MARCELA TERESA HERNANDEZ GARCIA
DOCTOR OF NATURAL RESOURCE SCIENCES

Contact

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Research interest

I am fascinated by the important role of microorganisms (bacteria and archaea) in different ecosystems. I want to understand how communities can establish in soils that have been perturbed either by human manipulation or by a natural disturbance. My research area focuses on total microbial community (16S rRNA gene in bacteria and archaea) and specifically in herbicide-degrading bacteria (*atz* genes), ammonia-oxidizing microorganisms (nitrifiers AOA and AOB, *amoA* genes), methane-oxidizing bacteria (methanotrophs, *pmoA* genes) and anaerobic methane-producers by archaea (methanogens, *mcrA* genes). I study their role in several agricultural soils (from Chile, Germany and China), flooded rice and upland soybean fields (from China) and volcanic soils (from Chile). My current project is to identify antimicrobial resistant bacteria in soil by using stable isotope probing (SIP). We aim to discover which bacteria constitute the soil resistome in different British soils. We also want to understand if horizontal gene transfer (HGT) occurs between potential pathogens within soil microbiomes.

Work experience

Sept. 2016 – present: NERC Research Fellow in Environmental Microbiology, University of Southampton, UK. Grant: Natural Environment Research Council (NERC), UK.
Aug 2015 - Aug 2016: Visiting fellow, University of Southampton, UK.
Jan 2013 - July 2015: Research fellow, Max Planck Institute for Terrestrial Microbiology (MPItM), Marburg, Germany. Host: Prof. Dr. Ralf Conrad. Grant: Max Planck Society.
Aug 2013 - May 2015: Scientific Coordinator. International Max Planck Research School for Environmental, Cellular and Molecular Microbiology. MPItM, Marburg, Germany.
Oct 2010 - Dec 2012: Humboldt Research Fellowship. Max Planck Institute for Terrestrial Microbiology. Marburg, Germany. Host: Prof. Dr. Ralf Conrad.
Jan 2005 - Feb 2006: Research Investigator. Universidad Santa María. Valparaíso, Chile
Jun - Dec 2004: Marine Biologist. Gestión Ambiental Acuícola S.A., Puerto Montt (3 months) & Head of Laboratory, Stirling Ltda., Puerto Montt (3 months).

Education

2006 - 2010: PhD in Natural Resource Sciences. Unanimous distinction. Universidad de La Frontera. Temuco, Chile. Mark obtained: 7,0 (Scale 1,0 to 7,0). Final mark: 6,6.
2006 - 2007: M.Sc. in Natural Resources. Maximum distinction. Universidad de La Frontera, Temuco, Chile. Mark obtained: 6,7 (Scale 1,0 to 7,0). Final Mark: 6,4. Ranking: 3rd.
1998 - 2004: B.Sc. in Marine Biology. Universidad Católica de la Santísima Concepción, Concepción, Chile. Mark obtained: 7,0 (Scale 1,0 to 7,0). Ranking: 2nd.

Scientific Internships

Jun - Aug 2009: Culture Collection University of Göteborg (CCUG) Laboratory, Sahlgrenska University Hospital, Göteborg University. Göteborg, Sweden.
Sep 2008 - Mar 2009: Max Planck Institute for Terrestrial Microbiology, Marburg, Germany.

Awards:

2017: Roadshow Awards: Research Communicator, University of Southampton, UK.

