

Ricardo Martinez-Garcia

Curriculum Vitae

Young Investigator Group Leader · Center for Advanced Systems Understanding (CASUS)
Helmholtz-Zentrum Dresden-Rossendorf · Conrad-Schiedt-Str. 20, D-02826 Görlitz, Germany
r.martinez-garcia@hzdr.de · rmtzgarcia.github.io · Born 2 February 1988 · Spanish national, resident in Germany since 2022

ACADEMIC DEGREES

- 2014** **Ph.D. in Physics**, University of the Balearic Islands, at the Institute for Cross-Disciplinary Physics and Complex Systems (IFISC), Spain. June 2014.
Including a three-month research stay at the Smithsonian Conservation Biology Institute, USA.
Distinguished by the Montserrat Casas Prize for the best doctoral research in the Balearic Islands.
- 2011** **M.Sc. in Physics**, University of the Balearic Islands, Spain.
- 2010** **B.Sc. in Physics**, specialisation in Theoretical Physics, University of La Laguna, Spain.

PROFESSIONAL APPOINTMENTS

- 2022 –** **Young Investigator Group Leader**, Center for Advanced Systems Understanding (CASUS) and Helmholtz-Zentrum Dresden-Rossendorf, Görlitz, Germany.
- 2022 –** **International Faculty**, Princeton / CUNY Center for the Physics of Biological Function, Princeton, USA.
- 2020 –** **External Faculty**, Graduate Program in Ecology, University of São Paulo, Brazil.
Accredited to supervise doctoral candidates and to teach within the program.
- 2020 – 22** **Simons Associate**, Quantitative Life Sciences section, Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy.
- 2019 – 22** **Simons–FAPESP Assistant Professor**, ICTP South American Institute for Fundamental Research (ICTP-SAIFR) and Institute for Theoretical Physics, State University of São Paulo, Brazil.
Tenure granted March 2022.
- 2016 – 19** **Life Sciences Research Foundation Postdoctoral Fellow**, Department of Ecology and Evolutionary Biology, Princeton University, USA.
- 2014 – 16** **Postdoctoral Research Associate**, Department of Ecology and Evolutionary Biology, Princeton University, USA.
- 2010 – 14** **CSIC JAE-Predoc Fellow**, Institute for Cross-Disciplinary Physics and Complex Systems (IFISC), Palma de Mallorca, Spain.

AWARDS AND HONOURS

- 2023** **Junior Scientific Award** of the Complex Systems Society.
- 2021** **Affiliated Member of the Brazilian Academy of Sciences**. Scientists under 40, elected by the regional presidencies of the Academy for a five-year membership.
- 2015** Honourable Mention of the Spanish National Research Council (CSIC) for research achievements in the academic year 2014/15.
- 2014** **Montserrat Casas Award**, Sciences, Engineering and Architecture — best doctoral research in the Balearic Islands, Spain.
- 2013** Banco Santander–UIB Award for outstanding doctoral candidates, University of the Balearic Islands.
- 2006** Bronze Medal, Spanish Physics Olympiad.

RESEARCH FUNDING

Principal Investigator on six competitive grants, approximately **€1.97 M** in total. Where an award consisted of positions rather than a cash sum, it is monetised at DFG standard personnel rates 2026 and this is stated explicitly. My own share is given for each grant. In addition, five externally funded fellowship holders (≈ €93,000) have been hosted in my group.

AS PRINCIPAL INVESTIGATOR

- 2025 – 28** **CASUS Open Project**, Center for Advanced Systems Understanding – Helmholtz-Zentrum Dresden-Rossendorf.
Competitive internal call with external peer review. Role: PI (Co-PI: Prof. Dr. Viola Priesemann). Awarded: €5,000 research costs and one doctoral researcher position in my group (E13, 75 %, 3 years). Monetised at DFG standard personnel rates 2026: **€188,600**.
- 2022 – 27** ***Self-organization and collective phenomena in complex biological systems***. CASUS Young Investigator Group, funded by CASUS–HZDR, budget line FWU-C.
Competitive open call, external application, peer-reviewed. Role: sole PI.
Awarded: own position (E14, 100 %, 5 years), two postdoctoral positions (E13, 100 %, 5 years) and €125,000 research expenses. Monetised at DFG standard personnel rates 2026: **€1,323,000**. Own share: 100 %.
- 2019 – 23** ***Towards a mechanistic theory for biological pattern formation and their ecosystem-management opportunities***. São Paulo Research Foundation (FAPESP), Brazil's largest state research foundation. Grant 2019/24433-0.
Awarded: R\$ 1,100,000 (≈ **€250,000** at the 2019 ECB annual average), funding one doctoral and two Master's fellowships plus research consumables over four years. Own share: 100 %.
- 2020 – 22** ***The role of environmental flows on the dynamics of microbial communities***. Simons Foundation, grant 284558FY19 — **€23,000**.
- 2020 – 22** ***Understanding the ecology and evolution of microbial social behaviors in turbulent environments: cooperation as a case study***. Instituto Serrapilheira, Serra-1911-31200.
Open national call with international peer review, success rate below 1 %. Awarded: 100,000 BRL (≈ **€22,700** at the 2019 ECB annual average).
- 2016 – 19** ***Using Dictyostelium discoideum to understand the role of ecology and multiple fitness tradeoffs in the evolution of multicellularity***. Life Sciences Research Foundation postdoctoral fellowship, funded by the Gordon and Betty Moore Foundation, GBMF2550.06.
Awarded: US\$ 180,000 (≈ **€162,600** at the 2016 ECB annual average). Own share: 100 % — US\$ 150,000 salary and US\$ 30,000 research expenses.

ACADEMIC HOST FOR COMPETITIVE FELLOWSHIP HOLDERS

- 2026 – 27** **Guilherme H. Costa**. International Postdoctoral Fellowship, Brazilian National Council for Scientific and Technological Development (CNPq), grant 201250/2026-8 — ≈ €26,000.
- 2025 – 26** **Ian Braga**. International Postdoctoral Fellowship, CNPq, grant 401209/2024-5 — ≈ €26,000.
- 2024** **Matheus Bongestab**. DAAD co-funded short-term research grant Brazil, ref. 91900240 — €5,750.
- 2023 – 24** **Rafael Menezes**. International doctoral stays, Brazilian Ministry of Education, CAPES-PRINT, fellowship 88887.889773/2023-00 — €19,310.
- 2023** **Nathan Silvano**. International doctoral stays, CAPES-PRINT, fellowship 88887.803415/2023-00 — €16,150.

