

The University of Bordeaux is recruiting a postdoctoral researcher with a statistics or quantitative ecology background to work on improving the *identifiability of dynamic ecological models*, with a focus on models describing the *population dynamics of interacting species*.

Model parameters are unidentifiable when several parameter values give rise to identical likelihoods, which causes frequent issues in nonlinear and/or dynamic models. While statisticians have long known about such difficulties [1, 2] these remain often neglected in the ecological and quantitative biology literatures, and have only recently become more mainstream [3, 4]. Ecological models of community dynamics, with several species interacting with each other, are particularly prone to identifiability issues since interactions between species greatly increase model dimensionality, making sometimes “inverse estimation” from population counts impossible. Combining multiple data streams in mechanistic models has been highlighted as a way forward to improve model identifiability [5, 6], especially in highly stochastic settings, bringing the philosophy of integrated population models [7] up to the community level.

The postdoc will work closely with Dr. Frédéric Barraquand at the Institute of Mathematics of Bordeaux. The postdoc position is part of a larger project where we plan to fit integrated predator-prey models for birds (collaboration with Olafur Nielsen, Icelandic INH; Olivier Gimenez, CNRS Montpellier) and explore the statistical properties of competitive/mutualistic models of primary producer communities (with Florian Hartig, University of Regensburg; Matteo Detto, Princeton). The recruited postdoc will have opportunities, depending on her or his interests, to work on:

- formal aspects of identifiability of stochastic dynamical systems with interacting species
- developing software for assessing model identifiability and combining various datasets
- integrated model fitting on case studies or simulated data sets

We are looking for a researcher with a strong statistics and/or modelling skillset, able to work in a team. Proficiency in coding (e.g. R, C/C++) is expected and some applied bayesian statistics (e.g. in Jags or Stan) would be very valuable. A good working knowledge of population dynamics or food web/competition models would be a plus.

The position is funded for 2.5 years (with salary based on experience) by an ANR JCJC grant to F. Barraquand. Informal enquiries are welcome. To formally apply, applicants should send a cover letter describing their interest in the position, a curriculum vitae, and name and contact information of three references. Contact: frederic.barraquand@u-bordeaux.fr

References

- [1] Rothenberg TJ (1971) Identification in parametric models. *Econometrica* 39:577–591.
- [2] Catchpole EA, Morgan BJ (1997) Detecting parameter redundancy. *Biometrika* 84:187–196.
- [3] Auger-Méthé M, et al. (2020) An introduction to state-space modeling of ecological time series. *arXiv preprint arXiv:2002.02001*.
- [4] Cole D (2020) *Parameter Redundancy and Identifiability* (CRC Press).
- [5] Barraquand F, Gimenez O (2019) Integrating multiple data sources to fit matrix population models for interacting species. *Ecological Modelling* 411:108713.
- [6] Barraquand F, Gimenez O (2021) Fitting stochastic predator–prey models using both population density and kill rate data. *Theoretical Population Biology* in press:xx–xx.
- [7] Besbeas P, Freeman SN, Morgan BJ, Catchpole EA (2002) Integrating mark–recapture–recovery and census data to estimate animal abundance and demographic parameters. *Biometrics* 58:540–547.