

# WALDAN K. KWONG

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## Education

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2015	Ph.D., Ecology & Evolutionary Biology, Yale University
2012	M.Sc., Ecology & Evolutionary Biology, Yale University
2009	B.Sc., Biology (major) & Physics (minor), University of British Columbia

## Positions Held

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2021 – present	<b>Group Leader – Microbial Genomics and Symbiosis</b> , Instituto Gulbenkian de Ciência
2017 – 2021	<b>Killam Research &amp; NSERC Postdoctoral Fellow</b> , Dept. of Botany, University of British Columbia <i>Supervisor:</i> Patrick J. Keeling
2013 – 2016	<b>Visiting scholar</b> , Center for Computational Biology and Bioinformatics, University of Texas at Austin
2010 – 2015	<b>Ph.D. candidate</b> , Dept. of Ecology and Evolutionary Biology, Yale University <i>Supervisor:</i> Nancy A. Moran
2008 – 2009	<b>Research assistant</b> , Centre for Molecular Medicine and Therapeutics, University of British Columbia
2006 – 2008	<b>Research assistant</b> , Dept. of Microbiology and Immunology, University of British Columbia

## Selected Awards & Funding

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### *Research grants and fellowships:*

2022 – 2027	European Research Council Starting Grant (€1,498,125)
2022 – 2027	Fundação para a Ciência e a Tecnologia Scientific Employment Stimulus (€268,000)
2022 – 2025	EMBO Installation Grant (€150,000)
2017 – 2019	Natural Sciences and Engineering Research Council of Canada Postdoctoral Fellowship (\$90,000)
2017 – 2019	Killam Postdoctoral Research Fellowship (\$104,000)
2015	Sigma Xi Grants-in-Aid of Research (\$700)
2014	Yale EEB Chair's Graduate Student Fund Award (\$2,800)
2012	Yale EEB Chair's Graduate Student Fund Award (\$1,800)
2012 – 2015	Natural Sciences and Engineering Research Council of Canada Postgraduate Scholarship (\$63,000)
2008	Child and Family Research Institute Summer Student Fellowship (\$3,750)
2006	Translational Research in Infectious Diseases Co-op Studentship (\$10,504)

### *Other awards:*

2018	Gordon and Betty Moore Foundation Scholarship (\$500)
2017	Society of Molecular Biology and Evolution Conference Registration Award (\$570)
2014	International Union for the Study of Social Insects - North American Section (\$2,000)
2014	Yale Graduate Student Assembly Conference Travel Fellowship (\$700)
2012	Canadian Society of Microbiologists, Student Award Competition Travel Bursary (\$438)
2008	UBC Multidisciplinary Undergraduate Research Conference – Oral Presentation Winner
2005	J. Fred Muir Memorial Scholarship in Science (\$500)
2003 – 2005	UBC Undergraduate Scholar Program Scholarship (\$7,500)

## Selected Conferences & Seminars

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2022	EMBO YIP Annual Meeting, Heidelberg, Germany
2022	Laboratory of Microbiology, University of Wageningen
2022	SymbNET Seminar Series
2021	1 <sup>st</sup> Microbiome Portugal Summit
2020	School of Biological Science, Monash University
2020	Department of Biology, University of Victoria
2020	HiLife Institute of Biotechnology, University of Helsinki
2019	Department of Biology, University of Toronto, Mississauga
2019	Invaio Sciences, Cambridge, MA, USA
2018	Entomological Society of America/Canada joint meeting, Vancouver, BC, Canada

2018	Meeting of the International Society of Protistologists, Vancouver, BC, Canada
2018	Michigan Beekeepers Association meeting, Lansing, MI, USA
2018	Department of Microbiology and Immunology, University of British Columbia
2017	Society of Molecular Biology and Evolution meeting, Austin, TX, USA
2017	Biodiversity Internal Seminar Series, University of British Columbia
2016	XXV International Congress of Entomology, Orlando, FL, USA
2016	Society for the Study of Evolution/American Society of Naturalists, Austin, TX, USA
2014	15 <sup>th</sup> International Symposium on Microbial Ecology, Seoul, South Korea
2014	International Union for the Study of Social Insects 17 <sup>th</sup> Congress, Cairns, Australia
2014	Keystone Symposium: Invertebrate-Microbe Interactions, Tahoe City, CA, USA
2013	Society of Molecular Biology and Evolution meeting, Chicago, IL, USA
2013	2 <sup>nd</sup> Annual Connecticut Symbiosis Symposium, University of Connecticut - Storrs
2012	14 <sup>th</sup> International Symposium on Microbial Ecology, Copenhagen, Denmark

## Invention Disclosures & Patents

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2022	Moran NA, Leonard S, Kwong WK, Powell EJ. Bee gut microbial formulation for use as a probiotic for improved bee health and pathogen resistance. US Patent App. 17/431,813.
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## Teaching & Supervision

