

Pierre-Jean G. MALÉ

PhD in Ecology & Evolutionary Biology



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CANADA

How do mutualisms persist over evolutionary time despite cheating? To what extent do genetic diversity and a symbiotic way of life influence each other? These questions are the focus of my research.

More specifically, I address the mechanisms that promote the maintenance of mutualistic relationships in spite of evolutionary conflicts between partners.

My ultimate goal is to build a comprehensive theory of mutualisms.

PRESENT POSITION

Post-doctoral Research Fellow

“Genomics and population genetics of ant-plant mutualisms”

Dept of Ecology and Evolutionary Biology, University of Toronto

Advisor: Dr. Megan Frederickson

RESEARCH HISTORY

- 2011 - 2013 **“Phylogenomics of a tropical tree family”**
Post-doctoral fellowship
Advisor: Dr. Jérôme Chave
Lab “Evolution & Biological Diversity”, Toulouse (France)
- 2007 - 2011 **“Evolutionary stability of mutualisms and control mechanisms: the case of an ant-plant relationship”**
PhD
Advisors: Dr. Jérôme Orivel & Dr. Angélique Quilichini
Lab “Evolution & Biological Diversity”, Toulouse (France)
- 2006 - 2007 **“Phylogeographic history and balancing selection: the origin of MHC gene polymorphism in the bank vole”**
MSc, 2nd year
Advisor: Dr. Nathalie Charbonnel
Center for Biology and Management of Populations, Montpellier (France)
- 2005 - 2006 **“Interactions between the ant *Allomerus decemarticulatus* and its host plant”**
MSc, 1st year
Advisors: Pr. Alain Dejean & Dr. Jérôme Orivel
Lab “Evolution & Biological Diversity”, Toulouse (France)
- 2005 **“The colony structure of a plant ant”**
Volunteer
Advisor: Pr. Alain Dejean
Lab “Evolution & Biological Diversity”, Toulouse (France)

EDUCATION

- 2007 - 2011 **PhD in Ecology and Evolutionary Biology**
University of Toulouse III (France)
- 2005 - 2007 **MSc in Evolutionary Biology and Ecology**
University of Montpellier II (France)
- 2002 - 2005 **BSc in Organism, Population and Ecosystem Biology**
University of Toulouse III (France)

GRANTS & AWARDS

- 2013 **Best PhD award – Academy of Sciences of Toulouse**
in the category “Life and Earth Sciences”
- 2011 **Travel grant – Society for the Study of Evolution**
to attend the 13th ESEB congress (Tübingen, Germany)
- 2010 **Travel grant – European Society for Evolutionary Biology**
to attend the Evolution 2010 congress (Portland, Oregon USA)
- Travel grant – International Union for the Study of Social Insects**
to attend the IUSSI 2010 international congress (Copenhagen, Denmark)
- 2009 **Best talk award – SEVAB Grad School**
at the SEVAB Grad School Day
- Travel grant – French Ecological Society**
to attend the 12th ESEB congress (Torino, Italy)
- 2008 **Research grant – Nouragues research station**
from CNRS and Nouragues research station (French Guiana)
- 2007 - 2011 **PhD supported by a scholarship**
awarded by the French Ministry of Higher Education and Research

RESEARCH SKILLS

FIELD EXPERIENCE

Multiple field seasons in **tropical rainforests** (over a year total): plant and insect sampling, micromammal and bird capture and manipulation, plant population surveys, controlled pollination experiments, survey of ant circadian rhythms.

LABORATORY SKILLS

Experiments involving **living organisms**: insect breeding, choice experiments in ants
At the **lab bench**: plant / animal / fungal DNA / RNA extractions, development / amplification / sequencing / genotyping of molecular markers, next-gen sequencing (shotgun, genome sequencing)

ANALYTICAL SKILLS

Statistics (R), **chromatogram interpretation** (Sequencher, GeneMapper, Geneious), **population genetics** (FSTAT, GENEPOP, Arlequin, SPAGeDi, Structure, TESS, Geneland), **pedigree reconstruction** (Cervus, COLONY, MasterBayes), **bioinformatics** (UNIX, NGS analysis tools such as bwa, velvet, OBITools), **Office, Adobe**

