ghrelin influences the behaviour of migratory birds indicates that the [hormone](#) may have alternative mechanisms. Even unacylated [ghrelin](#) can pass the blood-brain barrier. The unacylated form could possibly become activated and trigger a reaction in the central nervous system. "This could contribute to research, from a new perspective, into the regulation of food intake, metabolic disorders or obesity in people," says Fusani.

**More information:** Wolfgang Goymann et al, Ghrelin affects stopover decisions and food intake in a long-distance migrant, *Proceedings of the*

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