PARTICIPATION IN LARGE COORDINATED GRANTS

- 2022 – 27** **ICTP South American Institute for Fundamental Research: a regional centre for Theoretical Physics.** São Paulo Research Foundation (FAPESP), 2021/14335-0. PI: Prof. Dr. Nathan Berkovits. Total volume ≈ €2.2 M.
Role: responsible for leading the research line on complex systems and biological physics, with one postdoctoral appointment and travel funds under my direction.
- 2013 – 16** **Complex Systems Physics: Information, Technology, Society and Ecology (INTENSE@COSYP).** Spanish Ministry of Economy and Competitiveness, FIS2012-30634 (€515,460). PI: Prof. Dr. Maxi San Miguel.
Role: contributed to the work package on ecological systems.
- 2008 – 12** **Física Interdisciplinar de Sistemas Complejos (FISICOS).** Spanish Ministry of Education and Science, FIS2007-60327, CONSOLIDER C (€1,318,900). PI: Prof. Dr. Maxi San Miguel.
Role: contributed to the work package on ecological systems.

RESEARCH NETWORKS AND INTERNATIONAL COOPERATION

- 2025 – 29** **COST Action CA24104 — Stochastic Differential Equations: Computation, Inference, Applications (STOCHASTICA).**
European Cooperation in Science and Technology. Member. A European network linking applied modellers, theoretical mathematicians, numerical analysts and statisticians around the theory, numerics, inference and application of stochastic differential equations.
- 2026** **15th Sino-German Frontiers of Science and Technology Symposium (SINOGFOST 2026) — Advancing Resilience in Science, Health and Technology.** Suzhou, China.
Invited participant. 60 participants in total, 30 from Germany and 30 from China, selected by the **Alexander von Humboldt Foundation** and the Chinese Academy of Sciences.

PUBLICATIONS

40 peer-reviewed articles, 3 book chapters and 8 preprints under review. 18 as first or co-first author and 15 as senior author; senior or (co-)first author on approximately 70 % of published peer-reviewed articles.

Author markers: ♦ corresponding author · * shared first authorship · # equal contribution · † researcher mentored by me.

Peer-reviewed articles

- 40** M. Bongestab[†], D. Pinto-Ramos[†], **R. Martinez-Garcia[♦]**. Self-organized vegetation patterns promote persistence of plant–pollinator mutualisms under environmental stress. *PLOS Ecosystems*, in press. Preprint: 10.48550/arXiv.2512.00254
- 39** A. Martínez, A. García-Herrero, A. Roldán, M. García-Cobo, Z. Fresno, C. Camacho, M. Neunschwander Kurtz, M. Maranzano, F. Di Nezio, F. Cozzoli, S. Boulamail, **R. Martinez-Garcia**, E. Mateo, L. Moro, E. Domínguez, C.D. Jorge[†], D. Brankovits, H. Wilkens, J. Lario, R. Fernández, S. Mammola, D. Fontaneto, G. García-Gómez. Flagship species as subterranean monitoring tools: a case study in anchialine ecosystems in Lanzarote (Canary Islands). *Biodiversity and Conservation* 35(8), 211 (2026). 10.1007/s10531-026-03389-7
- 38** B. Garcia de Figueiredo[†], I. Silva, M.J. Noonan, C.H. Fleming, W.F. Fagan, J.M. Calabrese, **R. Martinez-Garcia[♦]**. How animal movement influences wildlife-vehicle collision risk: a mathematical framework for range-resident species. *Journal of Theoretical Biology* 627, 112471 (2026). 10.1016/j.jtbi.2026.112471
- 37** D. Pinto-Ramos[†], **R. Martinez-Garcia[♦]**. How spatial patterns can lead to less resilient ecosystems. *Proceedings of the National Academy of Sciences of the USA* 123(14), e2511994123 (2026). 10.1073/pnas.2511994123

