Théo Michelot

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EMPLOYMENT

Assistant professor in Statistics *Since 2022*
Dalhousie University, Halifax, Canada

Lecturer in Statistics *2022*
University of St Andrews, UK

Postdoctoral research fellow *2019–2021*
University of St Andrews, UK
Development of flexible continuous-time stochastic processes with applications in ecology

EDUCATION

PhD in Statistics *2016–2019*
University of Sheffield, UK
Stochastic models of animal movement and habitat selection

MSc in Mathematical and Software Engineering
INSA de Rouen, France *2012–2015*
INSA de Lyon, France *2010–2012*

PUBLICATIONS

24. **Michelot, T.** (in press). hmmTMB: hidden Markov models with flexible covariate effects in R. *Journal of Statistical Software*. Preprint: arXiv:2211.14139.

23. **Michelot, T.**, Klappstein, N.J., Potts, J.R., Fieberg, J. (in press). Understanding step selection analysis through numerical integration. *Methods in Ecology and Evolution*. Preprint: arXiv:2308.15678.

22. Invernizzi, E., **Michelot, T.**, Popov, V., Ng, N., Macqueen, E., Rouviere, A. and Sasaki, T. (in press). Using hidden Markov models to study ant collective behaviour: self-organised building activity regulated through a feedback loop. *Animal Behaviour*.

21. **Michelot, T.**, Glennie, R., Quick, N., Thomas, L., Harris, C.M. (2023). Continuous-time modelling of behavioural responses in animal movement. *Annals of Applied Statistics*. 17 (4), pp. 3570–3588.

20. Klappstein, N.J., Thomas, L., **Michelot, T.** (2023). Flexible hidden Markov models for behaviour-dependent habitat selection. *Movement Ecology*. 11 (30), DOI: 10.1186/s40462-023-00392-3.

19. Glennie, R., Adam, T., Leos-Barajas, V., **Michelot, T.**, Photopoulou, T., & McClintock, B.T. (2023). Hidden Markov models: pitfalls and opportunities in ecology. *Methods in Ecology and Evolution*. 14 (1), pp. 43–56.

18. Klappstein, N.J., Potts, J.R., **Michelot, T.**, Pilfold, N.W., Börger, L., Lewis, M.A., Derocher, A.E. (2022) Energy-based step selection analysis: modelling the energetic drivers of animal movement and habitat use. *Journal of Animal Ecology*, 91 (5), pp. 946–957.

17. **Michelot, T.**, Glennie, R., Harris, C., Thomas, L. (2021). Varying-coefficient stochastic differential equations with applications in ecology. *Journal of Agricultural, Biological and Environmental Statistics*, 26 (3), pp. 446-463.
Best 2020 paper in JABES.

16. Conners, M., **Michelot, T.**, Heywood, E., Orben, R.A., Phillips, R., Vyssotski, A., Shaffer, S.A., Thorne, L. (2021). Hidden Markov models reveal major animal movement modes from multi-sensor tags: a case study of four albatross species. *Movement Ecology*, 9 (7), DOI: 10.1186/s40462-021-00243-z.

15. Runde, B.J., **Michelot, T.**, Bacheler, N.M., Shertzer, K.W. and Buckel, J.A. (2020). Assigning fates in telemetry studies using hidden Markov models: an application to deepwater groupers released with descender devices. *North American Journal of Fisheries Management*, 40, pp. 1417–1434.

14. **Michelot, T.**, Blackwell, P.G., Chamaillé-Jammes, S., Matthiopoulos, J. (2020). Inference in MCMC step selection models. *Biometrics*, 76, pp. 438-447.
Selected for Young Biometrician Award 2021 (honourable mention).

13. Farhadinia, M.S., **Michelot, T.**, Johnson, P.J., Hunter, L.T.B., MacDonald, D.W. (2020). Understanding decision making in a food-caching predator using hidden Markov models. *Movement Ecology*, 8 (9), DOI: 10.1186/s40462-020-0195-z.

12. Spangenberg, M., Serrouya, R., Dickie, M., DeMars, C., **Michelot, T.**, Boutin, S., Wittmann, M.J. (2019). Slowing down wolves to protect boreal caribou populations: a spatial simulation model of linear feature restoration. *Ecosphere*, 10 (10), DOI: 10.1002/ecs2.2904.

11. **Michelot, T.**, Gloaguen, P., Blackwell, P.G., Étienne, M.P. (2019). The Langevin diffusion as a continuous-time model of animal movement and habitat selection. *Methods in Ecology and Evolution*, 10 (11), pp. 1894-1907.

