

Jimmy Garnier

CNRS chargé de recherche (CRCN)

UMR 5127 CNRS, Laboratoire de MATHématiques, Université Savoie Mont-Blanc, France

Mail: jimmy.garnier@univ-smb.fr

Webpage: <https://www.lama.univ-savoie.fr/pagesmembres/garnier/>

Current position

Since 2013 CNRS junior researcher at LAMA, Université Savoie Mont-Blanc, Chambéry

Education

- 2012 **Ph.D., Mathematics** INRAE and Aix-Marseille University
Mathematical analysis of population dynamics models: Partial Differential Equations integro-differential equations;
Advisors : F Hamel (LATP Marseille) and L Roques (INRAE Avignon)
Jury : H Berestycki, O Diekmann (Ref.), B Perthame (Ref.), A Rapaport and J M Roquejoffre
- 2009 **Agrégation de Mathématiques**
- 2008 **Master's degree in PDE and Numerical Analysis**, Aix-Marseille University
- 2006-2010 **École Normale Supérieure de Cachan**, interdisciplinary program in mathematics and biology.

Research interests – *Mathematical modeling applied to ecology*

Nonlinear Analysis of PDEs, Reaction–dispersion equations and propagation phenomena;
Mathematical modeling in ecology and evolution, biological invasion, biodiversity and adaptation to climate change;

Significant publications

Mathematics journals: (9 articles)

- V Calvez, **J Garnier** and F Patout. [A quantitative genetics model with sexual mode of reproduction in the regime of small variance](#), J École polytechnique — Mathématiques, 6, 537–579, (2019);
- E Bouin, C Henderson, **J Garnier** and F Patout. [Thin front limit of an integro–differential Fisher–KPP equation with fat–tailed kernels](#), SIAM J. Math. Anal., 50(3), 3365–3394, (2018);

Applied mathematics and theoretical ecology journals: (8 articles)

- M Martignoni, M M Hart, R Tyson and **J Garnier**, [Diversity within mutualist guilds promotes coexistence and reduces the risk of invasion from an alien mutualist](#), Proc. R. Soc. B, 2312, (2020);

General scientific journals: (5 articles, PNAS, Scientific Reports, Global Change Biology)

- S Jenouvrier, M Holland, D Iles, S Labrousse, L Landrum, **J Garnier**, H Caswell, H Weimerskirch, M La Rue, R Ji, C Barbraud . [The Paris Agreement objectives will likely halt future declines of emperor penguins](#), Global Change Biology, (2019);

International visibility

- MOPGA fellowship of R Tyson (1 year visit in my lab);
- International invitation (PIMS Distinguished Visitor award 1 month, NCAR 2 weeks);
- Invited speaker at international conferences (AIMS Taiwan, CIMPA, CIRM, BESM, Univ Boulder)
- (2019-2021) Committee member of SMCAI (Société Canadienne de Maths Appliquées et Industrielles);

Main collaborators

Mathematics:

France: L Roques, V Calvez, F Patout, E Bouin, F Hamel, T Giletti, G Nadin,

Canada/USA: M A Lewis, R Lui, R Tyson, C Henderson.

Interactions with ecologists:

France: S Ibanez, L Ledru, G Martin, W Thuillier,

Canada/USA: S Jenouvrier, M Hart.

Fellowships, projects and awards

2020	Award PIMS Distinguished Visitor at Univ British Columbia, Canada
2017	PI Biotherm and Mission Blue grant – Emperor penguins
2017-2021	Associated researcher to the ANR project – GlobNets
2015-2020	Secondary investigator (15%) of the ERC starting grant – MESOPROBIO
2015-2018	Associated researcher to the ANR project – NONLOCAL
2014	AAP project junior researcher Univ Savoie Mont-Blanc
Since 2014	Researcher in the French INRAE network – MEDIA ;
2011-2014	Associated researcher to the INRAE meta-project – AACC ;
2013	CIMI postdoctoral fellowship , Toulouse University (declined for the CNRS position);
2013	Thesis award from Aix-Marseille University.
2012 - 2013	Post-doctoral fellowship University of Alberta, Canada;