TEACHING

- Supervision During the last four years, I have participated in the **supervision of 6 undergraduate** students who were doing a Bachelor's degree.
- 2007 - 2012 **Science popularization for PhD students**
Theoretical and practical science popularization (written and spoken)
- 2010 - 2011 **Ecology and Evolutionary Biology for undergraduate students and graduate students doing a Master's degree (64 hours)**
Quantitative biology (statistics, population dynamics), Evolutionary biology and genetics, Comparative anatomy, Naturalistic knowledge (entomology, ornithology)
- 2007 - 2010 **Ecology and Evolutionary Biology for undergraduate students (192 hours)**
Quantitative biology (statistics, population dynamics), Evolutionary biology, Comparative anatomy

LABORATORY LIFE

ELECTED POSITIONS

- 2008 - 2014 **Vice-President of "Plume!"**
Non-profit organization for science popularization
- 2011 **Postdoc representative in a Research Federation scientific council**
at the Toulouse Agro-biosciences, Interactions & Biodiversity Research Federation
- 2009 **Graduate students representative at the laboratory council**
at the *Evolution & Diversité Biologique* laboratory
- 2008 **Graduate students representative at the molecular biology commission**
at the *Evolution & Diversité Biologique* laboratory

EVENT ORGANISATION

- 2011 **Member of the organizing committee of the 33rd PPD meeting**
"French congress of population biology and genetics", Toulouse
- 2008 **Member of the organizing committee of the 4th SERL meeting**
"Ecology & Behaviour" meeting, Toulouse
- 2007 **Co-founder and organizer of the Journal Club**
at the *Evolution & Diversité Biologique* laboratory

INVITED SEMINARS

- 2014 **Pr Marla Sokolowski's group**, University of Toronto (Canada)
- 2013 **Dr Megan Frederickson's group**, University of Toronto (Canada)
Pr Naomi Pierce's group, University of Harvard (USA)
Dr Christoph Vorburger's group, University of Zurich (Switzerland)
Pr Dieter Ebert's group, University of Basel (Switzerland)
Molecular Biology and Microbiology Commission, Lab EDB, Toulouse (France)

PEER-REVIEW ACTIVITIES

- 2014 **Evolutionary Ecology, Oecologia, Comptes Rendus Biologies**
- 2013 **Plant Ecology and Evolution, Acta Botanica Gallica**
- 2012 **Tropical Ecology**

SOCIETY MEMBERSHIPS

- 2010-2014 **Society for the Study of Evolution**
- 2009-2014 **French Ecological Society**
European Society for Evolutionary Biology
- 2009-2010 **International Union for the Study of Social Insects – French Section**
- 2009 **Association for Tropical Biology & Conservation**

PUBLICATIONS

At this time, I have published **19 peer-reviewed articles** of which ten have an impact factor greater than 3. My articles have been cited more than 200 times and my h-index is 8 (Web of Sciences).

I have also authored **six papers for science popularization** and outreach.

SELECTION OF 5 REPRESENTATIVE PUBLICATIONS (see below for the exhaustive list)

Malé P-JG, Bardon L, Besnard G, Coissac E, Delsuc F, Engel J, Lhuillier E, Scotti-Saintagne C, Tinaut A & Chave J (en ligne). Genome skimming by shotgun sequencing helps resolve the phylogeny of a pantropical tree family. *Molecular Ecology Resources*

➔ We used a shallow genome sequencing approach to unravel intergeneric phylogenetic relationships in a tropical tree family.

Malé P-JG, Ferdy JB, Leroy C, Roux O, Lauth J, Avilez A, Dejean A, Quilichini A & Orivel J (2014) Retaliation in response to castration promotes a low level of virulence in an ant-plant mutualism. *Evolutionary Biology* 41:22-28

➔ In this study, we demonstrated that ant-plants are able to retaliate against too virulent castrating ants by diminishing their investment in mutualistic traits.