- 36 J. van der Voort[♦], **R. Martinez-Garcia**, A. Doelman. Vegetation pattern formation induced by local growth outpacing susceptibility to non-local competition. *Journal of Theoretical Biology* 626, 112441 (2026). 10.1016/j.jtbi.2026.112441
- 35 R. Menezes[†], J.M. Calabrese, W.F. Fagan, **R. Martinez-Garcia**[♦]. The range-resident logistic model: a new framework to formalize the population-dynamics consequences of range residency. *Ecology Letters* 28(12), e70269 (2025). 10.1111/ele.70269
- 34 N.O. Silvano[†], J. Valeriano[†], E. Hernández-García, C. López, **R. Martinez-Garcia**[♦]. Flow spatial structure determines pattern instabilities in nonlocal models of population dynamics. *Communications Physics* 8, 326 (2025). 10.1038/s42005-025-02246-3
- 33 A. Surendran^{††}, D. Pinto-Ramos^{††}, R. Menezes^{††}, **R. Martinez-Garcia**[♦]. Spatial moment dynamics and biomass density equations provide complementary, yet limited, descriptions of pattern formation in individual-based simulations. *Physica D* 477, 134703 (2025). 10.1016/j.physd.2025.134703
- 32 W.F. Fagan[♦], A. Krishnan, Q. Liao, C.H. Fleming, D. Liao, C. Lamb, B. Patterson, T. Wheeldon, **R. Martinez-Garcia**, J. Menezes, M.J. Noonan, E. Gurarie, J.M. Calabrese. Intraspecific encounters can lead to reduced range overlap. *Movement Ecology* 12, 58 (2024). 10.1186/s40462-024-00501-w
- 31 V. Dornelas^{††}, P. de Castro^{††}, J.M. Calabrese, W.F. Fagan, **R. Martinez-Garcia**[♦]. Movement bias in asymmetric landscapes and its impact on population distribution and critical habitat size. *Proceedings of the Royal Society A* 480, 20240185 (2024). 10.1098/rspa.2024.0185
- 30 C. Cabal^{*}, G.A. Maciel^{††}, **R. Martinez-Garcia**[♦]. Plant antagonistic facilitation across environmental gradients: a soil-resource ecosystem engineering model. *New Phytologist* 244, 670–682 (2024). 10.1111/nph.20053
- 29 E.H. Colombo, **R. Martinez-Garcia**, J.M. Calabrese, C. López, E. Hernández-García[♦]. Pulsed interactions unify reaction–diffusion and spatial nonlocal models for biological pattern formation. *Journal of Statistical Mechanics: Theory and Experiment* 3, 034001 (2024). 10.1088/1742-5468/ad2b57
- 28 D.C.P. Jorge[†], **R. Martinez-Garcia**[♦]. Demographic effects of spatial patterns in the presence of a component Allee effect. *Journal of the Royal Society Interface* 21, 20240042 (2024). 10.1098/rsif.2024.0042
- 27 E. Ser-Giacomi[♦], **R. Martinez-Garcia**, S. Dutkiewicz, M.J. Follows. Dilution-driven heterogeneity enhances plankton productivity in Lagrangian ecosystems. *Nature Communications* 14, 6092 (2023). 10.1038/s41467-023-41469-2
- 26 **R. Martinez-Garcia**[♦], C. Cabal, J.M. Calabrese, E. Hernández-García, C.E. Tarnita, C. López, J.A. Bonachela. Integrating theory and experiments to link local mechanisms and ecosystem-level consequences of vegetation patterns in drylands. *Chaos, Solitons & Fractals* 166, 112881 (2023). 10.1016/j.chaos.2022.112881
- 25 M.P. Veldhuis[♦], **R. Martinez-Garcia**, V. Deblauwe, V. Dakos. Remotely-sensed slowing down in spatially patterned dryland ecosystems. *Ecography* e06139 (2022). 10.1111/ecog.06139
- 24 **R. Martinez-Garcia**[♦], C.E. Tarnita, J.A. Bonachela. Spatial patterns in ecological systems: from microbial colonies to ecosystem landscapes. *Emerging Topics in Life Sciences* ETL520210282 (2022). 10.1042/ETLS20210282
- 23 J. Nauta, P. Simoens, Y. Khaluf, **R. Martinez-Garcia**[♦]. Foraging behavior and patch size distribution jointly determine population dynamics in fragmented landscapes. *Journal of the Royal Society Interface* 19(191), 20220103 (2022). 10.1098/rsif.2022.0103
- 22 G.A. Maciel[†], **R. Martinez-Garcia**[♦]. Enhanced species coexistence in Lotka-Volterra competition models due to nonlocal interactions. *Journal of Theoretical Biology* 530, 110872 (2021). 10.1016/j.jtbi.2021.110872
- 21 M.J. Noonan[♦], **R. Martinez-Garcia**, G.H. Davis, M.C. Crofoot, R. Kays, B.T. Hirsch, E. Payne, A. Sih, D.L. Sinn, O. Spiegel, W.F. Fagan, C.H. Fleming, J.M. Calabrese. Estimating encounter location distributions from animal tracking data. *Methods in Ecology and Evolution* 12(7), 1158–1173 (2021). 10.1111/2041-210X.13597

- 20 **R. Martinez-Garcia**[♦], C. López, F. Vazquez. Species exclusion and coexistence in a noisy voter model with a competition-colonization tradeoff. *Physical Review E* 103, 032406 (2021). 10.1103/PhysRevE.103.032406
- 19 C. Cabal[♦], **R. Martinez-Garcia**, A. de Castro, F. Valladares, S.W. Pacala. Future paths for the exploitative segregation of plant roots. *Plant Signaling and Behavior* 1891755 (2021). 10.1080/15592324.2021.1891755
- 18 C. Cabal[♦], **R. Martinez-Garcia**, A. de Castro, F. Valladares, S.W. Pacala. The exploitative segregation of plant roots. *Science* 370(6521), 1197–1199 (2020). 10.1126/science.aba9877
Journal cover; highlighted by national and international media (New York Times, Folha de São Paulo, El Mundo).
- 17 **R. Martinez-Garcia**, C.H. Fleming, R. Seppelt, W.F. Fagan, J.M. Calabrese[♦]. How range-residency and long-range perception change encounter rates. *Journal of Theoretical Biology* 498, 110267 (2020). 10.1016/j.jtbi.2020.110267
- 16 F.W. Rossine^{*}, **R. Martinez-Garcia**^{*}, A.E. Sgro, T. Gregor[♦], C.E. Tarnita[♦]. Eco-evolutionary significance of loners. *PLoS Biology* 18(3), e3000642 (2020). 10.1371/journal.pbio.3000642
- 15 E.H. Colombo[♦], **R. Martinez-Garcia**, C. López, E. Hernández-García. Spatial eco-evolutionary feedbacks mediate coexistence in prey-predator systems. *Scientific Reports* 9, 18161 (2019). 10.1038/s41598-019-54510-6
- 14 **R. Martinez-Garcia**, C.D. Nadell[♦], R. Hartmann, K. Drescher, J.A. Bonachela[♦]. Cell adhesion and fluid flow jointly initiate genotype spatial distribution in biofilms. *PLoS Computational Biology* 14(4), e1006094 (2018). 10.1371/journal.pcbi.1006094
- 13 **R. Martinez-Garcia**, C.E. Tarnita[♦]. Seasonality can induce coexistence of multiple bet-hedging strategies in *Dictyostelium discoideum*. *Journal of Theoretical Biology* 426, 104–116 (2017). 10.1016/j.jtbi.2017.05.019
- 12 **R. Martinez-Garcia**[♦], J.M. Calabrese, C. López. Online games: a novel approach to explore how partial information influences human random searches. *Scientific Reports* 7, 40029 (2017). 10.1038/srep40029
- 11 **R. Martinez-Garcia**, C.E. Tarnita[♦]. Lack of ecological and life history context can create the illusion of social interactions in *Dictyostelium discoideum*. *PLoS Computational Biology* 12(12), e1005246 (2016). 10.1371/journal.pcbi.1005246
- 10 **R. Martinez-Garcia**[♦], C. Murgui[†], E. Hernández-García, C. López. Pattern formation in populations with density-dependent movement and two interaction scales. *PLoS ONE* 10(7), e0132261 (2015). 10.1371/journal.pone.0132261
- 9 **R. Martinez-Garcia**[♦], C. López, F. Vazquez. Optimal recruitment strategies in groups of interacting walkers with leaders. *Physical Review E* 91, 022117 (2015). 10.1103/PhysRevE.91.022117
- 8 C.E. Tarnita[♦], A. Washburne^{*}, **R. Martinez-Garcia**, A.E. Sgro, S.A. Levin. Fitness tradeoffs between spores and nonaggregating cells can explain the coexistence of diverse genotypes in cellular slime molds. *Proceedings of the National Academy of Sciences of the USA* 112(9), 2776–2781 (2015). 10.1073/pnas.1424242112
Commentary by P.B. Rainey, *PNAS* 112, 2639–2640.
- 7 **R. Martinez-Garcia**[♦], J.M. Calabrese, E. Hernández-García, C. López. Minimal mechanisms for vegetation patterns in semiarid regions. *Philosophical Transactions of the Royal Society A* 372(2027), 20140068 (2014). 10.1098/rsta.2014.0068
- 6 **R. Martinez-Garcia**[♦], J.M. Calabrese, C. López. Optimal search in interacting populations: Gaussian jumps vs. Lévy flights. *Physical Review E* 89, 032718 (2014). 10.1103/PhysRevE.89.032718
- 5 **R. Martinez-Garcia**[♦], J.M. Calabrese, E. Hernández-García, C. López. Vegetation pattern formation in semiarid systems without facilitative mechanisms. *Geophysical Research Letters* 40, 6143–6147 (2013). 10.1002/2013GL058797
- 4 **R. Martinez-Garcia**[♦], J.M. Calabrese, C. López. Spatial patterns in mesic savannas: the local facilitation limit and the role of demographic stochasticity. *Journal of Theoretical Biology* 333, 156–165 (2013). 10.1016/j.jtbi.2013.05.024