10. Bacheler, N. M., **Michelot, T.**, Cheshire, R. T., Shertzer, K. W. (2019). Fine-scale movement patterns and behavioral states of gray triggerfish Balistes capriscus determined from acoustic telemetry and hidden Markov models. *Fisheries Research*, 215, pp. 76-89.

9. **Michelot, T.**, Blackwell, P.G. (2019). State-switching continuous-time correlated random walks. *Methods in Ecology and Evolution*, 10 (5), pp. 637–649.

8. **Michelot, T.**, Blackwell, P.G., Matthiopoulos, J. (2019). Linking resource selection and step selection models for habitat preferences in animals. *Ecology*, 100 (1), DOI: 10.1002/ecy.2452.

7. Grecian, W.J., Lane, J., **Michelot, T.**, Wade, H., Hamer, K.C. (2018). Understanding the ontogeny of foraging behaviour: insights from combining marine predator bio-logging with satellite-derived oceanography in hidden Markov models. *Journal of the Royal Society Interface*, 15 (143), DOI: 10.1098/rsif.2018.0084.

6. McClintock, B., **Michelot, T.** (2018). momentuHMM: R package for generalized hidden Markov models of animal movement. *Methods in Ecology and Evolution*, 9 (6), pp. 1518-1530.

5. **Michelot, T.**, Langrock, R., Bestley, S., Jonsen, I.D., Photopoulou, T., Patterson, T.A. (2017). Estimation and simulation of foraging trips in land-based marine predators. *Ecology.* 98 (7), pp. 1932–1944.

4. Langrock, R., Kneib, T., Glennie, R., **Michelot, T.** (2017). Markov-switching generalized additive models. *Statistics and Computing.* 27 (1), pp. 259–270.

3. **Michelot, T.**, Langrock, R., Patterson, T.A. (2016). moveHMM: An R package for analysing animal movement data using hidden Markov models. *Methods in Ecology and Evolution*, 7 (11), pp. 1308–1315.

2. **Michelot, T.**, Langrock, R., Kneib, T., King, R. (2016). Maximum penalized likelihood estimation in semiparametric capture-recapture models. *Biometrical Journal*, 58, pp. 223–239.

1. Langrock, R., **Michelot, T.**, Sohn, A., Kneib, T. (2015). Semiparametric stochastic volatility modelling using penalized splines. *Computational Statistics*, 30, pp. 517–537.

PREPRINTS

Leos-Barajas, V., **Michelot, T.** (2018). An introduction to animal movement modeling with hidden Markov models using Stan for Bayesian inference. *arXiv preprint*. arXiv:1806.10639.

IN PREPARATION

Michelot, T. Multiscale models of animal movement with irreversible dynamics.

Klappstein, N.J., **Michelot, T.**, Fieberg, J., Avgar, T., Field, C., Mills Flemmind, J. Step selection analysis with penalised smooths.

Storey, E., **Michelot, T.** Scale dependence in hidden Markov models of animal movement.

Santos Neto, C., Dwyer, R., **Michelot, T.**, Cristescu, R. Land uses and urbanization shape movement behaviours of an endangered arboreal mammal.

Chance, A.M., Demarais, S., Strickland, B.K., Street, G.M., McKinley, W., **Michelot, T.** Mortality or mating: what drives male white-tailed deer movements during breeding season?

Schick, R.S., Adam, T., ..., **Michelot, T.**, ..., Harris, C.M. Analytical methods for characterizing the behavioral response of marine mammals to military sonars using animal borne sensors.

SOFTWARE

I have developed several software packages for the R programming language, including:

- **hmmTMB**: Hidden Markov models with non-parametric and random effects. Available on CRAN: `cran.r-project.org/package=hmmTMB`. Lead developer and maintainer.
- **moveHMM**: Analysis of animal movement data with hidden Markov models. Available on CRAN: `cran.r-project.org/package=moveHMM`. Lead developer and maintainer.
- **momentuHMM**: Analysis of multivariate ecological data with hidden Markov models (extension of moveHMM). Available on CRAN: `cran.r-project.org/package=momentuHMM`. Co-developer.
- **smoothSDE**: Varying-coefficient stochastic differential equations. Available on Github: `github.com/TheoMichelot/smoothSDE`. Lead developer and maintainer.

BOOK CHAPTERS

Antinori P., **Michelot T.**, Lescuyer P., Müller M., Acosta-Martin A.E. (2019)
Detection of unknown chemical adduct modifications on proteins: from wet to dry laboratory
In: Evans C., Wright P., Noirel J. (eds), Mass Spectrometry of Proteins
Methods in Molecular Biology, vol 1977. Humana Press, New York, NY.

