

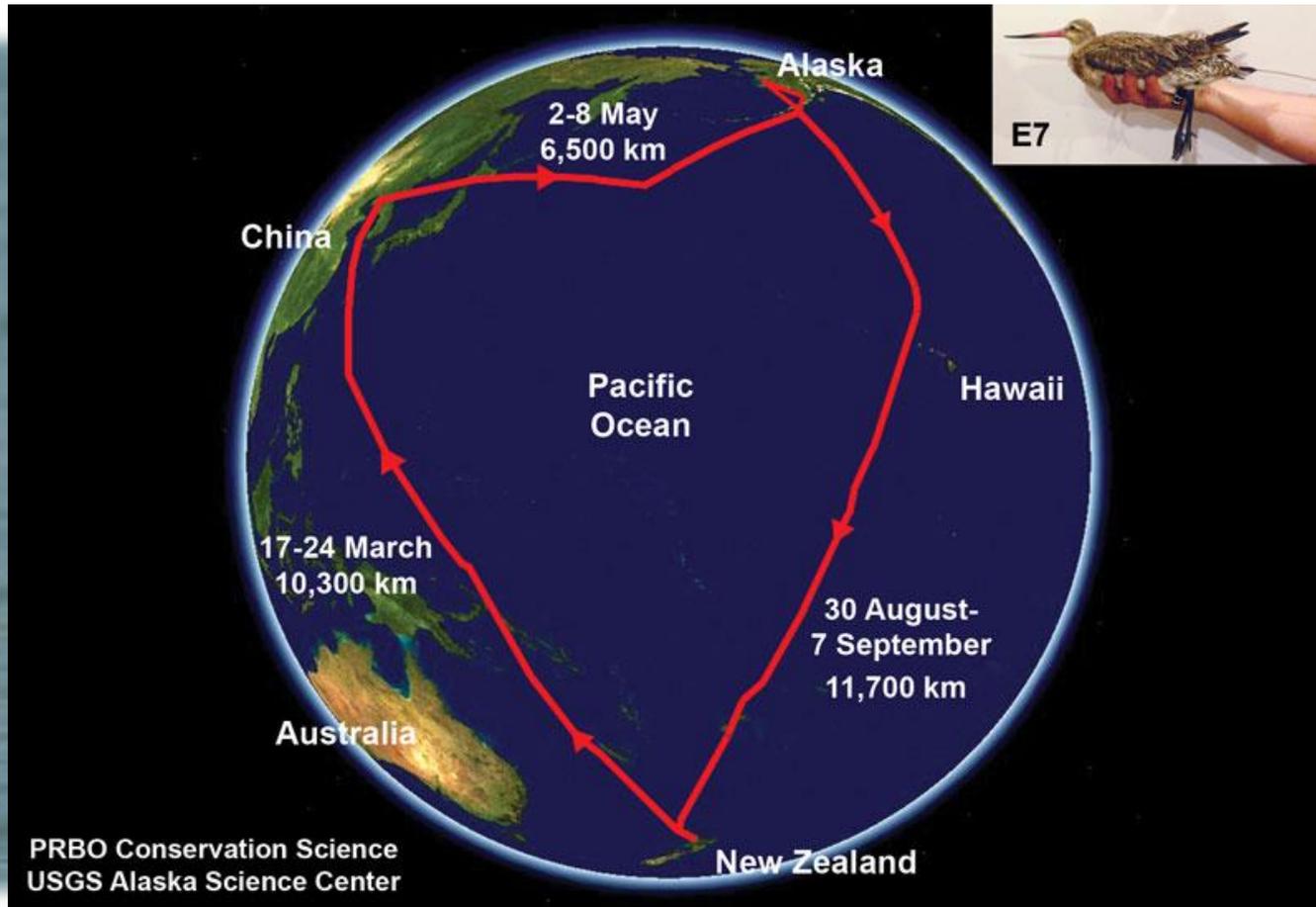


Why do birds fly in formation? Ongoing research with the Northern Bald Ibis

Johannes Fritz / Waldrappteam / LIFE+ Reason for Hope

Picture M Unsoeld





Bar-Tailed Godwit (*Limosa lapponica*)

Battley et al. (2012): Contrasting extreme long-distance migration patterns in bar-tailed godwits *Limosa lapponica*. **Journal of Avian Biology**, 43(1), 21-32.



