

Press Release

Waldrappteam Conservation and Research



Research for Animal Welfare

Innovative Study on the Aerodynamics of GPS Transmitters

Seekirchen am Wallersee, 22 September 2025 – GPS transmitters have become indispensable tools for research and species conservation. They provide precise data on migration routes, survival rates, and the behavior of endangered species such as the Northern Bald Ibis. But what has long been seen as a technological breakthrough also poses challenges: the devices themselves can significantly strain the animals' energy balance.

A key experience for Waldrappteam Conservation & Research came during a training flight with hand-reared ibises: although the test transmitters were extremely light, the birds showed clear signs of fatigue after only a few kilometers. Once the transmitters were removed, they were able to continue flying without difficulty. This observation prompted the team to investigate the aerodynamics of GPS transmitters systematically for the first time.

Wind Tunnel Research

As part of a project funded by the Austrian Science Fund (FWF, P30620-BBL), the team built one of the largest wind tunnels for biological research in Seekirchen am Wallersee. In controlled experiments, researchers compared box-shaped transmitters with aerodynamically optimized, teardrop-shaped designs.

The results were clear: birds equipped with optimized transmitters showed significantly lower heart rates – a strong indicator of reduced energy consumption. The position of the transmitter also proved crucial: when mounted further back on the body (using a leg-loop harness), aerodynamic drag was noticeably reduced.

Digital Flow Simulations and Physical Models

In a foundation-funded follow-up project, a Northern Bald Ibis specimen was digitally scanned in gliding position to run detailed computational fluid dynamics (CFD) simulations. In addition, a precise 3D-printed model was created to visualize airflow patterns in the wind tunnel using smoke trails.

These methods provided, for the first time, a detailed look at the aerodynamic effects of transmitters – data that could hardly be measured on live animals. The findings are unambiguous: birds with box-shaped transmitters experience around 10% more drag than birds without transmitters. To maintain the same flight speed, they must therefore expend about 10% more muscular effort. With aerodynamically optimized transmitters, however, drag increases by only 0.6%.



The glide ratio – a key parameter for soaring efficiency – also drops significantly with box-shaped transmitters: from 6.6 without transmitters to 6.0. With optimized transmitters, it remains unchanged.

Voices from the Project

“These results mark a milestone for animal welfare. We can now design and position GPS transmitters in a way that minimizes their impact on the birds’ energy expenditure,” says **Johannes Fritz**, Director of Waldrappteam Conservation & Research. “This allows us to combine cutting-edge research with practical applications in species conservation while replacing animal testing with a combination of simulations and model experiments.”

“As a fluid dynamicist, I find it fascinating how precisely we can simulate and optimize airflow around a bird’s body,” adds **Herwig Grogger**, former Professor of Fluid Dynamics at FH Joanneum Graz. “These results demonstrate that technological innovation and animal welfare can go hand in hand – provided the right methods are used.”

Significance for Conservation

This research sets new standards for ethically responsible animal studies and makes a direct contribution to saving one of Europe’s rarest bird species, the Northern Bald Ibis.

Mizrahy-Rewald O, Winkler N, Voelkl B, Grogger H, Ruf T & Fritz J (2023) The impact of shape and attachment position of logging devices in Northern Bald Ibises. *Animal Biotelemetry*. <https://doi.org/10.1186/s40317-023-00322-5>

Grogger H, Gossar M, Makovec M, Fritz J, Voelkl B, Neugebauer K, Amann F. (2022) A low-cost wind tunnel for bird flight experiments. *Journal of Ornithology*, 163, 599–610. <https://doi.org/10.1007/s10336-021-01945-2>

Picture 1. Flow simulations (Computational Fluid Dynamics, CFD) on the virtual 3D model of the Northern Bald Ibis; the strong turbulence above and behind the box-shaped transmitter housing is clearly visible.

Picture 2. Flow experiments with the physical Northern Bald Ibis model in the wind tunnel; airflow is visualized using smoke wands.

Picture 3. Pronounced airflow turbulence on the ibis model with a box-shaped transmitter housing.

Picture 4. Laminar airflow with minimal turbulence on the ibis model with an aerodynamically optimized transmitter housing.

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