- 3 **R. Martinez-Garcia**[♦], J.M. Calabrese, T. Mueller, K.A. Olson, C. López. Optimizing the search for resources by sharing information: Mongolian gazelles as a case study. *Physical Review Letters* 110, 248106 (2013). 10.1103/PhysRevLett.110.248106
Editor's Suggestion; highlighted by the American Physical Society (Physics Focus), Physics World, the Spanish Royal Society of Physics and the general press.
- 2 **R. Martinez-Garcia**[♦], F. Vázquez, C. López, M.A. Muñoz. Temporal disorder in up-down symmetric systems. *Physical Review E* 85, 051125 (2012). 10.1103/PhysRevE.85.051125
- 1 S. Brouard[♦], R. Martinez. Cavity-mediated entanglement between distant atoms: effect of spatial dispersion. *Physics Letters A* 375, 1640–1645 (2011). 10.1016/j.physleta.2011.03.004
Undergraduate paper, published under a different name.

Book chapters

- C. López[♦], E.H. Colombo, E. Hernández-García, **R. Martinez-Garcia**. Spatial competition and repulsion: pattern formation and the role of movement. In: L. Giuggioli, P.K. Maini (eds.), *The Mathematics of Movement*, Springer, Cham, pp. 251–263 (2026). 10.1007/978-3-032-00873-2_11
- C.H. Fleming[♦], W.F. Fagan, J.M. Alston, G. Anand, N. Hiram, E.Y. Lin, **R. Martinez-Garcia**, M.J. Noonan, J.M. Calabrese. Spatial distributions for animal movement processes. In: L. Giuggioli, P.K. Maini (eds.), *The Mathematics of Movement*, Springer, Cham, pp. 153–173 (2026). 10.1007/978-3-032-00873-2_7
- S. Vallina[♦], **R. Martinez-Garcia**, S.L. Smith, J.A. Bonachela. Models in microbial ecology. *Encyclopedia of Microbiology*, Elsevier, 4th edition (2019). 10.1016/B978-0-12-809633-8.20789-9

Preprints under review

- 8 W.F. Fagan[♦], M.A. Lewis, J.M. Calabrese, J.M. Flemming, M. McConnel, C. Che-Castaldo, R. Menezes[†], E.H. Colombo, S.C. Davidson, N. Ellison-Neary, C.D. Fagan, L. Giuggioli, M. Gonzalez-Suarez, A. Hein, A. King, M.J. Noonan, A. Surendran[†], B.R. Tsuru, R. Tyson, R.E. Baker, B. Garcia de Figueiredo[†], C.H. Fleming, E. Gurarie, K. Manlove, J.F.S. Menezes, I. Silva, G.M. Viswanathan, **R. Martinez-Garcia**. A hierarchical view of ecological encounters. Under review; full text available on request.
- 7 J.O. Abraham^{*♦}, **R. Martinez-Garcia**^{*♦}, F. Gijssman[#], E.M. Phillips[#], C.E. Tarnita. Should I stay or should I go? Modeling the decision-making process behind ungulate partial migration. bioRxiv 2026.07.07.737075. 10.64898/2026.07.07.737075
- 6 I. Braga[†], L. Wardil, **R. Martinez-Garcia**[♦]. Fixation probabilities for multi-allele Moran dynamics with weak selection. arXiv:2604.12004 (2026). Revised and resubmitted to *Physical Review Research*.
- 5 M. Tadej[♦], **R. Martinez-Garcia**, M. Hecht. Extinction and persistence criteria in the non-local Klausmeier model of vegetation dynamics on flat landscapes. arXiv:2601.06681. Revised and resubmitted to *Communications in Nonlinear Science and Numerical Simulation*.
- 4 J. Liang[♦], O. Peleg, C. Hui, P. Reich, Y. Gu, **R. Martinez-Garcia**. The architecture of forest intelligence: an evaluative framework. Revised and resubmitted to *PNAS Nexus*.
- 3 A. Surendran[†], J.M. Calabrese, W.F. Fagan, **R. Martinez-Garcia**[♦]. Using transient encounter rates to quantify spatial patterns of home-range organization. arXiv:2510.13017 (2025). 10.48550/arXiv.2510.13017
- 2 B. Garcia de Figueiredo[†], J.M. Calabrese, W.F. Fagan, **R. Martinez-Garcia**[♦]. Ergodicity shapes inference in biological reactions driven by a latent trajectory. arXiv:2409.11433 (2024). Revised and resubmitted to *Physical Review Research*.
- 1 M.J. Noonan[♦], **R. Martinez-Garcia**, C.H. Fleming, B. Garcia de Figueiredo[†] et al., J.M. Calabrese. The search behavior of terrestrial mammals. bioRxiv 2022.12.31.521874 (2022). Revised and resubmitted to *Nature Communications*.