Migratory flight is a story of extremes in terms of energy expenditure, fat deposition, water regime aerodynamic optimization or orientation.

Determining how birds overcome these various challenges has also significant implications for animal conservation.

Studies either use birds under laboratory conditions or capture anonymous birds in the wild. Both approaches have **major methodological limitations**.





We take advantage of the **human-led migration** with the Northern Bald Ibis.

These birds are **human-imprinted**, easy to manage by their foster parents.

We are able to **join and lead them** throughout a real migration journey.

The **individual life-history** is well known.

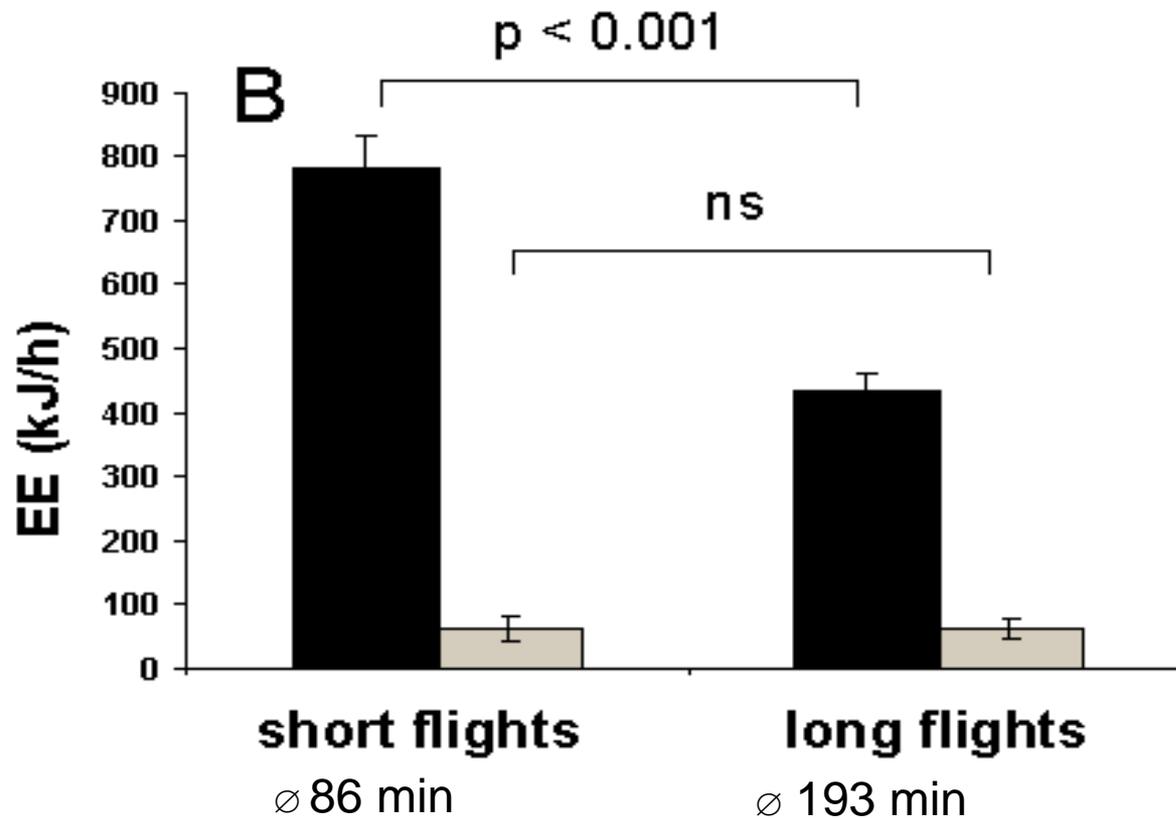
Various measures can be taken.







