# Body measurements for all 11,000 bird species released in open-access database

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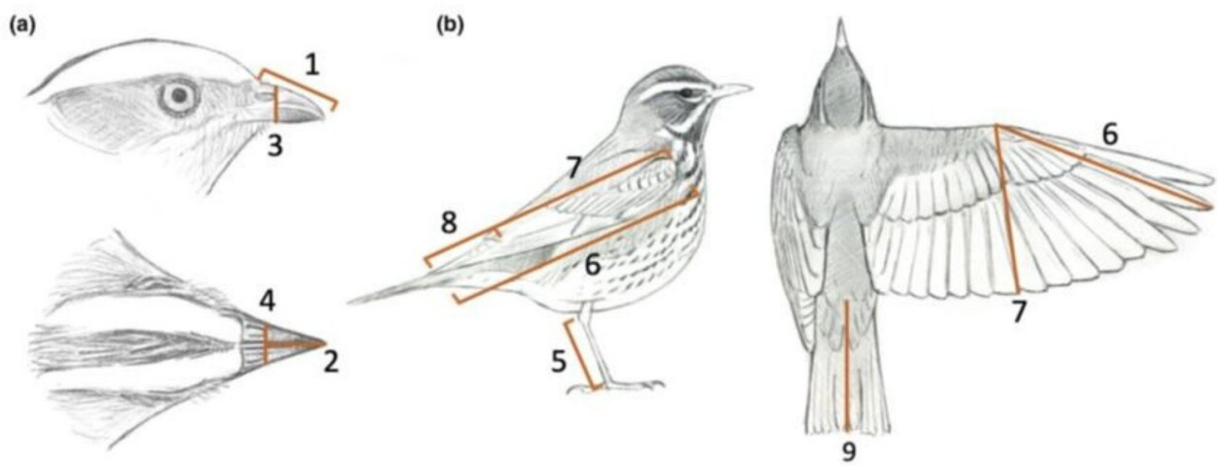


The database contains measurements of nine body features, or traits. Credit: Imperial College London

A new database called AVONET contains measurements of more than 90,000 individual birds, allowing researchers to test theories and aid conservation.

AVONET was collated by a team of international researchers, led by Dr. Joseph Tobias, from the Department of Life Sciences at Silwood Park at Imperial College London. In a special issue of the journal *Ecology Letters*, edited by Dr. Tobias, he and researchers from across the world present the first iteration of the complete AVONET database and some initial findings using the data.

Hayley Dunning talked to Dr. Tobias about why such a database is needed, how it came about, and what it has already uncovered about the evolution and ecology of birds worldwide.

## What bird traits are recorded in AVONET, and why are they important to study?

For each individual bird, we measured nine "morphological" traits, related to physical aspects of their bodies: four beak measurements, three wing measurements, tail length, and tarsus length (lower leg). AVONET also includes body mass and hand-wing index, which is calculated from three wing measurements to give an estimate of flight efficiency, and so the ability of a species to disperse or move across the landscape.

The final version contains measurements from 90,020 individual birds at an average of around nine individuals per species.

These measurements have been shown to correlate with important ecological features of species, including what they eat and how they search for food. Previous studies have most often used rather broad categories, such as habitat, life history or main food type, but these can be crude and relatively uniform across species. Some studies have included estimates of body size, but clearly the connection between body size and ecological function is relatively weak—for example, hawks and ducks have similar body masses but this says very little about their roles in the ecosystem.

Measurements of beaks, wings and legs provide much richer information, for example about the species' place in the local food web, how they move about, and how far they travel. Combinations of these traits can predict key functional characteristics of bird species, such as their precise diet and their foraging behavior, with much greater accuracy than body mass alone.

## How did the project originate?

To some degree, the publication of AVONET marks an endpoint of a personal journey. My own fascination with bird traits began in the 1980s as a schoolboy walking the tidelines and powerlines of Northumberland in search of bird corpses for dismembering. I owe a belated debt of thanks to my mother for abiding with bedroom shelves full of skulls and cabinets loaded with malodorous wings and tarsi.

The wider interest in studying bird morphological traits to predict ecology dates back to the 1960s, but it is only from the 2000s onwards that major studies have accelerated the trend. Over the last two decades, several research groups compiled and analyzed bird trait datasets of gradually increasing size, initially targeting samples of a few hundred species, and more recently spanning thousands of species worldwide.

However, these resources have until now been fragmented, with raw data largely incompatible and unpublished. The AVONET project represents an international collaboration between this network of bird researchers aimed at making their data accessible to the next generation of researchers. The initial inspiration for the venture was the TRY plant trait database, a successful catalyst of high-impact research in ecology and ecosystem science over the last decade.

Before and after: Dr Joe Tobias at the start of data collection (with Undulated Antpitta, Ecuador, 1991) and after finalising the AVONET dataset (with Blue-moustached Bee-eater, Ghana, 2021). Credit: Imperial College London

**How was the data collected?**

AVONET is the result of managers of different bird trait datasets joining forces to merge their work. The completion of this first iteration—AVONET 1.0—is a truly international effort, with vital expertise and data contributed by 115 authors based at 106 institutions in 30 countries.

Most of the measurements were taken from museum specimens, particularly at the Natural History Museum, London and the American Museum of Natural History, New York, with smaller samples from a further 76 collections.

In reality, the history and upkeep of these specimens means the project rests on the contributions of countless museum curators, field assistants and specimen collectors since the mid-1800s, some luminaries among them, including Charles Darwin, Alfred Russell Wallace, Ernest Shackleton and John James Audubon, all of whom prepared specimens subsequently measured for trait data.

## What kinds of insights has AVONET data already provided, and what future questions could it answer?

The data has been a great tool to test "rules" in evolution—patterns of evolution that appear widespread, but which remain contentious for one reason or another. For example, we used it to test the "island rule," where animals living on islands tend to evolve into either giants or dwarfs in relation to their continental ancestors. We found that this particular "rule" explains how the body evolution of animals varies across the Earth's islands, with an effect partly controlled by island size and isolation. There are plenty of other such rules that could be investigated.

A study into the hand-wing index also showed how dispersal ability varies across all bird species, providing insight into a range of topics such as their sensitivity to habitat loss or their ability to track suitable climates under climate change.

More generally, AVONET data can help us to understand and predict how ecosystems respond to environmental change. For example, some initial studies have looked into how bird communities around the world differ in their functional diversity—the form and variety of species filling useful roles. These estimates can provide information into the condition of useful ecological processes, such as seed dispersal and pest control, and their resilience in the face of changing habitats and climates.

## What is the future for AVONET?

Progress is underway towards AVONET 2.0, which will be expanded with more measurement data for each species, and also more life history and behavioral information. In the meantime, we hope that AVONET 1.0 can provide a rich resource for teaching and research across a wide range of fields in the life sciences.

In particular, we hope to use the bird trait data to develop an index of ecological health that can be used in identifying and tracking progress towards effective conservation actions designed to preserve biodiversity and ecosystem functions worldwide.

**More information:** Joseph A. Tobias et al, AVONET: morphological, ecological and geographical data for all birds, *Ecology Letters* (2022). DOI: 10.1111/ele.13898

Joseph A. Tobias, A bird in the hand: Global-scale morphological trait datasets open new frontiers of ecology, evolution and ecosystem science, *Ecology Letters* (2022). DOI: 10.1111/ele.13960

Provided by Imperial College London

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