MARIUS SOMVEILLE

Quantitative Ecology | Animal Movement | Global Change | Data Science

Personal Information

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Research Activities

I am a biologist aiming to advance our understanding of the forces driving where and when species exist on the planet and how they respond to global change. To address this challenge, I mainly investigate the **seasonal re-distribution of animals via migration**, using this phenomenon as a natural experiment to test ecological hypotheses and theories, with a particular focus on birds as they are highly migratory and particularly rich in data. I rely on advanced analytical skills that allow me to explore and analyse large spatial datasets and to develop sophisticated simulations and models. My research provides new fundamental understanding but also aims to inform conservation actions for protecting biodiversity.

Using distribution data for >10,000 species, I mapped, for the first time, global diversity patterns associated with bird migration. I found that despite the great biological and ecological diversity in migratory birds, strong spatial patterns emerge when all species are pooled together. Then, I explored the mechanisms underpinning these patterns. First, I investigated the effect of various environmental predictors on the patterns, and found strong support for the hypotheses that migratory birds move to their breeding grounds to exploit a seasonal surplus in energy and resources and avoid competition from residents, and then redistribute to the nearest suitable non-breeding grounds. I also found that migration allows species to track a temperature regime throughout the year. These results paved the way for an integrated mechanistic explanation of the seasonal geographical distribution of birds. I designed a model based on first principles of ecology and energetics to test the hypothesis that bird species distribute across the world in the most energy-efficient way. The model is able to predict very well the global seasonal distribution of birds, indicating that bird species distributions optimise the balance between energy acquisition from the environment and energy expenditure on biological processes (i.e. reproduction, movement and thermoregulation) while taking into account competition with other species. This work, published in *Nature Ecology & Evolution*, has provided a **simple explanation for the complex phenomenon of bird migration** worldwide, based on energy-efficiency and competition. It also provided unprecedented support for the species-energy relationship, a major macroecological theory for explaining how biodiversity is distributed globally. Applying the model to paleo-climate data, I then reconstructed the global seasonal distribution of birds over the past 50,000 years, revealing a strong flexibility of bird migration in response to climate change and providing a baseline for future predictions (published in *Nature Communications*). I also recently developed a modelling framework based on energetic optimality that simulates within-species migratory connectivity and accurately predicts empirical data (published in *Ecology Letters*). These results thus support the idea that **energy efficiency provides a general explanation for bird migration across scales**, from individual behaviour to global patterns. Now, I aim to develop forecasts predicting how animal migrations respond to human activities and climate change and how this response affects the structure of ecological communities and ecosystem functioning. These forecasts will in turn help understanding where we should focus conservation efforts for migratory species.

A second axis of my research program, which complements my work on migration, is to investigate **spatial distribution and diffusion in ecological systems**. I worked with interdisciplinary teams to unravel the complexity of avian brood parasitism–host interactions across the world (papers published in *Science* and *Ecology Letters*), as well as reveal an interplay between ecological and social processes for determining whether or not behavioural traditions establish in bird populations (published in *PLoS Comp Biol*). I have also recently developed a predictive model of how migrating Galapagos tortoises spread invasive plants (published in *Ecology & Evolution*).

Appointments

2024–present	**University of East Anglia** | Lecturer in Ecology and Conservation, School of Environmental Sciences
2024	**University of Oxford** | Research Fellow, Mathematical Institute
2021–2024	**University College London** | Research Fellow, Department of Genetics, Evolution and Environment
2020-2021	**Colorado State University** | Postdoctoral Researcher, Department of Biology
2018-2019	**BirdLife International** | Postdoctoral Researcher
2017-2019	**University of Oxford |** Research Associate, Department of Zoology
2017-2018	**Yale University** | Postdoctoral Researcher, Max Planck – Yale Center for Biodiversity Movement and Global Change
2016-2017	**University of Oxford |** Junior Research Fellow, Linacre College
2016	**Ecole Normale Supérieure |** Visiting Postdoc, Biology Institute (host: H. Morlon)
2015-2017	**University of Oxford** | Postdoctoral Fellow, Edward Grey Institute

