

# Jacob M. Graving

Max Planck Institute of Animal Behavior  
University of Konstanz, Department of Biology  
Centre for the Advanced Study of Collective Behaviour  
Universitätsstr. 10  
Konstanz, Germany 78464

✉ [jgraving@gmail.com](mailto:jgraving@gmail.com)

🌐 [jakegraving.com](http://jakegraving.com)

🐦 [twitter.com/jgraving](https://twitter.com/jgraving)

🏠 [github.com/jgraving](https://github.com/jgraving)

**Research Interests** Computational models for the study of animal behavior, Bayesian statistical inference, machine/deep learning, probabilistic programming, nonlinear dynamics

## Positions

2020–present

### **Independent Research Fellow**

Max Planck Institute of Animal Behavior  
Department of Biology, University of Konstanz  
Centre for the Advanced Study Collective Behaviour, University of Konstanz

**Role:** Working with researchers from the Department of Migration (Wikelski), Department of Collective Behavior (Couzin), and Department for the Ecology of Animal Societies (Crofoot) to develop novel, general-purpose methods for the study of animal behavior in laboratory and field environments using drones, advanced telemetry sensors, computer vision, machine/deep learning, and modern statistical techniques.

## Education

2020 (submitted)

### **Ph.D. (Dr.rer.nat.), Biology**

Department of Collective Behaviour, Max Planck Institute of Animal Behavior  
Department of Biology, University of Konstanz  
Centre for the Advanced Study Collective Behaviour, University of Konstanz  
International Max Planck Research School (IMPRS) for Organismal Biology

2015

### **M.S., Biology**

Department of Biological Sciences, Bowling Green State University

2013

### **B.S., Biology**

Department of Biological Sciences, Bowling Green State University

## Publications

In Preparation

Bath, D.E., Walter, T., **Graving, J.M.**, Vizcaíno, J.P., Couzin, I.D. Collective detection and processing of distributed information by fish schools. In prep.

In Review

Li, L., Nagy, M., **Graving, J.M.**, Bak-Coleman, J., Guangming X., Couzin, I.D. Schooling fish save energy by vortex-phase matching. In review

Preprints

**Graving, J.M.**, Couzin, I.D. (2020). VAE-SNE: a deep generative model for simultaneous dimensionality reduction and clustering. bioRxiv: <https://doi.org/10.1101/2020.07.17.207993>

2019

**Graving, J.M.**, Chae, D., Naik, H., Li, L., Koger, B., Costelloe, B.R., Couzin, I.D. (2019). DeepPoseKit, a software toolkit for fast and robust animal pose estimation using deep learning. eLife, 8. <https://doi.org/10.7554/elife.47994>  
bioRxiv: <https://doi.org/10.1101/620245> Code: <https://github.com/jgraving/deepposekit>  
Press: Quanta Magazine, Nature Methods, Nature News & Views, eLife Science Digests

2018

Alarcón-Nieto, G.\*, **Graving, J.M.\***, Klarevas-Irby, J.A.\*, Maldonado-Chaparro, A.A., Mueller, I., and Farine, D.R. (2018) An automated barcode tracking system for behavioural studies in birds. Methods in Ecology and Evolution 9 (6), 1536-1547. <https://doi.org/10.1111/2041-210X.13005> bioRxiv: <https://doi.org/10.1101/201590> \*contributed equally

2017

**Graving, J.M.**, Bingman, V.P., Hebets, E.A., and Wiegmann, D.D. (2017). Development of site fidelity in the nocturnal amblypygid *Phrynus marginemaculatus*. Journal of Comparative Physiology A, 203(5), 313-328. <https://doi.org/10.1007/s00359-017-1169-5>

Bingman, V.P., **Graving, J.M.**, Hebets, E.A., and Wiegmann, D.D. (2017). Importance of the antenniform legs, but not vision, for homing by the neotropical whip spider *Paraphrynus laevifrons*. Journal of Experimental Biology, 220(5), 885-890. <https://doi.org/10.1242/jeb.149823>  
Press: Discover Magazine, National Geographic