Popularization of science

2020	Seminar Panorama de la science ENS Paris Saclay;
2019	Mainstream press articles about What future do emperor penguins face?
2019	Public colloquium Buis organized by the association Parc et Jardin du Centre-Val de Loire;
2018-2019	Atelier Math en Jeans (high-school and middle-school)
2015-2018	Public presentation in high school for the “ Semaine des Mathématiques”;

Animation of science

2021	Co-organizer of symposium at International Society of Ecological Modeling conference, Canada
2018	Organizer of <i>Journées de l'ANR NONLOCAL</i> , 21-23 March 2018, Chambéry
2017	Co-organizer of <i>Journée Jeunes EDPistes 2017</i> (6th edition) with D Bresch, M Gisclon and E Miot, (70 participants, budget: 13k€);
Since 2015	Organizer of the seminar in PDE and applications, University Savoie Mont-Blanc;
Since 2014	Organizer of Workshop EDPs ² for team members of the lab;

Institutional responsibilities

Since 2021	member of consultative committee 25-26, Univ Savoie Mont-Blanc
2015-2020	member of the lab council LAMA
Referee	<i>Mathematics</i> : DCDS-Serie A, J Dyn Diff Equ, Nonlinearity, SIAM J Math Anal <i>Mathematical biology</i> : J Math Biol, Math Med Biol, Bull Math Biol, <i>Ecology and general science</i> : PNAS, Ecology Letters, Proc R Soc Interfaces;

Supervision and mentoring

phd student	L Ledru (since 2018) co-supervision with S Ibanez and C Gallet (LECA, Univ Savoie), P Lafontaine (2017-2020), co-supervision with D Bucur (Univ Savoie), [retired associate researcher LAMA] M Martignoni (2018-2020) co-supervision with R Tyson (Canada) [post-doc Memorial Univ] F Patout (2017-2019) co-supervision with V Calvez (ICJ, Univ. Lyon) [post-doc INRAE Avignon],
post doc	M Ohlmann (2020-2021) co-supervision with L Vuillon (LAMA) T Bourgeron (2015-2017) co-supervision with V Calvez,
stud visitor	N Marculis PhD student at Univ. Alberta, Canada, (1 month invitation) Y Youssouf (2015-2016), PhD student at Saint-Louis Univ, Senegal, (1 month invitation)
master stud	M Ferre, Lea Zuccali (2020) L Ledru (2018) co-supervision with S Ibanez; F Patout (2015-2016) co-supervision S Jenouvrier, L Desvillettes, V Calvez.

Teaching activities

2018-2020	Master course in Martingales and Markov Chain, Univ Savoie–Mont Blanc;
2017-2020	Master course in Mathematical modeling and scientific computing, Univ Savoie–Mont Blanc;
2015-2016	Doctoral and Master course in Mathematical modeling in life science, Univ Grenoble-Alpes;
2015	Lecture group on Reaction-diffusion equations in ecology, ENS Lyon

Publications in mathematics journals

- [1]. V Calvez, **J Garnier** and F Patout. [A quantitative genetics model with sexual mode of reproduction in the regime of small variance](#), *J École polytechnique — Mathématiques*, 6, 537–579, (2019);
- [2]. E Bouin, C Henderson, **J Garnier** and F Patout. [Thin front limit of an integro-differential Fisher-KPP equation with fat-tailed kernels](#), *SIAM J. Math. Anal.*, 50(3), 3365–3394, (2018);
- [3]. **J Garnier**, F Hamel and L Roques. [Transition fronts and stretching phenomena for a general class of reaction-dispersion equations](#), *Discrete Contin. Dyn. Syst. Ser. A*, 37(2):743–756, (2017);
- [4]. J Coville, O Bonnefon, **J Garnier** and L. Roques. [Inside dynamics of solutions of integro-differential equations](#), *Discrete Contin. Dyn. Syst. Ser. B*, 19(10):3057–3085, (2014);
- [5]. O Bonnefon, **J Garnier**, F Hamel and L Roques. [Inside dynamics of delayed travelling waves](#), *Math. Mod. Nat. Phen.*, 8: 44–61, (2013);
- [6]. **J Garnier**, T Giletti, G Nadin. [Maximal and Minimal spreading speed for reaction diffusion equations in nonperiodic slowly varying media](#), *J. Dynam. Differential Equations*, 24(3):521–538, (2012);
- [7]. **J Garnier**, T Giletti, F Hamel, L Roques. [Inside dynamics of pulled and pushed fronts](#), *J. Math. Pures Appl.*, 11:173–188, (2012);
- [8]. M Cristofol, **J Garnier**, F Hamel et L Roques. [Uniqueness from pointwise observations in a multi-parameter inverse problem](#), *Comm. Pure Appl. Anal.* 11(1): 173–188, (2012);
- [9]. **J Garnier**. [Accelerating solutions in integro-differential equations](#), *SIAM J. Math. Anal.*, 1955–1974, (2011).