Physiology and
energy
expenditure of
Northern bald
ibises
during human-
led autumn
migration



Function and
mechanism of
V-formation flight





Weimerskirch et al. (2001). Energy saving in flight formation. **Nature** 413, 697–698.



nature

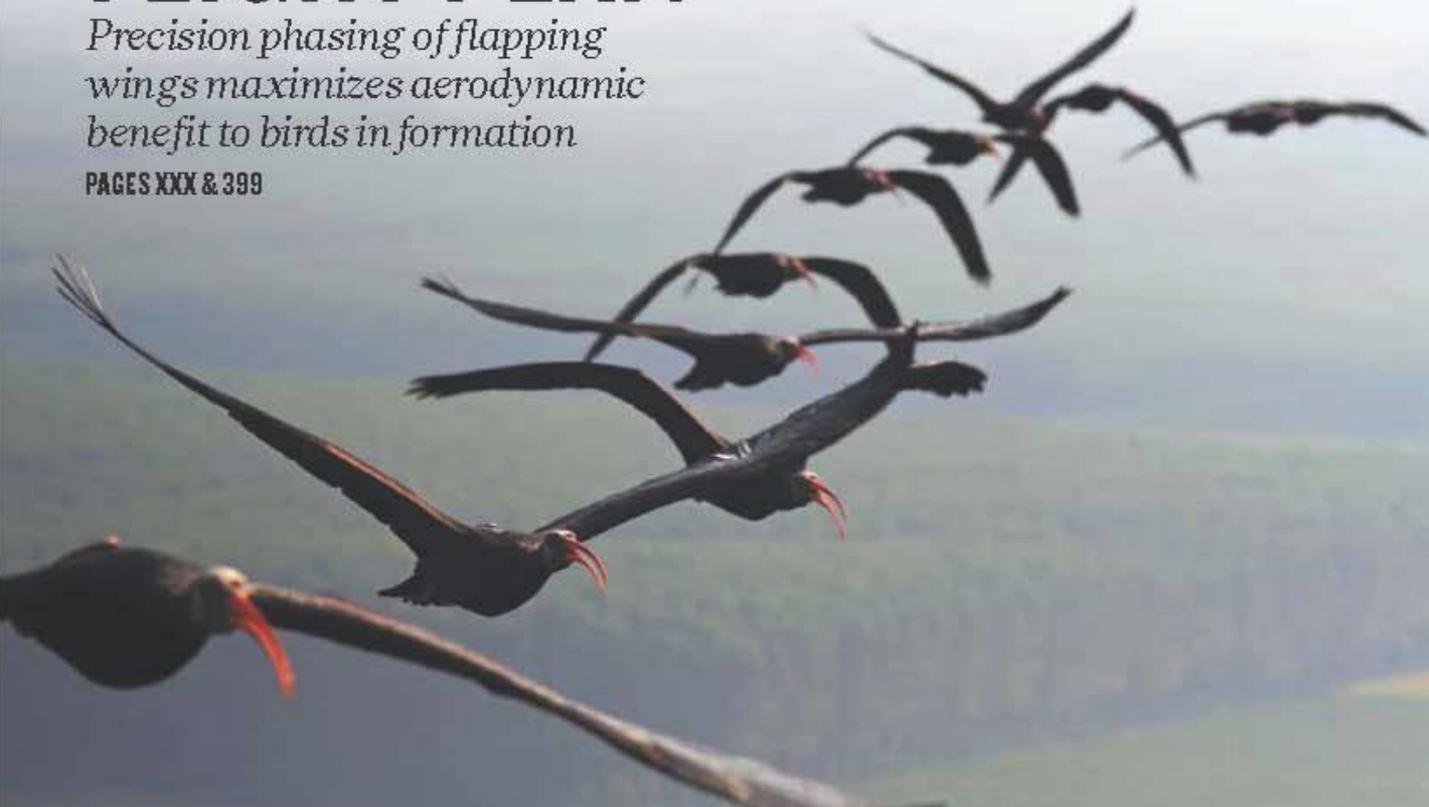
THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE

Frontiers in
biology

FLIGHT PLAN

Precision phasing of flapping wings maximizes aerodynamic benefit to birds in formation

PAGES XXX & 399



Portugal et al. (2014).
Upwash exploitation
and downwash
avoidance by flap
phasing in ibis
formation flight.
Nature, 505, 399-402.