Education

2011-2015	**University of Cambridge** | Ph.D. in Ecology, Department of Zoology Thesis: *The Global Ecology of Bird Migration: Patterns and Processes* Supervisors: Prof Andrea Manica and Dr Ana Rodrigues (CNRS, France)
2009-2011	**Université Paris-Saclay** | Dual Masters in Ecology and Biotechnology Awarded with distinction (*mention Bien*)
2006-2009	**Université Paris-Saclay** | Bachelor in Biological Sciences Trans-Atlantic Science Student Exchange Program at University of North Carolina

Specialised Training

06/2021	eX Modelo Summer School on model exploration methods | CNRS, France
09/2020	Population Genomics Data Analysis Course ConGen2020 | University of Montana.
06/2016	Complex Systems Summer School | Santa Fe Institute, USA.
08/2012	International course *species distributions modelling* | University of Copenhagen.

Awards & Grants (research funding is indicated)

2024	SCR Membership (non-stipendiary), St Hilda's College, Oxford
2023	BBSRC Grant – *Modelling to inform interventions during Highly Pathogenic Avian Influenza outbreaks in Great Britain* (£838,305) – Co-Investigator
2022	Royal Society / MOST International Exchange Grant, for developing a new collaboration with the Biodiversity Research Center in Taiwan (£24,000)
2021	UCL Grand Challenge Small Grant, University College London (£5,000)
2020	**Wolfson Excellence Fellowship**, University College London (£50,000)
2020	**Marie Sklodowska-Curie Global Fellowship** (€45,000; *declined*)
2020	**E. Rose Postdoctoral Fellowship**, Cornell Lab of Ornithology ($20,000; *declined*)
2018	**Young Researcher Prize**, French Society for Ecology & Evolution (£1,000)
2017	Lockey research and travel grant, University of Oxford (£1,500)
2017	Linacre travel grant, University of Oxford (£1,500).
2016-2017	Junior Research Fellowship (non-stipendiary), Linacre College, Oxford.
2015-2017	**Edward Grey Institute Postdoctoral Fellowship.** University of Oxford (£10,000).
2013	Research Studentship, Cambridge Philosophical Society (£3,500).

2013 Work Away Grant, Cambridge University. Visits to CNRS in Montpellier (£5,000)

2012 Travel Grant, Gonville & Caius College, Cambridge (£500)

2012 **Entente Cordiale Scholarship**, British Council & French Embassy in the UK. Prestigious bi-lateral award for French postgraduate students to study in the UK.

Talks & Seminars

I presented my work at >20 international conferences and >20 departmental seminars, including 26 invited presentations. Here is a selected list of recent talks:

10/2024 **Invited Symposium Talk**, American Ornithological Society 2024 Annual Meeting
Estes Park, USA Title: *Unravelling the seasonal distribution of birds in mountains*

03/2024 **Invited Seminar**, CEC Guest Seminar Series, University of Exeter.
Falmouth, UK Title: *Energy efficiency shapes bird migration*

01/2024 **Invited Seminar**, Swiss Ornithological Institute.
Sempach, CH Title: *Energy efficiency shapes bird migration flyways.*

11/2023 **Invited Seminar**, EGI Seminar Series, Department of Zoology, University of Oxford.
Oxford, UK Title: *Energy efficiency shapes bird migration*

10/2023 **Invited Keynote**, British Ornithologists' Union Global Flyway Conference
Online Title: *Energy efficiency shapes global bird migration flyways*

05/2023 **Invited Talk**, Gordon Research Conference on Movement Ecology of Animals
Lucca, Italy Title: *A data-driven model to predict how climate shapes bird migration*

11/2022 **Invited Seminars**, Academia Sinica & Taiwan Endemic Species Research Institute.
Taiwan Title: *Unravelling the ecological processes driving bird migration across scales*

05/2022 **Invited Seminar**, CIRAD-AMAP Lab.
Montpellier Title: *Evaluating the impact of agricultural intensification on migratory birds*

01/2019 **Invited Talk**, Meeting of the French Society for Ecology & Evolution.
Montpellier Title: *Energy efficiency drives the global seasonal distribution of birds*

12/2018 **Invited Plenary Talk**, 5th Colombian Zoology Congress.
Bogota Title: *The global ecology of bird migration: patterns and mechanisms*.