List of publications

1. Yuan, Q., **M. Hernández**, M. G. Dumont, J. Rui, A. Fernandez Scavino and R. Conrad. 2018. Soil bacterial community mediates the effect of labile carbon on methanogenic decomposition of soil organic matter. Soil Biology and Biochemistry. 116: 99-109.
2. Calabi-Floody M., J. Medina, C. Rumpel, L.M. Condron, **M. Hernández**, M.G. Dumont, M.L. Mora. 2018. Smart fertilizers as a strategy for sustainable agriculture. Advances in Agronomy 147: 119-157.
3. Méndez, V., S. Fuentes, V. Morgante, **M. Hernández**, M. González, E. Moore and M. Seeger. 2017. Hydrocarbonoclastic and metal-tolerant *Acinetobacter* and *Pseudomonas* strains from Aconcagua river oil-polluted soil. Journal of Soil Science and Plant Nutrition. 17: 1074-1087.
4. Reim, A.†, **M. Hernández**†, M. Klose, A. Chidthaisong, M. Yuttitham, and R. Conrad. Response of methanogenic microbial communities to desiccation stress in flooded and rain-fed paddy soil from Thailand. Frontiers in Microbiology. 2017. 8: 785.
5. **Hernández, M**.*, R. Conrad, M. Klose, K. Ma, and Y. Lu. Structure and function of methanogenic microbial communities in soils from flooded rice and upland soybean fields from Sanjiang plain, NE China. Soil Biology and Biochemistry. 2017. 105: 81-91.
6. Marileo, L.G., M.A. Jorquera, **M. Hernández**, G. Briceño, M.L. Mora, R. Demanet and G. Palma. Changes in bacterial communities by post-emergent herbicides in an Andisol fertilized with urea as revealed by DGGE. Applied Soil Ecology. 2016. 101: 141-151.
7. **Hernández, M.**, M.G. Dumont, Q. Yuan and R. Conrad. Different bacterial populations associated with the roots and rhizosphere of rice incorporate plant-derived carbon. Applied and Environmental Microbiology. 2015. 81: 2244-2253.
8. Deng, Y., X. Cui, **M. Hernández** and M.G. Dumont. Microbial diversity in hummock and hollow soils of three wetlands on the Qinghai-Tibetan Plateau revealed by 16S rRNA pyrosequencing. Plos One. 2014. 9: e103115.
9. **Hernández, M.***, M. Dumont, M. Calabi, D. Basualto and R. Conrad. Ammonia oxidizers are pioneer microorganisms in the colonization of new acidic volcanic soils from South of Chile. Environmental Microbiology Reports. 2014. 6: 70-79.
10. Wu Y., X. Ke, **M. Hernández**, B. Wang, M. Dumont, Z. Jia and R. Conrad. Autotrophic growth of bacterial and archaeal ammonia oxidizers in freshwater sediment microcosms incubated at different temperatures. Applied and Environmental Microbiology. 2013. 79: 3076-3084.
11. Morgante, V., C. Flores, X. Fadic, M. González, **M. Hernández**, F. Cereceda-Balic and M. Seeger. Influence of microorganisms and leaching on simazine attenuation in agricultural soils. Journal of Environmental Management. 2012. 95: S300-S305.
12. **Hernández, M.**, Z. Jia, M. Seeger and R. Conrad. Simazine application inhibits nitrification and changes the ammonia-oxidizing bacterial communities in a fertilized agricultural soil. FEMS Microbiology and Ecology. 2011. 78: 511-519.
13. Seeger, M., **M. Hernández**, V. Méndez, B. Ponce, M. Córdova and M. González. Bacterial degradation and bioremediation of chlorinated herbicides and biphenyls. Journal of Soil Science and Plant Nutrition. 2010. 10: 320-332.
14. Méndez, V., S. Fuentes, **M. Hernández**, V. Morgante, M. González, M. Seeger. Isolation of hydrocarbon-degrading heavy-metal-resistant bacteria from crude oil-contaminated soil in central Chile. 2010. Journal of Biotechnology 150s: s287.
15. Jorquera, M. A., **M. Hernández**, O. Martínez, P. Marschner, and M. L. Mora. Detection of aluminium tolerance plasmids and microbial diversity in the rhizosphere of plants grown in acidic volcanic soil. European Journal of Soil Biology. 2010. 46: 255-263.
16. **Hernández, M.**, V. Morgante, M. Ávila, P. Moralles, M. González, and M. Seeger. Novel *s*-triazine-degrading bacteria isolated from agricultural soils of central Chile for herbicide bioremediation. Electronic Journal of Biotechnology. 2008. 11: 01-07.
17. **Hernández, M.**, V. Morgante, C. Flores, P. Villalobos, M. González, P. Miralles, M. A. Dinamarca and M. Seeger. Modern approaches for the study of bioremediation of *s*-triazine herbicides in agricultural soils. Journal of Soil Science and Plant Nutrition. 2008. 8: 19-30.

18. **Hernández, M.**, P. Villalobos, V. Morgante, M. González, C. Reiff, E. Moore and M. Seeger. Isolation and characterization of a novel simazine-degrading bacterium from agricultural soil of central Chile, *Pseudomonas* sp. MHP41. FEMS Microbiology Letters. 2008. 206: 184-190.
19. Jorquera, M. A., **M. Hernández**, Z. Rengel, P. Marschner, and M. L. Mora. Isolation of culturable phosphobacteria with both phytate-mineralization and phosphate-solubilization activity from the rhizosphere of plants grown in a volcanic soil. Biology and Fertility Soils. 2008. 44: 1025-1034.
20. Martínez, P., L. Agulló, **M. Hernández**, and M. Seeger. Chlorobenzoate inhibits growth and induces stress proteins in the PCB-degrading bacterium *Burkholderia xenovorans* LB400. Archives in Microbiology. 2007. 188: 289-297.