TEACHING

Lead instructor

- STAT4370 Stochastic Processes, Dalhousie University *Fall 2023*
- STAT1060 Introductory Statistics for Science and Health Sciences, Dalhousie University *Winter 2023*
- MT5758 Multivariate Analysis, University of St Andrews *Spring 2022*

Guest lecturer

- MT4113 Computing in Statistics, University of St Andrews *Fall 2019*

- Ecological Modelling, University of Lisbon *Fall 2019*

Teaching training *Fall 2019*
Academic Staff Development Programme, University of St Andrews
- Assessment and feedback (half-day workshop)
- Effective lecturing (half-day workshop)

Workshop lecturer and demonstrator
Hidden Markov models for animal movement and other ecological data
- One-day workshop in Cape Town, South Africa. *June 2022*
- Two-day workshop in St Andrews, UK. *August 2017*
- Three-day workshop in Mossel Bay, South Africa. *March 2016*

Tutorial demonstrator and marker *2016–2018*
University of Sheffield
- MAS113 Introduction to Probability and Statistics (first year)
- MAS275 Probability Modelling (second year)
- MAS223 Statistical Inference and Modelling (second year)
- MAS6002 Statistical Laboratory (MSc)

STUDENT SUPERVISION

MSc dissertations
Joseph Barss (Dalhousie U., with Joanna Mills Flemming) *Since September 2023*
Topic: *Spatiotemporal modelling for fisheries*

Emma Storey (U. of St Andrews) *May–August 2022*
Topic: *Scale dependence in hidden Markov models of animal movement*

Tom Morgan (U. of St Andrews) *May–August 2022*
Topic: *Modelling the effect of financial market on bitcoin volatility*

MSc research placements
Carlina Feldmann (U. of St Andrews, with Theoni Photopoulou) *October–November 2019*
Topic: *Spatially-explicit models of animal movement for acoustic detection data*

Hugo Hervé (U. of St Andrews, with Len Thomas and Richard Glennie) *June–August 2019*
Topic: *Simulation study of multiple imputation techniques for the application of hidden Markov models to irregular and noisy telemetry data*

Honours projects
Mairi McHale (U. of St Andrews, with David Borchers) *2019–2020*
Topic: *Analysis of snow leopard movement data using hidden Markov models*

Student examination
Bantu Halam (U. of Cape Town, Department of Statistical Sciences) *September 2019*
External examiner for MSc thesis: *Mining a large shopping database to predict where, when, and what consumers will buy next*

GRANTS AND AWARDS

NSERC Discovery Grant *2023–2028*
"*Modelling animal movement and habitat selection across scales*"
$135,000

NSERC Discovery Launch Supplement *2023*
$12,500

Best 2020 paper in JABES
"*Varying-coefficient stochastic differential equations with applications in ecology*" (Michelot et al., 2021)

Young Biometrician Award – honourable mention *2021*
For "*Inference in MCMC step selection models*" (Michelot et al., 2020)
International Biometric Society (British and Irish Region) and Fisher Memorial Trust

Best student talk award *2016*
International Statistical Ecology Conference

PRESENTATIONS

Towards a mechanistic understanding of animal movement
Invited discussion leader at the Gordon Research Seminar on Movement Ecology, Bargga, Italy. May 2023.

Multiscale models of animal space use: from small-scale movement to large-scale distributions
Poster at the Gordon Research Conference on Movement Ecology, Bargga, Italy. June 2023.
Remote invited seminar for the BioMove research group. March 2023.

Flexible stochastic differential equations for animal movement
Invited talk at the International Conference in Statistics and Data Science, Florence, Italy. December 2022.

Varying-coefficient stochastic differential equations
Invited talk at the JABES showcase of the International Biometric Conference, online. October 2022.
Invited talk at the Joint Statistical Meeting, online. August 2022.

Detecting behavioural responses from movement data using stochastic differential equations
Talk at the International Statistical Ecology Conference, online. June 2022.

Multiscale models of animal movement and space use
Seminar at Dalhousie University, Halifax, Canada. February 2022.

Introduction to analysing animal movement data in R
Webinar of Ecological Forecasting Initiative & Ecological Society of America. February 2022.
Recording available online.

hmmTMB: hidden Markov models with non-parametric and random effects
Talk at the meeting of the National Centre for Statistical Ecology, online. June 2021.

Time-varying diffusion processes in movement ecology
Talk at the virtual International Statistical Ecology Conference, online. June 2020.