Malé P-JG, Martin J-F, Galan M, Deffontaine V, Bryja J, Cosson J-F, Michaux J & Charbonnel N (2012) Discongruence of Mhc and cytochrome b phylogeographical patterns in *Myodes glareolus* (Rodentia : Cricetidae). *Biological Journal of the Linnean Society* 105:881-899

➔ This study demonstrates that parasitic pressures are the most important evolutionary force shaping diversity at immune genes of a zoonose reservoir.

Malé P-JG, Leroy C, Dejean A, Quilichini A & Orivel J (2012) An ant symbiont directly and indirectly limits its host plant's reproductive success. *Evolutionary Ecology* 26:55-63

➔ In this study, we demonstrated that host plant reproduction is limited by both ant symbiont activities and good quality pollen availability. These major limitations affect the evolutionary fate of the association.

Malé P-JG (2008) Créationnisme et enseignement: le rapport Brasseur aboutit à une Résolution Européenne. *Plume! online*

➔ This article recalls the fight of a handful of politicians for preventing creationism and intelligent design to be taught in European schools as scientific alternative to evolution.

SYMPOSIA

At this time, I have participated in **22 symposia**. Four of them were **international symposia** where I gave a talk.

SELECTION OF 3 REPRESENTATIVE TALKS (see below for the exhaustive list)

Malé P-JG (2012) Building pedigrees on the kitchen worktop: a practical feedback. *Annual meeting of the French Research Network "Quantitative Genetics"*, Toulouse, France

➔ Invited talk. I shared my experience with various pedigree reconstruction techniques and their use in different scientific contexts.

Malé P-JG, Leroy C, Dejean A, Quilichini A, Orivel J (2010) Evolutionary conflicts and sanctions between a neotropical ant and its host plant. *Evolution 2010*, Portland (OR), USA

➔ Participation supported by a grant awarded by the European Society for Evolutionary Biology. I presented my results concerning mechanisms allowing the continuance of a mutualistic relationship despite evolutionary conflicts.

Malé P-JG, Gibert A, Casquet J (2009) Knowledge 'demythification': aims and challenges of science popularization by university people. *French Ecological Society Day*, Paris, France

➔ Invited talk. I discussed the societal importance of science popularization by university people including students, and how to overcome obstacles to its practice.

OUTREACH

- 2012-2013 **Inventor, presenter and organizer of the “ImprovSciences” performances** which gathers two scientists and two improv actors on a stage
- 2008-2013 **Stand animator at various national and local science festivals** for children or general public
- 2013 **Invited speaker for the lecture “The marital life of ants and plants” (1h30)** at the Popular University of Philosophy Alderan, Toulouse, France
- 2012 **Scientific advisor for part of the documentary “Through the jungle and up into space: a walk in French Guiana”** broadcasted on the German TV-channel ‘NDR’
- Designer of the exhibition “Animal societies: live and survive”** concerning the evolution of sociality in animals shown at the ‘knowledge festival’ La Novela, Toulouse, France
- 2011 **Invited speaker for the public lecture “The marital life of ants and plants” (1h30)** concerning ant-plant relationships over evolutionary times shown at the ‘knowledge festival’ La Novela, Toulouse, France
- Designer of the exhibition “Living world, cunning world”** concerning evolutionary strategies in animals to survive and reproduce shown at the ‘knowledge festival’ La Novela, Toulouse, France
- 2007 **Scientific advisor for a report in the evening news bulletin** broadcasted on the first French TV-channel
- 2006 **Scientific advisor for the documentary “Marriage of convenience”** which focused on the mutualistic relationship between a plant and an ant species

REFEREES

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Fax: +33 (0)4 99 62 33 45
Email: nathalie.charbonnel@supagro.inra.fr