09/2018 **Invited Seminar**, Cornell Lab of Ornithology.
Ithaca, USA Title: *The global ecology of bird migration: patterns and mechanisms*

03/2018 **Invited Seminar**, Yale Center for Biodiversity and Global Change.
New Haven Title: *Energy efficiency drives the global seasonal distribution of birds*

02/2016 **Invited Seminar**, College de France.
Paris Title: *Explaining global bird migration using a process-based model*

Teaching Activities

I accumulated ~200 hours of teaching using various formats. I supervised >20 undergraduate students in the Part II Zoology course at Cambridge. I was also a teaching assistant for >100 students (undergraduates and postgraduates) for courses on quantitative methods in biology at Oxford, Cambridge and Yale, and I delivered lectures on animal movement at Yale, Colorado State University and UCL. In addition, I organised workshops on mapping biodiversity patterns and individual-based models.

2021-2023 University College London
~50 students Lectures and essay marking for the MRes *Biodiversity, Evolution and Conservation*

01/2022 Centro de Investigación Científica de Yucatán, Mexico.
30 students I gave a lecture and led a tutorial for a workshop on *Conservation Genomics*

04/2020 Colorado State University
>50 students I gave lectures for the Undergraduate course in *Ornithology*

10-12/2019 >50 students	University of Cambridge I led tutorials for the Undergraduate course in *Mathematical Biology*
09/2018 10 students	Max Planck Institute of Animal Behavior I led a workshop on individual-based modelling for postgraduate students.
2018 25 students	Yale University I gave lectures and led tutorials for the course *Methods in Biodiversity Research*.
2017 20 students	University of Oxford Tutorial assistant for the Undergraduate course *Quantitative Methods for Biologists*
2012-2013 21 students	University of Cambridge Small-group supervisions for undergrads in *Population Biology*, *Behavioural Ecology*

Mentoring

Main supervisor of ***6 Masters students*** (UCL; 2022-2023), including one 8-month project, two 5-month projects and three 4-month projects; and ***4 Undergraduate summer projects*** (UCL; 2022-2023). I co-supervised a *PhD student*: Xiaodan Wang (Fudan University, China & UCL; 2021–2024); and an *MSc student*: Genaro Rodríguez Otero (UNAM, Mexico; 2021–2023). I was a member of the PhD committee of Louis Moisan (Université du Quebec à Rimouski; 2022) and Peng He (Max Planck Institute for Ornithology, 2018-2021). In addition, I mentored students for In2ResearchUK (summer 2023) and In2ScienceUK (summer 2021), which are programs promoting social mobility and diversity in STEM.

Publications

My research activities have led to 29 published articles – 13 of them as first author – including in Science, Nature Ecology & Evolution and Ecology Letters. My publications have been cited >1100 times and my research has been the focus of in-depth articles in the international press such as in The Washington Post ➔, Quanta Magazine ➔, Forbes ➔, National Geographic ➔ , The Conversation ➔.

29. **Somveille M**, Bossu CH, DeSaix MG, Alvarado AH, Gomez Villaverde S, Rodriguez Otero G, Hernandez-Banos BE, Smith TB, Ruegg KC (2024) Broad-scale seasonal climate tracking is a consequence, not a driver, of avian migratory connectivity. *Ecology Letters* 27: e14496. DOI doi.org/10.1111/ele.14496

28. Sethi SS, Bick A, Chen M, Crouzeilles R, Hillier BV, Lawson J, Lee C, Liu S, Henrique de Freitas Parruco C, Rosten CM, **Somveille M**, Tuanmu M, Banks-Leite C (2024) Large-scale avian vocalization detection delivers reliable global biodiversity insights. *PNAS* 121: e2315933121. DOI doi.org/10.1073/pnas.2315933121

27. **Somveille M**, Grainger-Hull J, Ferguson N, Sethi SS, Gonzalez-Garcia F, Chassagnon V, Oktem C, Disney M, Lopez Bautista G, Vandermeer J, Perfecto I (2024) Consistent andnscalable monitoing of birds and habitats along a coffee production intensity gradient. *bioRxiv* DOI doi.org/10.1101/2024.07.12.603271