RVC Royal
Veterinary
College
University of London



Birds' V formation finally explained

15.01.14 | Aerodynamik

Vögel sind effiziente Energiespar-Flieger

Birds That Fly in a V Formation Use An Amazing Trick

by Ed Yong

Why do birds fly in V formation? Ibises help scientists figure it out

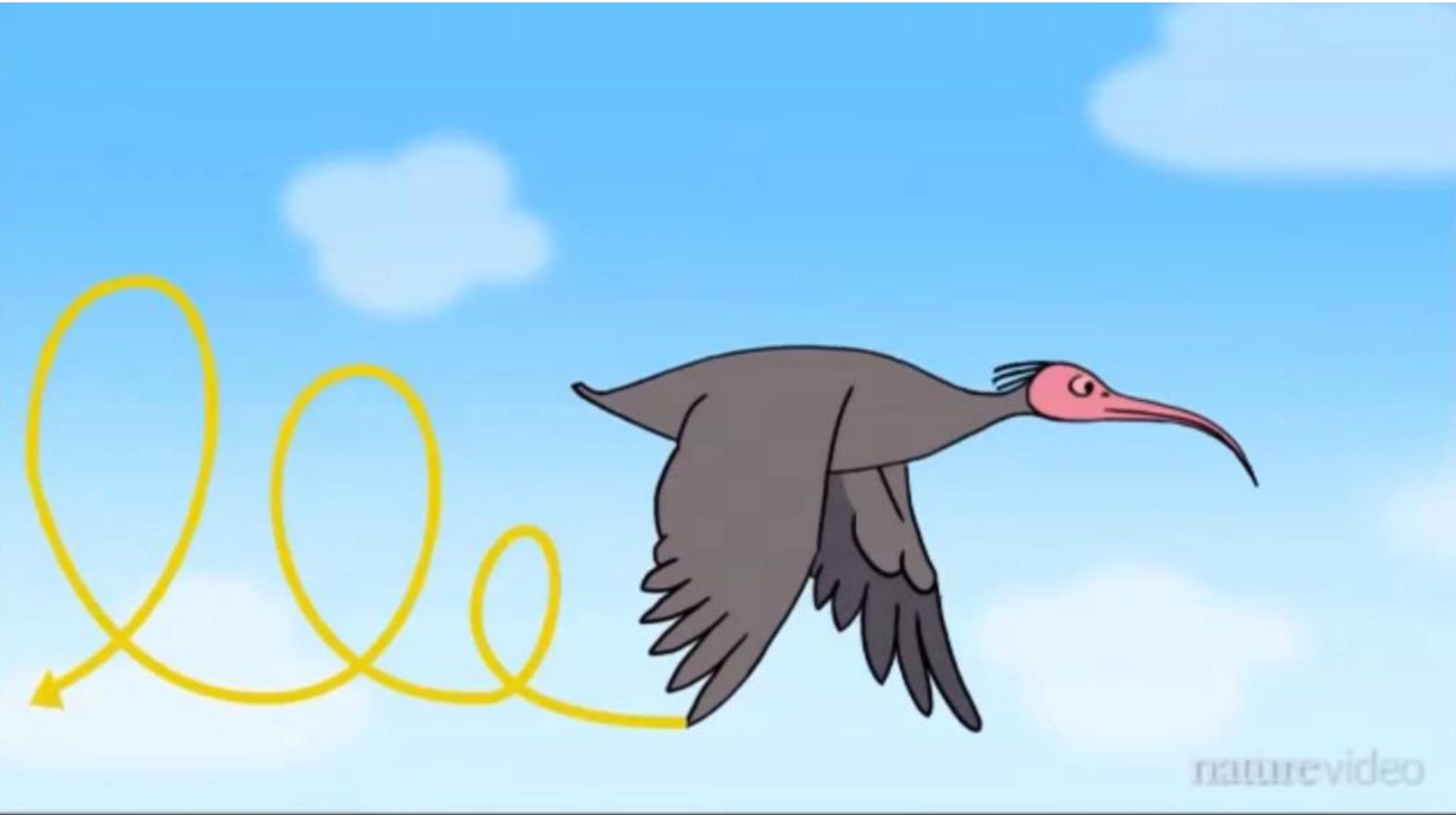
Malcolm Ritter, The Associated Press

Zugvögel: Flugexperiment zeigt Energiegeheimnis der V-Formation

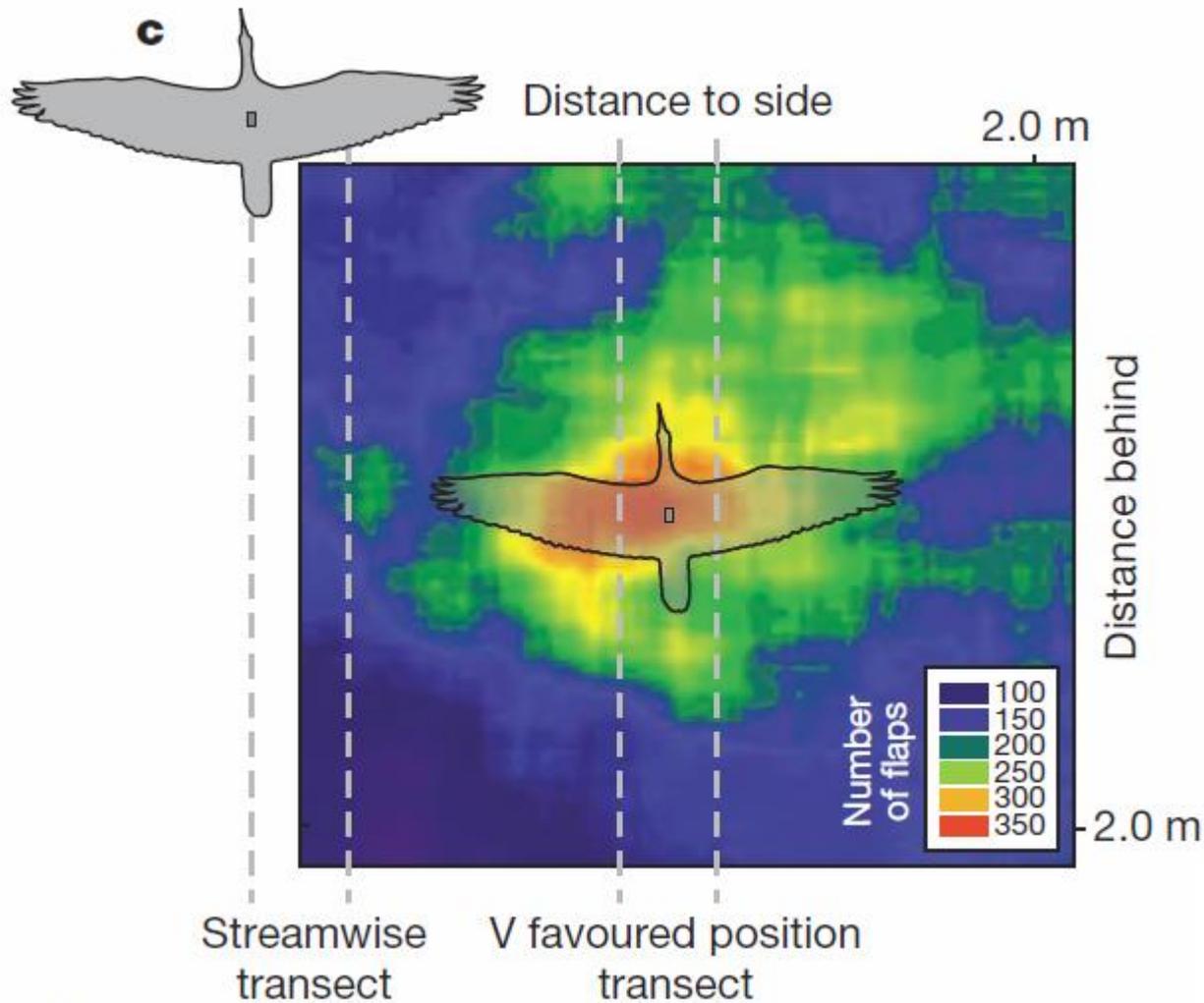
Von Nina Weber

SCIENCE

Bird Data Confirms That V's Help Save Energy



Portugal et al. (2014). Upwash exploitation and downwash avoidance by flap phasing in ibis formation flight. **Nature**, 505, 399-402.



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This **empirical study** indicates that birds flying in a formation behave as predicted by mathematical models which support the **energy saving hypothesis**.

Remarkable, that even these **juvenile, unexperienced birds** were able to coordinate in this complex way.

The **amount of energy saving** could not be quantified in this study.

Portugal et al. (2014). Upwash exploitation and downwash avoidance by flap phasing in ibis formation flight. **Nature**, 505, 399-402.





Who is going to fly in the front?

Mechanism and evolution of V-formation flight