PEER-REVIEWED

19. **Malé P-JG**, Leroy C, Lusignan L, Petitclerc F, Quilichini A & Orivel J (2015). The reproductive biology of the myrmecophyte, *Hirtella physophora*, and the limitation of negative interactions between pollinators and ants. *Arthropod-Plant Interactions* 9:23-31
18. Besnard G, Christin P-A, **Malé P-JG**, Lhuillier E, Lauzeral C, Coissac E & Vorontsova M (2014) From museums to genomics: old herbarium specimens shed light on a C3 to C4 transition. *Journal of Experimental Botany* 65:6711-6721
17. **Malé P-JG**, Bardon L, Besnard G, Coissac E, Delsuc F, Engel J, Lhuillier E, Scotti-Saintagne C, Tinaut A & Chave J (2014). Genome skimming by shotgun sequencing helps resolve the phylogeny of a pantropical tree family. *Molecular Ecology Resources* 14:966-975
16. **Malé P-JG**, Ferdy JB, Leroy C, Roux O, Lauth J, Avilez A, Dejean A, Quilichini A & Orivel J (2014) Retaliation in response to castration promotes a low level of virulence in an ant-plant mutualism. *Evolutionary Biology* 41:22-28
15. Besnard G, Christin P-A, **Malé P-JG**, Coissac E, Ralimanna H & Vorontsova M (en ligne) Phylogenomic and taxonomical surveys of Lecomtelleae (Poaceae), an isolated, early diverging panicoid tribe from Madagascar. *Annals of Botany*
14. Dejean A, Orivel J, Rossi V, **Malé P-JG**, Roux O, Céréghino R & Leroy C (2013) Predation success by a plant-ant indirectly favors the growth and fitness of its host myrmecophyte. *PLoS one* 8:e59405
13. Lauth J, **Malé P-JG**, Voglmayr H, Mayer VE, Dejean A & Orivel J (2013) Isolation and characterization of polymorphic microsatellite loci in the ant-associated fungus *Trimmatostroma* sp. (Ascomycota: Chaetothyriales) using pyrosequencing technology. *Molecular Ecology Resources* 13:546-549
12. **Malé P-JG**, Martin J-F, Galan M, Deffontaine V, Bryja J, Cosson J-F, Michaux J & Charbonnel N (2012) Discongruence of Mhc and cytochrome b phylogeographical patterns in *Myodes glareolus* (Rodentia : Cricetidae). *Biological Journal of the Linnean Society* 105:881-899
11. Debout G, Lhuillier E, **Malé P-JG**, Pujol B & Thébaud C (2012) Development and characterization of 24 polymorphic microsatellite loci in two *Antirrhinum majus* subspecies (Plantaginaceae) using pyrosequencing technology. *Conservation Genetics Resources* 4:75-79
*all the authors equally contributed to the production of this publication.
10. **Malé P-JG**, Leroy C, Dejean A, Quilichini A & Orivel J (2012) An ant symbiont directly and indirectly limits its host plant's reproductive success. *Evolutionary Ecology* 26:55-63
9. Malausa T, Gilles A, Megléczy E, Blanquart H, Duthoy S, Costedoat C, Dubut V, Pech N, Castagnone-Sereno P, Délye C, Feau N, Frey P, Gauthier P, Guillemaud T, Hazard L, Le Corre V, Lung-Éscarmant B, **Malé P-JG**, Ferreira S & Martin J-F (2011) High throughput microsatellites isolation with 454 GS-FLX Titanium pyrosequencing. *Molecular Ecology Resources* 11:638-644
8. Ruiz-González MX, **Malé P-JG**, Leroy C, Dejean A, Gryta H, Jargeat P, Quilichini A & Orivel J (2011) Specific, non-nutritional association between an Ascomycete fungus and *Allomerus* plant-ants. *Biology Letters* 7:475-479
7. Mariano CSF, da Silva Santos I, Groc S, Leroy C, **Malé P-JG**, Ruiz-Gonzalez MX, Dejean A & Delabie JHC (2011) The karyotypes of *Gigantiops destructor* (Fabricius) and other ants from French Guiana (Formicidae). *Annales de la Société Entomologique de France* 47:140-146
6. **Malé P-JG**, Malausa T, Martin JF, Orivel J & Quilichini A (2011) Isolation and characterization of polymorphic microsatellite loci in the ant-plant *Hirtella physophora* (Chrysobalanaceae) using pyrosequencing technology. *Molecular Ecology Resources* 10:1106-1108
5. Orivel J, Lambs L, **Malé P-JG**, Leroy C, Grangier J, Otto T, Quilichini A & Dejean A (2011) Dynamics of the association between a long-lived understory myrmecophyte and its specific associated ants. *Oecologia* 165:369-376