TEACHING

Seven semester-long university courses at four institutions in three countries, approximately **290 contact hours**, at graduate and undergraduate level. Every course was newly developed and designed by me; I was sole

instructor in all of them except the Princeton practicum. In addition, five invited summer-school and short courses (2019–2025, $\approx$ 31 contact hours). Because credit systems are not comparable across countries, each entry states contact hours alongside the local credit value and, where meaningful, the equivalent in Semesterwochenstunden (SWS).

SEMESTER-LONG UNIVERSITY COURSES

- 2025, 2026** **Spatial models in environmental sciences** (Vorlesung)
 Carl von Ossietzky Universität Oldenburg — M.Sc. Environmental Modeling (block course).
Teaching within the German university system.
 Role: sole instructor. Course development: newly developed and designed by me.
 Level: graduate. Format: 14 two-hour lectures per edition (28 contact hours; 56 in total, taught twice); 3 ECTS, $\approx$ 2 SWS equivalent. Language: English. Students: 3 (2025); 13 (2026).
- 2022** **Stochastic models in biology and ecology**
 Institute of Theoretical Physics, State University of São Paulo (UNESP) and Bioscience Institute, University of São Paulo (USP) — Serrapilheira / ICTP-SAIFR Training Program in Quantitative Biology and Ecology.
 Role: sole instructor. Course development: newly developed and designed by me.
 Level: graduate. Format: 16 two-hour lectures (32 contact hours); 6 credits, local scale; $\approx$ 2 SWS equivalent. Language: English. Students: 30.
Offered jointly to graduate students in theoretical physics at UNESP, graduate students in ecology at USP, and students of the training program.
- 2022** **Advanced topics in biology and ecology**
 Institute of Theoretical Physics, UNESP and Bioscience Institute, USP — Serrapilheira / ICTP-SAIFR Training Program in Quantitative Biology and Ecology.
 Role: sole instructor. Course development: newly developed and designed by me.
 Level: graduate. Format: 32 two-hour lectures (64 contact hours); 12 credits, local scale; $\approx$ 4 SWS equivalent. Language: English. Students: 30.
Offered jointly to graduate students in theoretical physics at UNESP, graduate students in ecology at USP, and students of the training program.
- 2021** **Deterministic and stochastic nonlinear dynamics: theory and applications**
 Instituto de Física Teórica, UNESP — Master's in Theoretical Physics.
 Role: sole instructor. Course development: newly developed and designed by me.
 Level: graduate. Format: 32 two-hour lectures (64 contact hours); 12 credits, local scale; $\approx$ 4 SWS equivalent. Language: English. Students: 10.
- 2020** **Non-linear dynamical systems and applications**
 Instituto de Física Teórica, UNESP — Master's in Theoretical Physics.
 Role: sole instructor. Course development: newly developed and designed by me.
 Level: graduate. Format: 16 two-hour lectures (32 contact hours); 6 credits, local scale; $\approx$ 2 SWS equivalent. Language: English. Students: 12.
- 2019** **Introduction to stochastic processes with applications in physics and biology**
 Instituto de Física Teórica, UNESP — Master's in Theoretical Physics.
 Role: sole instructor. Course development: newly developed and designed by me.
 Level: graduate. Format: 16 two-hour lectures (32 contact hours); 6 credits, local scale; $\approx$ 2 SWS equivalent. Language: English. Students: 8.
- 2015** **EEB 325 — Mathematical modeling in biology and medicine**
 Princeton University — Department of Ecology and Evolutionary Biology.
 Role: teaching assistant to Prof. Dr. Corina E. Tarnita; delivered the practicums. Course development: developed the teaching material and content I lectured.
 Level: undergraduate. Format: 10 contact hours. Language: English. Students: 50.

INVITED SUMMER SCHOOLS AND SHORT COURSES

- 2025** **Random walk theory in physics and biology** — IFT-Perimeter-SAIFR Journeys into Theoretical Physics, ICTP-SAIFR, São Paulo, Brazil.
Invited lecturer, sole instructor. Level: undergraduate. 5 contact hours. Language: English. Students: ≈ 80.
- 2023** **Spatial models in ecology** — Minicourse on Lattice Models and Applications to Biological Problems, ICTP-SAIFR, São Paulo, Brazil.
Invited lecturer, sole instructor. Level: graduate and advanced undergraduate. 6 contact hours. Language: English. Students: ≈ 25.
- 2022** **Introduction to statistical mechanics and its applications beyond physics** — II Summer School ICTP-SAIFR for Young Physicists, São Paulo, Brazil.
Invited lecturer, sole instructor. Level: high school. 4.5 contact hours. Language: Portuguese. Students: ≈ 30.
- 2021** **Nonlinear phenomena in biology** — III School Jayme Tiomno in Theoretical Physics, Institute of Physics, University of São Paulo, Brazil.
Invited lecturer, sole instructor. Level: undergraduate. 10 contact hours. Language: Portuguese. Students: ≈ 25.
- 2019** **Nonlinear phenomena in biology** — IFT-Perimeter-SAIFR Journeys into Theoretical Physics, ICTP-SAIFR, São Paulo, Brazil.
Invited lecturer, sole instructor. Level: undergraduate. 5 contact hours. Language: English. Students: ≈ 80.