Publications in applied mathematics and theoretical ecology journals

- [1]. **J Garnier** and P Lafontaine. [Dispersal and good habitat quality promote neutral genetic diversity in metapopulations](#), *Bull Math Biol* 83, 20 (2021);
- [2]. M Martignoni, **J Garnier**, M Hart and R Tyson. [Investigating the impact of the mycorrhizal inoculum on the resident fungal community and on plant growth](#), *Ecol. Model.*, 438, 109321, (2020);
- [3]. M Martignoni, **J Garnier**, M Hart and R Tyson. [Parasitism within mutualist guilds explains the maintenance of diversity in multi-species mutualisms](#), *Theo. Ecol.*, 13, 615–627, (2020);
- [4]. M Martignoni, M M Hart, R Tyson and **J Garnier**, [Diversity within mutualist guilds promotes coexistence and reduces the risk of invasion from an alien mutualist](#), *Proc. R. Soc. B*, 2312, (2020);
- [5]. N Marculis, **J Garnier**, R Lui and M A Lewis. [Inside dynamics for stage-structured integrodifference equations](#), *J. Math. Biol.*, (2019);
- [6]. **J Garnier** et M Lewis. [Expansion under climate change: the genetic consequences](#), *Bull. Math. Biol*, 78(11), 2165–2185, (2016);
- [7]. J Coville, O Bonnefon, **J Garnier**, F Hamel and L. Roques. [The spatio-temporal dynamics of neutral genetic diversity](#), *Ecol. Complexity*, 20: 282–292, (2014);
- [8]. **J Garnier**, F Hamel, L Roques. [Success rate of a biological invasion and the spatial distribution of the founding population](#), *Bull. Math. Bio.*, 74:453–473, (2012);

Publications in general scientific journals

- [1]. L Roques, C Desbiez, K Berthier, S Soubeyrand, E Walker, E Klein, **J Garnier**, B Moury and J Papaix. [Emerging strains of watermelon mosaic virus in Southeastern France: model-based estimation of the dates and places of introduction](#), *Scientific Reports*, (2021), accepted;
- [2]. S Jenouvrier, M Holland, D Iles, S Labrousse, L Landrum, **J Garnier**, H Caswell, H Weimerskirch, M La Rue, R Ji, C Barbraud . [The Paris Agreement objectives will likely halt future declines of emperor penguins](#), *Global Change Biology*, (2019);
- [3]. L Roques, **J Garnier** and G Martin [Beneficial mutation-selection dynamics in finite asexual populations: a free boundary approach](#). *Scientific Reports*, 7, 17838 (2017);
- [4]. F Patout, S Jenouvrier, **J Garnier** and L Desvillettes. [Influence of dispersion behaviors on the metapopulation dynamic of species endangered by climate change](#), *Biological Conservation*, 212(A):63–73, (2017);
- [5]. L Roques, **J Garnier**, F Hamel and E Klein. [Allee effect promotes diversity in traveling waves of colonization](#), *Proc. Natl. Acad. Sci. USA*, 109(23): 8828–8833, (2012);

Chapters in book

- [1]. L Roques, J-P Rossi, H Berestycki, J Rousselet, **J Garnier**, J-M Roquejoffre, L Rossi, S Soubeyrand, C Robinet, [Modeling the Spatio-temporal Dynamics of the Pine Processionary Moth](#), in *Processionary Moths and Climate Change: An Update*, eds Springer Netherlands, 10.1007/978 – 94 – 017 – 9340 – 7_5, 2015.