Manuscripts submitted and in preparation

1. McDaniel, M.D., D. Saha, M. G. Dumont, **M. Hernández** and M.A. Adams. The effect of land-use change on soil CH_4 and N_2O fluxes: a meta-analysis. Submitted to Ecosystems.
2. Wu, S., **M. Hernández**, Y. Deng, C. Han, X. Hong, J. Xu, W. Zhong, H. Deng. Do exoelectrogens suppress methanogens and methane emission in representative rice paddy of China?. Submitted to Environmental Science & Technology.
3. **Hernández, M*.**, M.G. Dumont, M. Calabi and R. Conrad. Microbial diversity in volcanic soils of various ages from Llaima, Chile. In preparation.
4. Barbosa Lima, A.[†], **M. Hernández**[†], A. Westphal Muniz and M.G. Dumont. Bacterial community responses to soil moisture variations in Amazonian Dark Earth and adjacent forest soils. In preparation.
5. McDaniel, M.D.[†], **M. Hernández**[†], M.G. Dumont, L.J. Ingram and M.A. Adams. Soil microbial communities and links to carbon cycling along a soil/vegetation gradient in a sub-alpine Australian ecosystem. In preparation to be submitted to ISME Journal.
6. Conrad, R., **M. Hernández**, M. Klose, A. Enrich. Methanogenic microbial communities in temporarily flooded ecosystems of Amazonia. In preparation to be submitted to Soil Biology and Biochemistry.
7. **Hernández, M.**, M.G. Dumont, C.W. Keevil. Stable isotope probing with ^{18}O-water to investigate antimicrobial resistant bacteria in British agricultural soil. In preparation to be submitted to PNAS.

* Corresponding author.
[†] These authors have contributed equally to this work.

Book:

1. Dumont, M., **M. Hernández**. Stable isotope probing, in Methods in Molecular Biology. Springer Nature. In process to be published in 2019.

Book chapters and patent

Book Chapters:

1. **Hernández, M.**, J.D. Neufeld and M.G. Dumont. 2016. Enhancing functional metagenomics of complex microbial communities using stable isotopes. In: Functional Metagenomics: Tools and Applications. Springer.
2. Seeger, M., V. Morgante, and **M. Hernández.** 2009. Bacterial degradation of herbicides in soils. In: Microbial Populations: Structure and Evolution (Lodeiro, A., ed.), Vol 1, Editorial Research Signpost, Kerala, India.

Patent:
Hernández, M., V. Morgante, P. Villalobos, C. Flores, M. González, and M. Seeger. (2007-2009): *s*-Triazine herbicide-degrading bacteria, product for the bioremediation and method of

bioremediation. Chilean Patent, No 1982-2007 dated 06.07.2007. American Patent, No 12/166,961 dated 02.07.08. Canadian Patent, No 2,636,856 dated 07.07.08. Columbian Patent, No 0806 8859 dated 04.07.08. Argentinian Patent, No 08 01 02903 dated 04.07.09.

Research grants

2018: University of Southampton - Global Research Initiator Scheme for collaboration with Prof. Yong Li (Zhejiang University) (~5000 GBP).
2017: Research Councils UK (RCUK), Newton Fund - UK-China Antimicrobial Resistance (AMR) Centre Partnerships Initiative for a participation in a workshop in Shanghai, China (~1500 GBP)
2013 - 2015: Max Planck Society Postdoctoral fellowship. Max Planck Institute for Terrestrial Microbiology. Marburg, Germany (~50400EUR).
2010 - 2013: Alexander von Humboldt Foundation Postdoctoral fellowship. Max Planck Institute for Terrestrial Microbiology. Marburg, Germany (EUR~82350 EURO).
Dec 2009: National Commission of Investigation, Science and Technology (CONICYT-CHILE) for conference attendance Chile. (Acomodation & Registration).
Jun 2009: CONICYT-CHILE for conference attendance Sweden(~2500 USD).
Feb 2009: Max Planck Society conference atendance. Göttingen, Germany (100 EUR).
Sept 2008: Congress Organization Commission conference atendance, Spain. (~1000EUR).
2008 - 2009: CONICYT-CHILE Internship, Germany (~7000EUR).
Aug 2008: CONICYT-CHILE for conference attendance, Australia (~2500 USD).
2008 - 2010: Support fellowship for doctoral thesis. CONICYT-CHILE (~4000 GBP).
Dec 2007: CONICYT-CHILE for conference attendance. Chile (~1000EUR).
2006 - 2010: CONICYT-CHILE Doctoral Scholarship grant (~30000 GBP).
Nov 2003: Congress Organization grant. Chile. (Registration fee).