26. Wang X, **Somveille M**, Dokter AM, Cao W, Cheng C, Liu J, Ma Z (2024) Macro-scale relationship between body size and timing of bird migration. *Nature Communications* 15: 4111. DOI doi.org/10.1038/4S41467-024-48248-7

25. Moisan L, Gravel D, Legagneux P, Léandri-Breton D, Gauthier G, **Somveille M**, Therrien J, Lamarre J, Bêty J. (2023) Scaling migrations to communities: an empirical case of migration network in the Arctic. *Frontiers in Ecology and Evolution* 10: 1077260. DOI doi.org/10.3389/fevo.2022.1077260

24. **Somveille M** & Ellis-Soto D (2022) Linking animal migration and ecosystem processes: data-driven simulation of propagule dispersal by migratory herbivores. *Ecology and Evolution* 12: e9383. DOI doi.org/10.1002/ece3.9383

23. La Sorte FA, **Somveille M**, Dokter A, Miller ET (2022) Seasonal species richness of birds on the world's islands and its geographical correlates. *Proc R Soc B* 289: 20221105. DOI doi.org/10.1098/rspb.2022.1105

22. Kennerley JA, **Somveille M**, Hauber ME, Richardson NM, Manica A, Feeney WE (2022) The overlooked complexity of avian brood parasite-host relationships. *Ecology Letters* 25: 1889–1904. DOI doi.org/10.1111/ele.14062

21. **Somveille M**, Bay RA, Smith TB, Marra PP, Ruegg KC (2021) A general theory of avian migratory connectivity. *Ecology Letters* 24: 1848–1858. DOI doi.org/10.1111/ele.13817

20. He P, Montiglio P, **Somveille M**, Cantor M, Farine DR (2021) The role of habitat configuration in shaping animal population processes: a framework to generate quantitative predictions. *Oecologia* 196: 649–665. DOI doi.org/10.1007/s0042-021-04967-y

19. Miller EF, Green R, Balmford A, Beyer RM, **Somveille M**, Leonardi M, Amos W, Manica A (2021) Bayesian Skyline Plots disagree with range size changes based on Species Distribution Models for Holarctic birds. *Molecular Ecology* 30: 3993–4004. DOI doi.org/10.1111/mec.16032

18. Ruegg KC, Anderson EC, **Somveille M**, Bay RA, Whitfield M, Paxton EH, Smith TB (2021) Linking climate niches across seasons to assess population vulnerability in a migratory bird. *Global Change Biology* 27: 3519–3531. DOI doi.org/10.1111/gcb.15639

17. Miller EF, Leonardi M, Beyer RM, Krapp M, **Somveille M**, Somma GL, Desler PM, Manica A (2021) Post-glacial expansion dynamics, not refugial isolation, shaped the genetic structure of a migratory bird, the Yellow Warbler (Setophaga petechia). *bioRxiv* DOI doi.org/10.1101/2021.05.10.443405 (submitted to *PNAS*)

16. La Sorte FA & **Somveille M** (2021) The island biogeography of the eBird citizen science programme. *Journal of Biogeography* 48: 628–638. DOI doi.org/10.1111/jbi.14026

15. Bonnet-Lebrun A, **Somveille M**, Rodrigues ASL, Manica A (2021) Exploring intraspecific variation in migratory destinations to investigate the drivers of migration. *Oikos* 130: 187–196. DOI doi.org/10.1111/oik.07689

14. **Somveille M**, Dias MP, Weimerskirch H, Davies TE (2020) Projected migrations of southern Indian Ocean albatrosses as a response to climate change. *Ecography* 43: 1683–1691. DOI doi.org/10.1111/ecog.05066

13. Frankish CK, Manica A, Clay TA, **Somveille M**, Phillips RA (2020) Environmental drivers of movement in a threatened seabird: insights from a mechanistic model and implications for conservation. *Diversity and Distributions* 26: 1315–1329. DOI doi.org/10.1111/ddi.13130

12. **Somveille M**, Wikelski M, Beyer RM, Rodrigues ASL, Manica A, Jetz W (2020) Simulation-based reconstruction of global bird migration over the past 50,000 years. *Nature Communications* 11: 801. DOI doi.org/10.1038/s41467-020-14589-2

