Théo Michelot

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theo.michelot@dal.ca

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

26. Santos Neto, C., Dwyer, R., **Michelot, T.**, Cristescu, R. (in press). Effects of urbanisation on the movements of an arboreal specialist using hidden Markov models. *Movement Ecology*.

25. **Michelot, T.** (2025). hmmTMB: hidden Markov models with flexible covariate effects in R. *Journal of Statistical Software*, 114(5), pp. 1–45.

24. Klappstein, N., **Michelot, T.**, Fieberg, J., Pedersen, E., & Flemming, J. M. (2024). Step selection analysis with non-linear and random effects. *Methods in Ecology and Evolution*, 15, pp. 1332–1346.

23. Invernizzi, E., **Michelot, T.**, Popov, V., Ng, N., Macqueen, E., Rouviere, A., Webster, M., & Sasaki, T. (2024). Identifying cues for self-organized nest wall-building behaviour in the rock ant, Temnothorax rugatelus, using hidden Markov models. *Animal Behaviour*.
DOI: 10.1016/j.anbehav.2024.01.008.

22. **Michelot, T.**, Klappstein, N.J., Potts, J.R., Fieberg, J. (2024). Understanding step selection analysis through numerical integration. *Methods in Ecology and Evolution*. 15, pp. 24–35.

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

Michelot, T. (2024) Multiscale modelling of animal movement with persistent dynamics. *arXiv preprint*. arXiv:2406.15195.

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

Klappstein, K., **Michelot, T.**, Togunov, R.R., Mills Flemming, J. Three-dimensional correlated random walks for animal movement and habitat selection.

Kim, D., **Michelot, T.**, Mertes, K., Stabach, J.A., Fieberg, J. Detecting disease progression from animal movement using hidden Markov models.

Larue, B., Farr, J., ..., **Michelot, T.**, ..., Hebblewhite, M. Inferring behavioral states from tracking data with hidden Markov models – A validation study using GPS video-camera collars.

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

- STAT3360 Probability, Dalhousie University *2025*
- STAT3460 Intermediate Statistical Theory, Dalhousie University *2024, 2025*
- STAT3450 Statistical Learning with R, Dalhousie University *2024, 2025*
- STAT4370 Stochastic Processes, Dalhousie University *2023, 2024, 2025*

- STAT1060 Introductory Statistics for Science and Health Sciences, Dalhousie University *2023*
- MT5758 Multivariate Analysis, University of St Andrews *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 co-instructor

Topics: Hidden Markov models, ecological data analysis

- One-day workshop in Swansea, UK *July 2024*
- One-day remote workshop (University of Porto) *February 2024*
- One-day remote workshop (International Statistical Ecology Conference) *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)

SUPERVISION

PhD students

Margo Paris (Dalhousie U., with Joanna Mills Flemming) *Since September 2024*
Topic: *Statistical models for modelling encounters in animal movement data*

MSc students

Parker Wiseman (Dalhousie U.) *Since September 2025*
Topic: *TBD*

Joseph Barss (Dalhousie U., with Joanna Mills Flemming) *2023–2025*
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*

Postdoctoral researchers

Hassen Allegue (Dalhousie U.) *Since September 2025*
Topic: *Modelling biological hotspots in the ocean*

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 dissertations

Mark McTaggart (Dalhousie U.) *Winter 2024*
Topic: *Exploring model selection in animal movement hidden Markov models*

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

Student examination

Martin Pettersen (NTNU, Department of Mathematical Sciences) *August 2025*
External examiner for MSc thesis: *Comparative study of likelihood approximations for the Langevin movement model*

Aurélien Nicosia (U. Laval, Department of Mathematics and Statistics) *October 2024*
External examiner for PhD thesis: *General multistate models for the analysis of animal movement*

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 paper of the year 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

Modèles lisses de déplacement animal/Smooth models of animal movement
Invited talk at the annual meeting of the Statistical Society of Canada, Saskatoon, Canada. May 2025.
SSC Bilingualism prize

Multiscale modelling of animal movement
Invited talk for marine animal movement workshop, online. May 2025.

Modèles multi-échelles pour les déplacements d'animaux
Invited seminar at Université de Laval, Québec, Canada. October 2024.

Multiscale modelling of animal movement with underdamped dynamics
Talk at the International Statistical Ecology Conference, Swansea, UK. July 2024.
Invited talk at the annual meeting of the Statistical Society of Canada, St John's, Canada. June 2024.

Analysing animal movement and behaviour in R
Invited remote workshop for University of Porto, Portugal. February 2024.
Invited workshop at Memorial University of Newfoundland, St John's, Canada. November 2023.

Flexible hidden Markov models in ecology and the R package hmmTMB
Invited seminar at Memorial University of Newfoundland, St John's, Canada. November 2023.
Invited talk at CANSSI/OTN early-career workshop, Halifax, Canada. November 2023.
Invited webinar for the Journal of Statistical Theory and Practice, online. November 2023.
Recording available online.

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
Remote seminar for Dalhousie University, Halifax, Canada. February 2022.

Introduction to analysing animal movement data in R
Invited webinar for 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.

SERVICE

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

Reviewer
Advances in Statistical Analysis, *Annals of Applied Statistics*, *Biometrics*, *Bulletin of Mathematical Biology*, *Ecography*, *Ecological Applications*, *Ecological Monographs*, *Ecology*, *Ecology and Evolution*, *Ecology Letters*, *Journal of Agricultural, Biological, and Ecological Statistics*, *Journal of Animal Ecology*, *Journal of the Royal Statistical Society Series C*, *Journal of Statistical Theory and Practice*, *Landscape Ecology*, *Mathematical Biosciences*, *Methods in Ecology and Evolution*, *Movement Ecology*, *Nature Ecology & Evolution*, *Plos One*, *Scientific Reports*, *Statistics and Probability Letters*.

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++
Tools	git, LaTeX, R development tools (devtools, unit testing, profiling, documentation)
Languages	French, English