MARIUS SOMVEILLE

Macroecology | Animal Movement | Global Change | Data Science

Personal Information

Address: Center for Biodiversity and Environment Research, University College London, UK
Email: marius@somveille.com **Phone**: +44 7544379680 **Website**: www.mariussomveille.com

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, recently 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. This research provides powerful new predictive tools for determining how species and ecosystems respond to global change. Using 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*). Now, I aim to understand the processes driving how migratory individuals redistribute between seasonal grounds and explaining their migratory trajectories.

A second axis of my research program, which complements my work on migration, is to investigate the **spatial distribution and diffusion of behavioural traits in ecological systems**. Patterns in the distribution of behavioural diversity in populations and communities are not well understood, and I am interested in exploring the ecological mechanisms underpinning them at different scales. I worked with interdisciplinary teams to reveal a correlated evolution between brood parasitism and cooperative breeding in birds (published in *Science*) and interplay between ecological and social processes for determining whether or not behavioural traditions establish in bird populations (published in *PLoS Comp Biol*).

Appointments

2021–present	**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	**University of Paris-Sud** | Dual Masters in Ecology and Biotechnology Awarded with distinction (*mention Bien*)
2006-2009	**University of Paris-Sud** | Bachelor in Biological Sciences One semester at the University of North Carolina at Chapel Hill (USA), as part of the Trans-Atlantic Science Student Exchange Program.

Specialised Training

09/2020	Population Genomics Data Analysis Course ConGen2020 | University of Montana
06/2016	Complex Systems Summer School | Santa Fe Institute, USA.
07/2012	International PhD course on *modelling species distributions under climate change* | Center for Macroecology, Evolution and Climate, University of Copenhagen.

Awards & Grants

I have been awarded several competitive scholarships and postdoctoral fellowships, which allowed me to conduct my research largely independently. I have also received a national prize.

2020	**Wolfson Excellence Fellowship**, University College London
2020	**Marie Sklodowska-Curie Global Fellowship** (*declined*)
2020	**Edward W. Rose Postdoctoral Fellowship**, Cornell Lab of Ornithology (*declined*)
2018	**Young Researcher Prize**, French Society for Ecology & Evolution
2017	Lockey research and travel grant, University of Oxford.
2017	Linacre travel grant, University of Oxford.
2016-2017	**Junior Research Fellowship** (non-stipendiary), Linacre College, Oxford.
2015-2017	**Edward Grey Institute Postdoctoral Fellowship.** University of Oxford.
2013	Research Studentship, Cambridge Philosophical Society.
2013	Work Away Grant, University of Cambridge. For collaborative work with the Center for Functional and Evolutionary Ecology in Montpellier, France.
2012	Travel Grant, Gonville & Caius College, Cambridge
2012	**Entente Cordiale Scholarship**, British Council & French Embassy in the UK. Prestigious bi-lateral award for French postgraduate students to study in the UK.

Publication List

My research activities have led to 19 published articles – 9 of them as first author – including in Science, Nature Ecology & Evolution and Nature Communications. My publications have been cited >400 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 ➔ and The Conversation ➔. In 2018, the altmetric score of my Nature Ecology & Evolution article was in the 99th percentile of all tracked articles of similar age in all journals, and my 2019 Ecography paper has received the Editor's Choice.

Manuscripts published:

Ruegg KC, Anderson EC, **Somveille M**, Bay RA, Whitfield M, Paxton EH, Smith TB (in press) Linking climate niches across seasons to assess population vulnerability in a migratory bird. *Global Change Biology*

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

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

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

He P, Montiglio P, **Somveille M**, Cantor M, Farine DR (2020) The role of habitat configuration in shaping animal population processes: a framework to generate quantitative predictions. *bioRxiv* DOI doi.org/10.1101/2020/.07.30.228205 (submitted to *Oikos*)

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

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

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

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

Miller EF, Green R, Balmford A, Beyer RM, **Somveille M**, Leonardi M, Amos W, Manica A (2019) mtDNA-based reconstructions of change in effective population sizes of Holarctic birds do not agree with their reconstructed range sizes based on paleoclimates. *bioRxiv* DOI doi.org/10.1101/2019.12.13.870410 (submitted to *Proc B*)

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.

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.

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.

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

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

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

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

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

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

Talks & Seminars

I presented my work at >10 international conferences and 8 departmental seminars, including 11 invited presentations. Here is a selected list:

11/2020 Online	**Invited Talk**, Colloque Migration 2020, organised by LPO and MNHN. Title: *Ecologie à grande échelle de la migration des oiseaux*
08/2020 Online	**Invited Talk**, North American Ornithological Conference 2020. Title: *Migratory birds follow an optimal redistribution across seasons*
02/2020 London	**Invited Seminar**, Institute of Zoology, Zoological Society of London. Title: *Causes and consequences of animal migration*
01/2019 Montpellier	**Invited Talk**, Meeting of the French Society for Ecology & Evolution. Presentation of my work for the Young Researcher Prize. Title: *Energy efficiency drives the global seasonal distribution of birds*
12/2018 Bogota	**Invited Plenary Talk**, 5th Colombian Zoology Congress. Title: *The global ecology of bird migration: patterns and mechanisms*.
09/2018 Ithaca, USA	**Invited Seminar**, Cornell Lab of Ornithology. Title: *The global ecology of bird migration: patterns and mechanisms*
03/2018 New Haven	**Invited Seminar**, Yale Center for Biodiversity and Global Change. Title: *Energy efficiency drives the global seasonal distribution of birds*
02/2016 Paris	**Invited Seminar**, College de France. Title: *Explaining global bird migration using a process-based model*

Teaching

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 gave lectures on animal migration at Yale and Colorado State University. In addition, I organised workshops at Yale and the Max Planck Institute on mapping biodiversity patterns and individual-based models. I accumulated ~130 hours of teaching using various formats.

04/2020 >50 students	**Teaching assistant** (set of lectures), Colorado State University Undergraduate course: *Ornithology*
10-12/2019 >50 students	**Teaching assistant**, University of Cambridge Undergraduate course: *Mathematical Biology*
09/2018 10 students	**Workshop on individual-based modelling in Ecology**, Max Planck Institute for Ornithology. Full day workshop for postgraduates including lectures and tutorials.
2018 25 students	**Teaching assistant**, Yale University. Postgraduate course: *Concepts and methods in biodiversity research*.
2017	**Teaching assistant**, University of Oxford.

20 students	Undergraduate course: *Quantitative Methods for Biologists*
2012-2013	**Teaching assistant**, University of Cambridge.
21 students	Undergraduate courses: *Population Biology* and *Behavioural Ecology*

Programming & Data Analytics

I have expertise in spatial statistical analysis and mapping (e.g. species distribution modelling), 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

Reviewing	I reviewed scientific papers for Science, Nature Climate Change, Nature Communications, Ecology Letters, American Naturalist, Journal of Animal Ecology, Functional Ecology, Global Ecology and Biogeography, Ecography, Global Change Biology, Diversity and Distributions, The Auk, Movement Ecology, Scientific Reports, and Ecology.
Advising	Member of the PhD committee of Peng He (MPI for Ornithology, 2018-2021)
Organising	I organised the Ecology Seminar Series in the Department of Zoology at Cambridge (2013-2014), and was also elected as environmental officer at Gonville & Caius College, Cambridge (2013-2014), setting up initiatives to make the College more eco-friendly. I have also contributed to widening participation in science for students from developing countries by being in the organising committee of the Cambridge' Student Conference in Conservation Science (2013-2015 and 2019).