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### *Graduate students supervised:*

2022 – present 1 PhD student, 1 PhD student (committee); Instituto Gulbenkian de Ciência

### *Undergraduates supervised:*

2017 – 2021 3 students, University of British Columbia (UBC SURE and NSERC Fellowship recipients)  
 2013 – 2016 4 students, University of Texas at Austin (incl. 2 UT Research Fellowship recipients)  
 2012 1 student, Yale University

### *Teaching:*

2019 Guest lecturer, Evolutionary Cell Biology, University of British Columbia  
 2015 Guest lecturer, Entomology, University of Texas at Austin  
 2013 Teaching assistant, Lab for Principles of Evolution, Ecology & Behavior (EEB 223L), Yale University  
 2012 Teaching assistant, Evolutionary Biology (EEB 225), Yale University  
 2012 Guest lecturer, General Biology, Common Ground High School, New Haven, CT, USA  
 2011 Teaching assistant, Diversity of Life (EEB 160), Yale University  
 2011 Teaching assistant, Principles of Ecology, Evolution, and Behavior (EEB 122), Yale University  
 2003 – 2010 Private tutor, for undergraduate and high school level math and science courses.

## Service, Outreach, & Other Activities

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### *Field work:*

2018 – 2021 Curaçao  
 2014 Australia, Malaysia, Singapore, Hong Kong, South Korea

### *Visitors hosted:*

2022 – present 2 long term (>1 yr), 1 short term; Instituto Gulbenkian de Ciência

### *Selected service & outreach:*

2018, 2020 Bee Master Course, Province of British Columbia (Invited lecturer)  
 2018 Microbiome Network Symposium, University of British Columbia (Organizing committee)  
 2013 Connecticut Beekeepers Association meeting, Windsor, CT, USA (Invited speaker)  
 2011 – 2013 Yale EEB Graduate Student & Post-doc Colloquium (Organizing committee)  
 2012 Careers in Scientific Research – Yale College Junior Class Council (Invited panelist)

### *Reviewer for journals:*

The American Naturalist  
 Animal Microbiome

Apidologie  
 Applied and Environmental Microbiology

Biofilms and Microbiomes  
Biology Letters  
BMC Evolutionary Biology  
BMC Microbiology  
Current Biology  
Ecology Letters  
eLife  
Environmental Entomology  
Environmental Microbiology  
FEMS Microbial Ecology  
Frontiers in Microbiology  
Genome Biology and Evolution  
Insect Science  
Insects  
Int. Journal of Systematic and Evolutionary Microbiology  
The ISME Journal  
Journal of Apicultural Research

Journal of Invertebrate Pathology  
mBio  
Microbiome  
Molecular Ecology  
Nature Communications  
Nature Ecology and Evolution  
Nutrients  
Parasitology  
PeerJ  
PLoS Biology  
PLoS ONE  
PLoS Pathogens  
Philippine Journal of Science  
Proceedings of the National Academy of Sciences USA  
Scientific Reports  
Symbiosis  
Trends in Microbiology

*Reviewer for funding agencies:*

Eva Crane Trust  
National Science Centre Poland  
U.S. National Science Foundation

*Media interviews:*

American Bee Journal, BioTechniques, Daily Texan, Nature, Nature Reviews Microbiology, La Recherche, Live Science, Science in the City, The Scientist, UBC Science News, Ubyssy

## Publications

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\* equal contribution; † alphabetical authorship; ‡ student mentee

32. George EE, Tashyreva D, Kwong WK, Okamoto N, Horák A, Husnik F, Lukeš J, Keeling PJ. 2022. **Gene transfer agents in bacterial endosymbionts of microbial eukaryotes**. In revision.
31. Keeling PJ, Mathur V, Kwong WK. 2021. **Coralicollids: The elusive coral-infecting apicomplexans**. PLoS Pathogens. 17(9):e1009845. [\[LINK\]](#)
30. Kwong WK, Irwin NAT, Mathur V, Na I‡, Okamoto N, Vermeij MJA, Keeling PJ. 2021. **Taxonomy of the apicomplexan symbionts of coral, including Coralicollida ord. nov., reassignment of the genus *Gemmocystis*, and description of new species *Coralicolla aquarius* gen. nov. sp. nov. and *Anthozoaphila gnarlus* gen. nov. sp. nov.** Journal of Eukaryotic Microbiology. e12852. ([bioRxiv](#)). [\[LINK\]](#) [Jul./Aug. 2021 issue cover](#)
29. Mathur V, Kwong WK, Husnik F, Irwin NAT, Kristmundsson A, Gestral C, Freeman M, Keeling PJ. 2020. **Phylogenomics identifies a new major subgroup of apicomplexans, Marosporida class. nov., with extreme apicoplast genome reduction**. Genome Biology and Evolution. 13(2):evaa244. [\[LINK\]](#)
28. Kwong WK. 2020. **Microbiome evolution: Having the guts to be different**. Current Biology. 30(13):R766-R768. [\[LINK\]](#)
27. Kwong WK. 2020. **Bee microbiomes go viral**. Proceedings of the National Academy of Sciences of the United States of America. 117(21):11197–11199. [\[LINK\]](#)
26. George EE\*, Husnik F\*, Tashyreva D\*, Prokopchuk G\*, Horák A, Kwong WK, Lukeš J, and Keeling PJ. 2020. **Highly reduced genomes of protist endosymbionts show evolutionary convergence**. Current Biology. 30(5):925-933.e3. ([bioRxiv](#)). [\[LINK\]](#)