4. Guivier E, Galan M, **Malé P-JG**, Kallio E, Voutilainen L, Henttonen H, Olsson G, Lundkvist A, Tersago K, Augot D, Cosson JF & Charbonnel N (2010) Associations between Major Histocompatibility Complex genes and PUUV infection in *Myodes glareolus* are detected in wild populations but not from experimental infection data. *Journal of General Virology* 91:2507-2512
3. **Malé P-JG**, Loiseau A, Estoup A, Quilichini A & Orivel J (2010) Characterization of polymorphic microsatellite loci in the neotropical plant-ant *Allomerus decemarticulatus* (Formicidae: Myrmicinae) and multiplexing with other microsatellites from the ant subfamily Myrmicinae. *European Journal of Entomology* 107:673-675
2. Grangier J, Dejean A, **Malé P-JG**, Solano PJ & Orivel J (2009) Mechanisms driving the specificity of a myrmecophyte-ant association. *Biological Journal of the Linnean Society* 97:90-97
1. Grangier J, Dejean A, **Malé P-JG** & Orivel J (2008) Indirect defense in a highly specific ant-plant mutualism. *Naturwissenschaften* 95:909-916

POPULAR SCIENCE

6. Bonhomme V, Cailleau A, Froissart R, Guerreiro R & **Malé P-JG** (2011) Evolution 101 : Petit cours d'évolution à l'usage des non biologistes. 32pp. Plume!-eds. Acta, Plume!, Montpellier.
5. **Malé P-JG** (2010) Un mathématicien en prise avec la société. *Plume! online*
4. **Malé P-JG** (2009) Struggle for evolution. *Plume!, vulgarisation scientifique* 11:8-9
3. **Malé P-JG** (2008) Tour d'horizon des interactions biologiques. *Plume!, vulgarisation scientifique* 8:4-5
2. **Malé P-JG** (2008) Raison et sentiments. *Plume!, vulgarisation scientifique* 7:6-7
1. **Malé P-JG** (2008) Créationnisme et Enseignement : Le Rapport Brasseur aboutit finalement à une Résolution Européenne. *Plume! online*

SYMPOSIUM LIST

TALKS

18. **Malé P-JG** (2014) Evolutionary stability of mutualisms and control mechanisms: insights from ant-plant relationships. *Atwood Colloquium in Ecology and Evolution*, Toronto (ON), Canada
17. **Malé P-JG** (2012) Construire des pedigrees dans sa cuisine : retour d'expérience. *Annual meeting of the French Research Network "Quantitative Genetics"*, Toulouse, France
16. Lauth J, Leroy C, **Malé P-JG**, Petitclerc F, Dejean A, Orivel J (2012) Development of non-food agriculture in ants through the vertical transmission of a fungal symbiont. *International Symbiosis Society Congress*, Kraków, Poland
15. Lauth J, **Malé P-JG**, Leroy C, Roux O, Dejean A, Orivel J (2012) A mutualistic community of ants, plant and fungi: how a third partner affects plant biotic protection by ants. *Joint Meeting of ATBC & Society for Tropical Ecology*, Bonito, Brazil
14. **Malé P-JG**, Leroy C, Dejean A, Quilichini A, Orivel J (2011) Le rôle du mode de transmission d'une association dans la résolution des conflits entre partenaires : le cas d'une relation plante-fourmis. *Biology and Population Genetics Symposium "Le Petit Pois Déridé"*, Toulouse, France
13. **Malé P-JG**, Leroy C, Dejean A, Quilichini A, Orivel J (2011) The importance of sanctions and transmission mode in conflicts resolution: insights from an ant-plant mutualism. *ESEB 13th Congress*, Tübingen, Germany
12. **Malé P-JG**, Leroy C, Dejean A, Quilichini A, Orivel J (2010) The importance of sanctions and transmission mode in conflicts resolution: insights from an ant-plant mutualism. *Final Conference of the EUROCORES programme*, Budapest, Hungary
11. **Malé P-JG**, Leroy C, Dejean A, Quilichini A, Orivel J (2010) Evolutionary conflicts and sanctions between a neotropical ant and its host plant. *IUSSI 2010*, Copenhagen, Denmark
10. **Malé P-JG**, Leroy C, Dejean A, Quilichini A, Orivel J (2010) Evolutionary conflicts and sanctions between a neotropical ant and its host plant. *Evolution 2010*, Portland (OR), USA