Preprints and ongoing project

- J Garnier – Habilitation à Diriger des Recherches**: work in progress (Spring 2022);
G Clucas, S Jenouvrier, **J Garnier** and J Younger. [Genetic structure informs us on penguins dispersal](#), ongoing;
J Garnier, S Ibanez, L Ledru, [Eco-evolution of adaptative foraging](#), ongoing work;
E Bouin, T Bourgeron, V Calvez, O Cotto, **J Garnier**, T Lepoutre, O Ronce [Adaptation to a changing environment: what me Normal?](#), ongoing work;
E Bouin, V Calvez, O Cotto, **J Garnier**, O Ronce [Equilibria of quantitative genetics models beyond the Gaussian approximation II: Senescence and changing environment](#), ongoing work;
C Gallet, **J Garnier**, S Ibanez, L Ledru, [Spatial structure of natural boxwood and box tree moth in Europe can promote long-term coexistence](#), submitted;
T Bourgeron, V Calvez, **J Garnier**, T Lepoutre [Existence of recombination–selection equilibria for populations structured by an age variable](#), preprint;

Significant publications

According to theoretical and experimental ecologists, there is a need in quantitative models that are able to cope with the complexity of issues arising in life science. The great challenge of my research is to develop and analyze complex PDEs models for biological propagation and adaptation phenomena. My strong interactions with ecologist needed to provide relevant and meaningful models and feedback on applications as well as the development of new mathematical approaches required to perform the analyze, are two powerful sources of motivation for my research. As an applied mathematician, I publish articles in mathematical journals, applied mathematics or theoretical ecology journals or even in general scientific journals. Here are 4 selected articles showing the diversity of my scientific research with strong interactions with ecology.

Mathematics journals:

- V Calvez, **J Garnier** and F Patout. [A quantitative genetics model with sexual mode of reproduction in the regime of small variance](#), *J École polytechnique — Mathématiques*, 6, 537–579, (2019);

Recent developments in evolution biology have proposed a new quantitative PDE model to understand the complex phenomenon of adaptation in sexual population. The mathematical challenge is to understand the convergence towards a stationary distribution observed in many experiments. Conversely to previous studies, we use perturbative analysis techniques combined with rigid contraction properties to construct our stationary solutions. Our alternative methodology extends previous results obtained with linear operators and it provides a general approach to understand spectral properties of nonlinear operators.

- E Bouin, C Henderson, **J Garnier** and F Patout. [Thin front limit of an integro–differential Fisher–KPP equation with fat–tailed kernels](#), *SIAM J. Math. Anal.*, 50(3), 3365–3394, (2018),

Accelerating propagation phenomenon has been reported experimentally and theoretically in various scientific fields (ecology, physics, evolution) and many PDE models reproduce this behavior. However, this phenomenon is far from being well understood. We have developed a new general method, based on sub and super-solutions of PDEs and geometrical optics approach, to describe the accelerating solutions of these models.

Applied mathematics and theoretical ecology journals: (8 articles)

- M Martignoni, M M Hart, R Tyson and **J Garnier**, [Diversity within mutualist guilds promotes coexistence and reduces the risk of invasion from an alien mutualist](#), *Proc. R. Soc. B*, 2312, (2020),

Green fertilizers based on Arbuscular Mycorrhizal Fungi (AMF) seems to be a relevant and ecological alternative to chemical fertilizers. But what is the impact of these industrial fertilizers on the wild-type AMF

communities? Although predator-prey systems receive a lot of attentions, mutualistic systems are badly understood. Here, we provides a theoretical framework to explore the stability and the spreading properties of this system. In particular, we show that diversity is a source of stability among this system.

General scientific journals: (5 articles, PNAS, Scientific Reports, Global Change Biology)

- S Jenouvrier et al. [The Paris Agreement objectives will likely halt future declines of emperor penguins](#), Global Change Biology, (2019),

*Understanding the ecological consequences of climate changes are a major issue of our century. To tackle this issue, we focus on an emblematic species of Antarctica, the Emperor Penguin (*Aptenodytes forsteri*). By combining our mathematical model on this species dynamics and the most recent climate projections, we have shown that if climate change continues at its current rate, Emperor Penguins could virtually disappear by the year 2100 due to loss of Antarctic sea ice. However, a more aggressive global climate policy such as the Paris' agreement on climate, can halt the penguins' march to extinction.*

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