Voelkl, Portugal, Unsöld, Usherwood, Wilson & Fritz (2015). Matching times of leading and following suggest cooperation through direct reciprocity during V-formation flight in ibis. **Proceedings of the National Academy of Sciences** 112/7: 2115–2120.

Voelkl B & Fritz J (2017). Relation between travel strategy and social organization of migrating birds with special consideration of formation flight in the northern bald ibis. **Phil. Trans. R. Soc. B** 372: 20160235.



As the leading bird in a formation cannot profit a **social dilemma** arises around the question who is leading.

We could show that the birds **frequently change their position** in the flock.

The amount of **time a bird is leading** a formation is **strongly correlated** with the **time it can itself profit** from flying in the wake of another bird.

These results suggest that bald ibis **cooperate** by directly taking turns in leading a formation.

The **cooperation** allowed the V-formation flight to become an **evolutionary stable strategy**.

But V-formation is not the only energy saving strategy....

Voelkl et al. (2015). Matching times of leading and following suggest cooperation through direct reciprocity during V-formation flight in ibis. **Proceedings of the National Academy of Sciences** 112/7: 2115–2120.

Voelkl B & Fritz J (2017). Relation between travel strategy and social organization of migrating birds with special consideration of formation flight in the northern bald ibis. **Phil. Trans. R. Soc. B** 372: 20160235.





Animation ColourFIELD tell-a-vision 2014



Costs and benefits of formation flight and thermal flight in birds



MAX-PLANCK-GESELLSCHAFT



UNIVERSITY OF
OXFORD



universität
wien



waldrappteam



Optimization of the human-led migration flight technique:

Extension of the **daily flight duration** up to 8 hours per day.

Extension of the **daily flight distance** up to 360 km per day.

Increase of the **bids flock size** up to 32 individuals per human-led migration flight.

We largely equal the migration pattern of wild Northern Bald Ibises.

But more is possible...





Since 2016, we observe a total of 18 bird with an **opacity of the cornea in one eye** in varying intensity up to blindness.

We also found a strong correlative relationship between one-eye opacity and **GPS-devices fixed on the upper back of the birds.**

The most parsimonious explanation for the symptomatic is a **permanent slight irritation of one eye during sleeping.**

We conclude that eye opacity is mainly caused by **placement of the device on the upper back.**

This position seems to have also a further impairing effect....





GPS-dummy on th upper back





GPS-device on the lower back



Asian Crested Ibis (*Nipponia nippon*)
release project in Japan

Significant lower survival rate of
tagged birds.