CURRICULUM AND PROGRAM DEVELOPMENT

- 2021 – 22** **ICTP-SAIFR / Instituto Serrapilheira Research Training Program in Quantitative Biology and Ecology**
Institute of Theoretical Physics, UNESP, Brazil. Role: **founder and academic coordinator**.
Designed the program structure and syllabus, selected the international teaching faculty, ran student admissions, coordinated the first two editions with a four-person administrative team, and taught two of the courses listed above. The program was tuition-free and scholarship-funded, admitting approximately 30 students from across South America. Annual budget ≈ €200,000.

SUPERVISION AND EARLY-CAREER MENTORING

6 doctoral candidates (2 completed, 4 in progress) · 9 Master's theses (6 completed) · 9 postdoctoral researchers · 2 undergraduate research projects.

Postdoctoral researchers

- 2026 –** Dr. Guilherme H. Costa. CNPq International Postdoctoral Fellow.
- 2025 –** Dr. Rafael Menezes. Based at ICTP-SAIFR, São Paulo.
- 2025 – 26** Dr. Ian Braga. CNPq International Postdoctoral Fellow. Now postdoctoral researcher at Academia Sinica, Taiwan.
- 2024 –** Dr. David Pinto-Ramos.
- 2023 –** Dr. Anudeep Surendran.
- 2022 – 23** Dr. Pablo Souza de Castro. Now **Assistant Professor** at the University of São Paulo, Brazil.
- 2021 – 22** Dr. Jesús M. Encinas Riveros. Now postdoctoral researcher at Università di Padova, Italy.
- 2020 – 22** Dr. Vivian Dornelas. Now **Assistant Professor** at the Federal University of Southern Bahia, Brazil.
- 2020 – 22** Dr. Gabriel Andreguetto Maciel. Now data analyst at GTI IT Solutions, Curitiba, Brazil.

Doctoral candidates

- 2025 – Jelle van der Voort** — *Resilience in complex systems through adaptive spatial pattern formation*. **Mathematics, Universiteit Leiden**. Co-supervisor, with Prof. Dr. Arjen Doelman and Prof. Dr. Max Rietkerk.
- 2025 – Zihao Liu** — *Encounter statistics between cross-correlated stochastic processes*. Physics, University of Göttingen. Main supervisor.
- 2026 – Paulo E. de Cerqueira Junior** — *A functional network approach to investigate dryland resilience*. Physics, University of Göttingen. Joint with Prof. Dr. Viola Priesemann.
- 2025 – Melissa Fuentealba** — *Mathematical models of fungus–plant interactions*. Physics, University of Concepción, Chile. Co-supervisor, with Dr. Ignacio Ormazábal.
- 2021 – 25 Dr. Rafael Menezes** — *Not so well-mixed: range-resident logistic model and movement-based crowding indexes*. Ecology, University of São Paulo. Main supervisor. Now postdoctoral researcher in my group.
- 2022 – 24 Dr. Nathan O. Silvano** — *Non-equilibrium dynamics: phase transitions and pattern formation*. Physics, State University of Rio de Janeiro. Co-supervisor. Now postdoctoral researcher at IFISC, Spain.

Master's candidates

- 2026 – Timon Althaus** — *Competition–colonization tradeoffs and plant species coexistence in fragmented landscapes*. M.Sc. Physics, Technische Universität Dresden.
- 2025 – Khaled Yasein** — *Quorum sensing and social dilemmas in microbial communities*. M.Sc. Applied and Engineering Physics, Technische Universität München.
- 2025 – Vinicius Menuci** — *How animal movement structures vegetation spatial patterns through seed dispersal*. M.Sc. Theoretical Physics, IFT-UNESP, Brazil.
- 2021 – 23 João Pedro Valeriano** — *The effect of a chaotic environmental flow on the evolution of microbial social behaviors*. M.Sc. Theoretical Physics, IFT-UNESP. Now doctoral candidate at CENTURI, Université Aix-Marseille, France.
- 2021 – 23 Daniel Cardoso Pereira Jorge** — *Aggregation patterns of living organisms: connecting mathematical modelling to data*. M.Sc. Theoretical Physics, IFT-UNESP. Now doctoral candidate at Princeton University, USA.
- 2020 – 23 Benjamin Garcia de Figueiredo** — *Absorption statistics of movement models with home-ranging behavior*. M.Sc. Theoretical Physics, IFT-UNESP. Now doctoral candidate at Princeton University, USA.
- 2019 – 20 Jairo M. Rojas** — *Aging as a survival strategy in a microbial ecosystem*. M.Sc. Theoretical Physics, IFT-UNESP. Now doctoral candidate at the University of Illinois Urbana-Champaign, USA.
- 2018 Dr. Rodrigo Martínez** — *A consumer-resource description of public-goods production in microbes*. M.Sc. Physics of Complex Systems, IFISC, Spain. Now postdoctoral researcher at the Donostia International Physics Center, Spain.
- 2017 Dr. Víctor Buendía** — *Modelling quorum-sensing mechanisms in bacterial populations*. M.Sc. Physics of Complex Systems, IFISC, Spain. Now senior postdoctoral researcher at Bocconi University, Italy.

Undergraduate research projects

- 2016 David Pereñíguez** — Aggregation patterns of living organisms: mathematical modelling and experiments. SURF summer internship, IFISC, Spain. Now postdoctoral researcher at the Niels Bohr Institute, University of Copenhagen.
- 2013 Clara Murgui** — Aggregation in populations with density-dependent movement. IFISC-Intro summer internship, Spain. Now tenure-track scientist at the Institute of High-Energy Physics, Barcelona.

INVITED LECTURES

66 invited presentations: 43 department and institute colloquia and 23 invited conference lectures. An asterisk (*) indicates a lecture delivered online during the COVID-19 pandemic.