11. La Sorte FA & **Somveille M** (2020) Survey completeness of a global citizen-science database of bird occurrence. *Ecography* 43: 34–43. DOI doi.org/10.1371/journal.pcbi.1006647

10. Raimbault J, Broere J, **Somveille M**, *et al*. (2020) A spatial agent based model for industrial symbiotic processes. *Resources, Conservation and Recycling* 155: 104538. DOI doi.org/10.1016/j.resconrec.2019.104538

9. **Somveille M**, Manica A, Rodrigues ASL (2019) Where the wild birds go: explaining the differences in migratory destinations across terrestrial bird species. *Ecography* 41: 1–12. DOI dx.doi.org/10.1111/ecog.03531.

8. **Somveille M**, Firth JA, Aplin LM, Farine DR, Sheldon BC, Thompson RN (2018) Movement and conformity interact to establish local behavioural traditions in animal populations. *PLoS Computational Biology* 14(12): e1006647. DOI doi.org/10.1371/journal.pcbi.1006647.

7. **Somveille M**, Rodrigues ASL, Manica A (2018) Energy efficiency drives the global seasonal distributions of birds. *Nature Ecology & Evolution* 2: 962–969. DOI dx.doi.org/10.1038/s41559-018-0556-9.

6. Revell C & **Somveille M** (2017) A Physics-inspired mechanistic model of migratory movement patterns in birds. *Scientific Reports* 7:9870. DOI dx.doi.org/10.1038/s41598-017-09270-6

5. **Somveille M** (2016) The global ecology of bird migration: patterns and processes. *Frontiers of Biogeography* 8:e32694. DOI dx.doi.org/10.21425/F58332694.

4. **Somveille M**, Marshall K, Gluckman T-L (2016) A global analysis of bird plumage patterns reveals no association between habitat and camouflage. *PeerJ* 4:2658. DOI dx.doi.org/10.7717/peerj.2658

3. **Somveille M**, Rodrigues ASL, Manica A (2015) Why do birds migrate? A macroecological perspective. *Global Ecology and Biogeography* 24: 664-674. DOI dx.doi.org/10.1111/geb.12298

2. Feeney WE, Medina I, **Somveille M**, *et al.* (2013) Brood parasitism and the evolution of cooperative breeding in birds. *Science* 342(6165): 1506-1508. DOI dx.doi.org/10.1126/science.1240039

1. **Somveille M**, Manica A, Butchart SHM, Rodrigues ASL (2013) Mapping global diversity patterns for migratory birds. *PLoS ONE* 8: e70907. DOI dx.doi.org/10.1371/journal.pone.0070907

Programming & Data Analytics

I have expertise in spatial statistical analysis and mapping (e.g. species distribution modelling), data visualisation, network analysis, agent-based and predictive modelling, as well as computational simulations. I have accumulated approximately **~3500 hours of programming in R and Python**, and I have also programmed significantly in Julia and Matlab. I also have good experience with ArcGIS and using HPC clusters. My Github page: https://github.com/msomveille.

Additional Activities

Editing & Reviewing

I am an **Associate Editor for Journal of Animal Ecology** (since June 2023)

I reviewed scientific papers for Nature, Science, PNAS, Nature Climate Change, Nature Communications, Ecology Letters, Methods in Ecology & Evolution, American Naturalist, Proceedings B, Journal of Animal Ecology, Functional Ecology, Global Ecology and Biogeography, Ecography, Global Change Biology, Diversity and Distributions, Journal of Avian Biology, The Auk, Movement Ecology, Scientific Reports, and Ecology.

Organising

Member of the Organising Committee for BOU 2025 Annual Conference: Frontiers in Ornithology

Member of the organising committee of the Cambridge' Student Conference in Conservation Science (2013-2015 and 2019), contributing to widening participation in science for students from developing countries.
Main organiser of the Ecology Seminar Series in the Department of Zoology at Cambridge University (2013-2014).
Environmental officer at Gonville & Caius College, Cambridge (2013-2014), setting up various initiatives to make the College more environmentally-friendly.