Linking scales of animal movement using statistical samplers
Invited seminar at the University of Alberta, Edmonton, Canada. March 2020.

Behavioural response studies of beaked whales using accelerometer data and diffusion models
Talk at the British Ecological Society conference, Belfast, UK. December 2019.

Spline-based diffusion models and application to accelerometer data
Invited seminar at the University of Glasgow, UK. November 2019.
Seminar at the University of St Andrews, UK. November 2019.

Hidden Markov models of animal movement and behaviour
Invited seminar at the University of Lisbon, Portugal. November 2019.
Invited talk at the congress of Soc. Portuguesa de Estatistica, Amarante, Portugal. November 2019.

Modelling animal movement and habitat selection across scales
Invited talk at the annual meeting of the BES movement ecology group, Sheffield, UK. July 2019.

The Langevin diffusion as a model of animal movement and habitat selection
Talk at the meeting of the National Centre for Statistical Ecology, Edinburgh, UK. June 2019.

Modelling animal movement and habitat selection across scales
Invited seminar at the School of Biosciences of the University of Cardiff, UK. March 2019.

Analysing telemetry data with hidden Markov models
Invited seminar at the Duke University Marine Lab, Beaufort, USA. March 2019.

Do animals move like statistical samplers?
Talk at the Research Students' Conference in Statistics and Probability, Sheffield, UK. July 2018.

Markov chain Monte Carlo as a model of animal movement and space use
Talk at the International Statistical Ecology Conference, St Andrews, UK. July 2018.

moveHMM and momentuHMM – Analysing animal movement in R
Invited tutorial at the moving2gather meeting, Montpellier, France. December 2017.

Can animals do MCMC? Linking resource selection and step selection models
Poster at the Bio-logging symposium, Konstanz, Germany. September 2017.

From movement to space use
Flash talk at the BES movement ecology group meeting, London, UK. July 2017.

momentuHMM: an R package for the analysis of general telemetry data using hidden Markov models
Talk at the EURING meeting, Barcelona, Spain. July 2017.

Can animals do MCMC? Integrating resource selection and step selection
Talk at the meeting of the National Centre for Statistical Ecology, Canterbury, UK. June 2017.

Analysing animal movement data with moveHMM – Conservation action plan for the wild haggis
Talk at the International Statistical Ecology Conference, Seattle, USA. June 2016.
Best student talk award

Multistate Ornstein-Uhlenbeck processes for modelling animal movement
Talk at the Research Students' Conference in Probability and Statistics, Dublin, Ireland. June 2016.

moveHMM: an R package for modelling animal movement with hidden Markov models
Seminar at the Australian Antarctic Division, Hobart, Australia. June 2016.
Seminar at the Sea Mammal Research Unit, St Andrews, UK. November 2015.

A statistical introduction to animal movement modelling
Talk at the German Statistical Week, Hamburg, Germany. September 2015.

COMMUNITY INVOLVMENT

Associate Editor *Since 2021*
Journal of Statistical Theory and Practice

Reviewer

Advances in Statistical Analysis (2020), *Animals* (2019), *Bulletin of Mathematical Biology* (2023), *Ecography* (2018), *Ecological Applications* (2017), *Ecological Monographs* (2019), *Ecology* (2023), *Ecology and Evolution* (2016, 2017, 2023), *Ecology Letters* (2019), *Emu – Austral Ornithology* (2018), *Fish and Fisheries* (2021), *Fisheries Research* (2023), *Journal of Agricultural, Biological, and Ecological Statistics* (2017, 2018), *Journal of Animal Ecology* (2019, 2022), *Journal of Mammalogy* (2018), *Journal of the Royal Statistical Society Series C* (2023), *Journal of Statistical Theory and Practice* (2022), *Journal of Zoology* (2019), *Marine Ecology Progress Series* (2022), *Mathematical Biosciences* (2023), *Methods in Ecology and Evolution* (2016, 2017×3, 2018, 2021, 2022), *Movement Ecology* (2016×3, 2019, 2020×3, 2022×2), *Nature Ecology & Evolution* (2020), *Oikos* (2022), *Plos One* (2018), *Scientific Reports* (2018, 2019), *Sensors* (2021).

Early career researcher representative *2019–2022*

Executive committee of the National Centre for Statistical Ecology, UK

Seminar organiser

Dalhousie Statistics seminar series *Since 2022*

National Centre for Statistical Ecology seminar series *2021–2022*

OTHER SKILLS

Programming	R (including Rcpp, Stan, TMB), C++, Python
Tools	git, LaTeX, R development tools (devtools, unit testing, profiling, documentation)
Languages	French, English