Department and institute colloquia

- 2026** *Robustness and self-organization in complex living systems.* Fudan University, Shanghai, China.
Robustness and self-organization in complex living systems. Centuri Seminar, Université Aix-Marseille, France.
Robustness and self-organization in complex living systems. Physics and Astronomy Colloquium, University of Rochester, USA.
- 2025** *From spatial patterns to functional resilience: dryland ecosystems as a case study.* Institute Colloquium, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany.
Self-organization in drylands: from pairwise plant interactions to ecosystem robustness. Institute Colloquium, Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany.
The range-resident logistic model: how movement influences population dynamics. Helmholtz Centre for Environmental Research (UFZ), Leipzig, Germany.
- 2024** *Understanding belowground plant interactions mechanistically: from competition to facilitation.* Faculty of Physics and Earth System Sciences, University of Leipzig, Germany.
Ecological systems are rarely well-mixed. Institute for Chemistry and Biology of the Marine Environment, Carl von Ossietzky Universität Oldenburg, Germany.
Lattice models applied to population dynamics. Wrocław University of Science and Technology, Poland.
Causes and consequences of imperfect coordination in collective behaviors across scales. Dutch Institute for Emergent Phenomena, Amsterdam, Netherlands.
Causes and consequences of imperfect coordination in collective behaviors across scales. Mathematical Biology Seminar, University of Maryland, USA.
- 2023** *The role of resource dynamics in below-ground plant interactions.* Senckenberg, Görlitz, Germany.
To leave or not to leave: a mechanistic model for ungulate partial migration. Bioscience Colloquium, Swansea University, UK.
Population dynamics models with non-local spatial interactions. Mathematics Colloquium, Swansea University, UK.
A physics foray into ecology: modelling vegetation dynamics in water-limited ecosystems. Physics Colloquium, Federal University of Paraná, Curitiba, Brazil.
Ecological systems are rarely well-mixed. Computational and Mathematical Biology Seminar, University of Bath, UK.
- 2022** *Ecological dynamics with long-range individual interactions: from stochastic individual-based models to nonlocal partial differential equations.* Department of Mathematics, University of Dundee, UK.
Ecological systems are rarely well-mixed. IFT Colloquium, State University of São Paulo, Brazil.
How can statistical mechanics help ecology? Theoretical Physics Group Seminar, Università Federico II, Naples, Italy.
A physics foray into ecology. Molecular Sciences Colloquium, University of São Paulo, Brazil (in Portuguese).
- 2021** * *Beyond the law of mass action in ecology: range residency and encounter statistics.* White Rose Mathematical Biology Seminars (Leeds, Sheffield and York), UK.
* *The role of nonlocal interactions in ecological dynamics.* Biomath Seminar, Department of Mathematics and Applied Mathematics, Virginia Commonwealth University, USA.
* *Species exclusion and coexistence in stochastic models with a competition–colonization tradeoff.* Complex Systems Seminar, Pontifical Catholic University of Rio de Janeiro, Brazil.

- * *How can (simple) mathematical models help understand below-ground plant interactions?* CNPEM Agriculture and SPARC Seminar, Campinas, Brazil.
- * *Self-organized patterns: linking behavior with ecological and evolutionary processes.* Center for Advanced Systems Understanding (CASUS), Görlitz, Germany.
- * *A physics foray into ecology.* Universidade Federal de Minas Gerais, Belo Horizonte, Brazil.
- * *How can statistical mechanics help ecology?* Perimeter Institute Colloquium, Waterloo, Canada.
- * *Mathematical modelling of belowground plant interactions.* Quantitative Life Science Seminar, ICTP, Trieste, Italy.
- * *A physics foray into ecology.* Universidade Federal do ABC, Santo André, Brazil.

- 2019** *Linking collective behaviors to diversity in microbial communities.* Centro de Estudios Avanzados de Blanes (CEAB-CSIC), Spain.
Self-organized patterns: linking behavior with ecological and evolutionary processes. ICTP-SAIFR, São Paulo, Brazil.
Linking collective behaviors to diversity in microbial communities. IFISC Seminar, Palma de Mallorca, Spain.
- 2018** *Self-organized patterns: linking behavior with ecological and evolutionary processes.* Queensland University of Technology, Brisbane, Australia.
Self-organized patterns: linking behavior with ecological and evolutionary processes. Centre for Integrative Biology, Toulouse, France.
Asynchrony in the transition to aggregative multicellularity. Rutgers, The State University of New Jersey, USA.
Biological self-organization across spatiotemporal scales. Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy.
- 2016** *Online games: how partial information influences random search processes.* IFISC Seminar, Palma de Mallorca, Spain.
- 2015** *The role of ecology in the evolution of multicellularity.* IFISC Seminar, Palma de Mallorca, Spain.
- 2014** *Nonequilibrium statistical physics in ecology: animal mobility and temporal fluctuations.* IMEDEA Seminar, Esporles, Spain.
Optimizing the search for resources: the Mongolian gazelle. Institute for Chemistry and Biology of the Marine Environment, Carl von Ossietzky Universität Oldenburg, Germany.
Vegetation patterns: the role of nonlocal interactions. IFISC Seminar, Palma de Mallorca, Spain.
- 2013** *Searching with communication: the case of the Mongolian gazelle.* IFISC Seminar, Palma de Mallorca, Spain.
- 2011** *The effect of temporal disorder in complex systems.* Seminar of the Faculty of Physics, University of La Laguna, Spain.

Invited conference oral presentations

- 2026** *Vegetation patterns in heterogeneous drylands and their consequences for ecosystem resilience.* Mini-symposium on pattern formation in socio-ecological systems, Conference on Mathematical Models in Ecology and Evolution, Cork, Ireland.
Crowding indexes and population dynamics of range-resident animals. ERC Workshop on the dynamics of species-rich forests, Helmholtz Centre for Environmental Research (UFZ), Leipzig, Germany.
The role of transients in ecological regime shifts: dryland vegetation as a case study. Workshop on transient dynamics: theory and applications, Potsdam Institute for Climate Impact Research, Germany.
- 2025** *Nonreciprocal interactions induce early desertification in patterned ecosystems.* 16th Dynamical Systems Applied to Biology and Natural Sciences (DSABNS), Naples, Italy.
- 2024** *Mathematical modelling of below-ground plant interactions: from competition to facilitation.* Dynamics Days Europe, Bremen, Germany.