9. **Malé P-JG**, Gibert A, Casquet J (2009) Démythification des savoirs : les enjeux de la vulgarisation dès l'université. *Journée de la Société Française d'Ecologie*, Paris, France
8. **Malé P-JG**, Leroy C, Decombeix I, Hornoy B, Orivel J, Quilichini A (2009) Caractérisation et résolution de conflits évolutifs entre mutualistes obligatoires : Exemple d'une relation myrmécophyte. *SEVAB Graduate School Day*, Castanet Tolosan, France
7. Leroy C, **Malé P-JG**, Quilichini A, Ruiz-Gonzalez MX, Dejean A & Orivel J (2009) Ecology and maintenance of a novel tripartite mutualistic association. *Joint Meeting of ATBC & Society for Tropical Ecology*, Marburg, Germany
6. **Malé P-JG**, Leroy C, Decombeix I, Hornoy B, Orivel J, Quilichini A (2009) Système de reproduction et structuration génétique des populations de la plante myrmécophyte *Hirtella physophora*. *Biology and Population Genetics Symposium "Le Petit Pois Dérivé"*, Grenoble, France
5. Charbonnel N, Galan M, Bryja J, Deter J, **Malé P-J**, Guivier E, Chaval Y, Deffontaine V, Michaux J, Moran S, Cosson JF (2008) Immunogenetics and hantaviruses: From genes to the assessment of emergence risk. *Leibniz-Institute for Zoo and Wildlife Research Congress*, Berlin, Germany
4. Charbonnel N, Galan M, Bryja J, Deter J, **Malé P-J**, Guivier E, Chaval Y, Deffontaine V, Michaux J, Moran S, Cosson JF (2008) Immunogenetics and hantaviruses: From genes to the assessment of emergence risk. *EDEN Project annual meeting*, Brno, Tzech Republic
3. Orivel J, Lambs L, Grangier J, Leroy C, Otto T, **Malé P-J** & Dejean A (2008) Dynamics of the association between a long-lived understory myrmecophyte and its specific associated ants. *4th European Meeting of IUSSI*, La Roche en Ardenne, Belgium
2. Grangier J, Dejean A, **Malé P-J**, Orivel J (2007) La défense biotique des myrmécophytes est-elle toujours optimale ? *French Meeting of IUSSI*, Toulouse, France
1. **Malé P-JG**, Charbonnel N (2007) Histoire phylogéographique et Sélection balance : quelle origine pour le polymorphisme des gènes du CMH chez le campagnol roussâtre ? *Biology and Population Genetics Symposium "Le Petit Pois Dérivé"*, Poitiers, France

POSTERS

4. **Malé P-JG**, Bardon L, Besnard G, Coissac E, Delsuc F, Engel J, Scotti-Saintagne C, Tinaut A, Chave J (2013) Genome skimming by shotgun sequencing helps resolve the phylogenetic tree of a pantropical tree family. *ESEB 14th Congress*, Lisbon, Portugal
3. **Malé P-JG**, Chave J (2012) Using Next-Gen Sequencing to resolve the phylogeny of a tropical tree family. *Evolution 2012*, Ottawa (ON), Canada
2. Quilichini A, Leroy C, **Malé P-JG** (2009) Floral biology and pollination of *Hirtella physophora* (Chrysobalanaceae) in French Guiana. *International conference "Knowledge-based management of tropical rainforests"*, Cayenne, French Guiana
1. **Malé P-JG**, Leroy C, Orivel J, Quilichini A (2009) Evolutionary conflicts between a neotropical ant and its host-plant. *ESEB 12th Congress*, Torino, Italy