Research collaborator:

2016 - present: NERC grant NE/N02026X/1: Occurrence and horizontal gene transfer of carbapenemase and ESBL genes in soil microbiomes. Research fellow.
2008 - 2009: Chile. 130836: Biorremediación de suelos contaminados con COPs y metales pesados: desde sus bases moleculares a estudios de biorremediación. PhD student.
2005 - 2009: Bicentenary Program in Science and Technology, Conicyt PSD-26: Study on environmental factors on transference of plasmid, which harbour phosphorus solubilizing genes, present in agro-ecosystems from southern Chile. PhD student.
2002 - 2005: European Union – Project N° INCO ICA4-CT-2002-10011: Innovative approaches to understand complex microbial communities for eco-engineering the degradation of herbicides in stressed agricultural soils. Bachelor student.

Outreach activities

2006: XII National week of Science and Technology. Universidad de La Frontera, Chile.
2007: 1000 CIENTIFICOS, 1000 AULAS. Talk in Liceo de Ciencias y Humanidades, Chile.
2009: Talk in Liceo Los Guindos de Buin and Liceo Politécnico de Buin, Santiago de Chile.
2009: 1000 CIENTIFICOS, 1000 AULAS. Talk in Colegio Manantial. Viña del Mar. Chile.
2017: Science week primary school John Keble, Winchester, 8th February 2017, U.K.
2017: Winchester Science Festival, 17 February 2017, U.K.
2017: Cheltenham Science Festival, 8-9 June 201, U.K.

Invited talks:

Jan 2017: Stable isotope probing with ^{18}O-water to investigate antimicrobial resistant bacteria in natural environments. Understanding real world interactions Workshop. University of Southampton.
Oct. 2017: Soil microbial communities and links to carbon cycling. Nanjing Normal University, Nanjing, China. October 14th, 2017.

Oct. 2017: Identification of bacteria using plant-derived carbon from rice root exudates. Nanjing University of Information Science and Technology, Nanjing, China. October 15th, 2017.
Oct 2017: Multi-drug resistant bacteria in British agricultural soil. 2nd Global Soil Biodiversity Conference, October 2017, Nanjing, China.
Oct 2017: Elucidating microbial succession: a study of remote volcanic soils. Symposium on microbial metabolism of trace gas - a tribute to Ralf Conrad. Nanjing, China. October 17th, 2017.
Nov. 2017: Application of stable-isotope labelling techniques for the detection of bacteria using plant-derived carbon and pathogens in agricultural soils. Zhejiang University. Hangzhou, China. November 20th, 2017.
Dec. 2017: Exploring the niches of complex soil- and plant-associated microbial communities with the aid of high-throughput sequencing and stable-isotope probing. Leibniz Institute DSMZ - German Collection of Microorganisms and Cell Cultures, Germany, December 21st, 2017.

Laboratory techniques:
Molecular lab techniques: Environmental nucleic acid extraction (DNA and RNA), real time PCR, cloning, Bacterial isolation and characterization, Microcosm incubations, antimicrobial resistant bacteria, RNA- and DNA-stable isotope probing.
Molecular data analysis: High throughput sequencing for 16S rRNA and functional genes., sequence analysis tools and databases (ARB, BLAST, CLUSTAL, RDP, Silva), R statistical analysis platform, Mothur and Uparse meta-sequence analysis platforms.

Peer reviews: Biology and Fertility of Soils, Plos One, FEMS Microbiology and Ecology, Science of the Total Environment, Environmental Earth Sciences, Sustainability, Journal of Ocean University of China, Journal of Soil Science and Plant Nutrition, European Journal of Soil Biology.

Other activities
Aug 2017 - present: Postdoc representative, Biological Sciences.
Jan - May 2017: Organisation committee member for the Festival of Doctoral Research, University of Southampton.
2017: Supervisory team for the PhD studies of Iytzia Castañeda Davalos, CONACYT-Mexico.
2018: Supervisor of Master student Ms. Dorothee Kinkel (University of Bonn, Germany). Visiting research stay (3 months). Fund: Erasmus.