- 2023** *Ecological dynamics with long-range individual interactions: from stochastic individual-based models to non-local partial differential equations.* XIX Workshop on Instabilities and Nonequilibrium Structures (Enrique Tirapegui), Pontifical University of Valparaíso, Chile.
Ecological dynamics with long-range individual interactions. ICMS workshop Diffusive Systems: pattern formation, bifurcations and biological applications, Edinburgh, UK.
Spatially explicit models of population dynamics: a dialogue between statistical physics and ecology. Autumn Meeting of the Brazilian Physical Society, Federal University of Ouro Preto, Brazil.
- 2022** *The role of nonlocal competition in vegetation pattern formation.* Mini-symposium on mathematical models of vegetation dynamics: nonlinear PDE approach, Mathematical Models in Ecology and Evolution, Reading, UK.
** The role of nonlocal interactions in ecology: from pattern formation to biodiversity maintenance.* 2022 Spring Eastern Sectional Meeting of the American Mathematical Society.
A game-theoretical approach to soil resource acquisition by roots. 3rd AgroEnviro Workshop, Sirius, Campinas, Brazil.
- 2021** ** The role of nonlocal competition in ecological systems.* ICMS workshop Diffusive Systems: pattern formation, bifurcations and biological applications, Edinburgh, UK.
** The exploitative segregation of plant roots.* Annual Meeting of the Society for Mathematical Biology, mini-symposium on modelling social behaviors in biological systems.
** Uma incursão da física na ecologia.* Semana da Física, Universidade de Brasília, Brazil (in Portuguese).
** The role of European researchers abroad and the benefits of a scientific diaspora.* First meeting of EU researchers in Brazil, EURAXESS Brazil and LAC.
- 2020** ** The effect of range residency and long-range perception on encounter rates.* AMS Special Session on Mathematical Methods for Ecology and Evolution in Structured Populations.
** How can statistical mechanics help population ecology?* XLIII Congresso Paulo Leal Ferreira de Física, IFT-UNESP, São Paulo, Brazil.
- 2019** *Eco-evolutionary consequences of imperfect aggregative multicellularity.* Mini-symposium on the evolution of life cycles, Mathematical Models in Ecology and Evolution, Lyon, France.
Self-organized patterns: linking behavior with ecological and evolutionary processes. Joint ICTP-SAIFR / ICTP-Trieste School on Mathematical Models of Evolution, São Paulo, Brazil.
Spatial self-organization as a tool for ecosystem management. Explorando o Campo da Biologia e Biodiversidade, São Paulo, Brazil.
Pattern formation in populations with density-dependent movement and two interaction scales. Perspectives in Nonlinear Dynamics, São Paulo, Brazil.
- 2018** *Loners can confer adaptive advantages to the rest of the population.* Microbiology Society Annual Meeting, Birmingham, UK.
- 2017** *The role of life-history tradeoffs and environmental heterogeneity in Dictyostelium discoideum diversity.* Conference on Ecology and Evolutionary Biology: Deterministic and Stochastic Models, Toulouse, France.

ACADEMIC SERVICE

Editorial	PLOS Ecosystems (2025 –) · PLOS Computational Biology (2022 –) · PLOS ONE (2017 – 25).
Societies	Board member, Complex Systems Society (2025 – , three-year tenure).
Examining	External reviewer of 12 doctoral theses and several Master's theses, at my own and at external institutions; member of more than 15 qualification committees.
Funding	Reviewer for the Leverhulme Trust (2026), the Balearic Agency for Quality Assurance in Higher Education, AQUIB (2026), the Human Frontier Science Program (2022), FAPESP, Brazil (2020 –) and Instituto Serrapilheira, Brazil (2020).

Journals
(selected) Referee for PNAS, Nature Communications, Science Advances, Physical Review Letters, Physical Review X, PRX Life, eLife, Ecology Letters, Journal of Ecology, Methods in Ecology and Evolution, Journal of the Royal Society Interface, Journal of Theoretical Biology, Physical Review Research and Physical Review E.

ORGANISATION OF SCIENTIFIC EVENTS

2026 School on Biological Physics across Scales: phase transitions. ICTP-SAIFR, São Paulo, Brazil.

2024 Workshop on Applied Stochastic Processes for Encounter Problems, Brin Mathematics Research Center, University of Maryland, USA.

2024 School on Biological Physics across Scales: pattern formation. ICTP-SAIFR, São Paulo, Brazil.

2023 Minicourse on Lattice Models and Applications to Biological Problems. ICTP-SAIFR, São Paulo, Brazil.

2022 ICTP Huddle: Eco-evolutionary Dynamics of Microbial Communities Across Scales. Trieste, Italy.

2021 ICTP-SAIFR Physics Discussions — online colloquium series with world-leading speakers, including Nobel Laureate Prof. Donna Strickland.

2020 Summer School on Community Ecology: from patterns to principles. ICTP-SAIFR, São Paulo, Brazil.

PUBLIC ENGAGEMENT

2020, 2021 Thermodynamics and introduction to statistical mechanics — 20-hour course for high-school students, ICTP-SAIFR, São Paulo, Brazil (in Portuguese).

2024 Patterns in nature: a pretty coincidence or a search for survival? ICTP-SAIFR outreach lecture, São Paulo, Brazil (in Portuguese).

2021 Biological complex systems: a physics approach to living systems. Seminar series of the Brazilian Academy of Sciences (in Portuguese).
Mathematics and ecology: do they need each other? Instituto Cervantes, Brasília, Brazil (in Spanish).
Por que o Nobel de Física representa o futuro da ciência. Blog Ciência Fundamental, Folha de São Paulo (in Portuguese).

2020 Complex systems: when the whole is more than the sum of its parts. Física em Casa outreach webinar series, ICTP-SAIFR, Brazil (in Portuguese).
Round table on the 17 UN Sustainable Development Goals. Forum Renascimento, Festival de Arte da Serrinha, Brazil (in Portuguese).
Round table on science and art. Mesa Ciência e Arte, Festival de Arte da Serrinha, Brazil (in Portuguese).

2013 *La comunicación entre individuos podría optimizar la búsqueda de recursos en algunas especies.* Física Hoy, Spanish Royal Society of Physics (in Spanish).

LANGUAGES

Spanish — native. **English** — fluent; working language since 2014. **Portuguese** — fluent; used as a language of instruction. **German** — intermediate (B1), in continued study; resident in Germany since 2022.