2016

Wiegmann, D.D., Hebets, E.A., Gronenberg, W., **Graving, J.M.**, and Bingman, V.P. (2016). Amblypygids: model organisms for the study of arthropod navigation mechanisms in complex environments. Frontiers in Behavioral Neuroscience, 10, 47. <https://doi.org/10.3389/fnbeh.2016.00047>

## Teaching

2019

### **ASAB 2019 Summer Conference, University of Konstanz**

Workshop Organizer and Lecturer

– Seminar on "Machine Learning in the Behavioral Sciences"

– Practical Workshop on "Quantifying Behavior with Machine Learning"

2016–2020

### **University of Konstanz, Department of Biology**

Lecturer and Project Advisor, Intensive Research Course for Master's Students

– Measuring Animal Behavior with Computer Vision

– Analyzing Behavioral Data

– Introduction to Programming in Python

2013–2015

### **Department of Biological Sciences, Bowling Green State University**

Graduate Assistant

– Advanced Biostatistics

– Introduction to Biostatistics

– Population and Community Ecology

– Introductory Biology for Non-Science Majors

– Guest Lecture on "Arthropod Navigation", Animal Behavior

## Invited Talks

2019

### **Revealing the Behavioral Algorithms of Social Animals**

Princeton Neuroscience Institute (PNI)

Princeton University, Princeton, New Jersey, USA

July 2, 2019

2018

### **Perception and Motion in Locust Swarms**

Integrated Behavioral Research Group (IBRG)

Princeton University, Princeton, New Jersey, USA

March 16, 2018

### **Perception and Motion in Locust Swarms**

Department of Biological Sciences Seminar Series

Bowling Green State University, Bowling Green, Ohio, USA

February 28, 2018

## Outreach

2017–2019

### **Konstanzer Lange Nacht Der Wissenschaft**

"Long Night of Science" Public Outreach Event

Volunteer

Konstanz, Germany

2016

### **Das Schwarmverhalten der Fische**

Public Seminar by Prof. Jens Krause

Volunteer Co-organizer

Konstanz, Germany

2013–2014

### **Kid's Tech University, Bowling Green State University**

Public Outreach Event for Schoolchildren Grades K–8  
Volunteer  
Bowling Green, Ohio, USA

## Advisees

### Graduate

Simon Gommel, M.S. Biology, University of Konstanz  
Taylor Carter, M.S. Biology, University of Konstanz  
Ingabritta Hormann, M.S. Biology, University of Konstanz

### Undergraduate

Nicole Meister, B.S. Computer Science, Princeton University  
Chiara Hirschhorn, B.S. Biology, University of Konstanz  
Daniel Chae, B.S. Computer Science, Princeton University  
Connie Santangelo, B.S. Biology, Bowling Green State University  
Lindsey Cunningham, B.S. Biology, Bowling Green State University  
Tracy Togba, B.S. Biology, Bowling Green State University

## Peer Review

*Journals:* eLife, Science Advances, PNAS, Methods in Ecology and Evolution  
*Grants:* IMPRS Project Grant, IMPRS Travel Grant

## Skills

*Languages:* Python (Expert), R (Intermediate), MATLAB (Intermediate)  
*Applications:* Bayesian inference, statistical analysis, data visualization,  
machine learning, deep learning, computer vision, and image processing  
*Libraries:* Stan, TensorFlow, PyTorch, scikit-learn, OpenCV

## References

### **Iain D. Couzin**

Director, Max Planck Institute of Animal Behavior  
Professor, University of Konstanz  
Department of Collective Behaviour  
icouzin@ab.mpg.de  
+49 7531 88-4928

### **Daniel D. Wiegmann**

Associate Professor  
Bowling Green State University  
Department of Biological Sciences  
ddwiegm@bgsu.edu  
+1 (419) 372 2691

### **Verner P. Bingman**

Distinguished Research Professor  
Bowling Green State University  
Department of Psychology  
vbingma@bgsu.edu  
+1 (419) 372 6984

### **Sheryl L. Coombs**

Professor Emeritus  
Bowling Green State University  
Department of Biological Sciences  
scoombs@bgsu.edu  
+1 (419) 372 1206