25. Zheng H\*, Perreau J\*, Powell JE, Zhang W, Du Y, Kwong WK, Tringe SG, and Moran NA. 2019. **Division of labor in honey bee gut microbiota for plant polysaccharide digestion.** Proceedings of the National Academy of Sciences of the United States of America. 116(51):25909–25916. [\[LINK\]](#)
24. Kwong WK, del Campo J, Mathur V, Vermeij MJA, and Keeling PJ. 2019. **A widespread coral-infecting apicomplexan with chlorophyll biosynthesis genes.** Nature. 568(7750):103–107. ([bioRxiv](#)). [\[LINK\]](#) F1000 Recommended, [Nature News & Views Commentary](#)
23. Romero S\*, Nastasa A\*, Chapman A, Kwong WK, and Foster L. 2019. **The honey bee gut microbiota: Strategies for study and characterization.** Insect Molecular Biology. 28(4):455–472. [\[LINK\]](#)
22. Mazel F, Davis KM, Loudon A, Kwong WK, Groussin M, and Parfrey LW. 2018. **Is host filtering the main driver of phylosymbiosis across the tree of life?** mSystems. 3:e00097-18. [\[LINK\]](#)
21. Bean BDM, Dziurdzik SK, Kolehmainen KL, Fowler CMS, Kwong WK, Grad LI, Davey M, Schluter C, and Conibear E. 2018. **Competitive organelle-specific adaptors recruit Vps13 to membrane contact sites.** Journal of Cell Biology. 217(10):3593–3607. [\[LINK\]](#) [JCB Spotlight](#)
20. Kwong WK, Steele MI, and Moran NA. 2018. **Genome sequences of *Apibacter* spp., gut symbionts of Asian honey bees.** Genome Biology and Evolution. 10(4):1174–1179. [\[LINK\]](#)
19. Mockler BK‡, Kwong WK, Moran NA, and Koch H. 2018. **Microbiome structure influences infection by the parasite *Crithidia bombi* in bumble bees.** Applied and Environmental Microbiology. 84(7):e02335-17. [\[LINK\]](#)
18. Steele MI, Kwong WK, Whiteley M, and Moran NA. 2017. **Diversification of Type VI Secretion System toxins reveals ancient antagonism among bee gut microbes.** mBio. 8(6):e01630-17. [\[LINK\]](#)
17. Kwong WK, Zheng H, and Moran NA. 2017. **Convergent evolution of a modified, acetate-driven TCA cycle in bacteria.** Nature Microbiology. 2:17067. [\[LINK\]](#) [Behind the Paper](#)
16. Kwong WK, Medina LA‡, Koch H, Sing KW, Soh EJY, Ascher JS, Jaffé R, and Moran NA. 2017. **Dynamic microbiome evolution in social bees.** Science Advances. 3(3):e1600515. [\[LINK\]](#) News coverage by The Scientist, BioTechniques, the Daily Texan, Phys.org, BioscienceTechnology, and Sci-News.com
15. Kwong WK\*, Mancenido AL\*‡, and Moran NA. 2017. **Immune system stimulation by the native gut microbiota of honey bees.** Royal Society Open Science. 4(2):170003. [\[LINK\]](#) [Nature Research Highlight](#), featured by La Recherche
14. Powell JE\*, Leonard SP\*, Kwong WK\*, Engel P, and Moran NA. 2016. **Genome-wide screen identifies host colonization determinants in a bacterial gut symbiont.** Proceedings of the National Academy of Sciences of the United States of America. 113(48):13887–13892. [\[LINK\]](#)
13. Zheng H, Nishida A, Kwong WK, Koch H, Engel P, Steele MI, and Moran NA. 2016. **Metabolism of toxic sugars by strains of the bee gut symbiont *Gilliamella apicola*.** mBio. 7(6):e01326-16. [\[LINK\]](#)
12. Kwong WK and Moran NA. 2016. **Gut microbial communities of social bees.** Nature Reviews Microbiology. 14(6):374–384. [\[LINK\]](#) [Jun. 2016 issue cover](#), featured by Bee Culture Magazine
11. Engel P, Kwong WK, McFrederick Q, Anderson KE, Barribeau SM, Chandler JA, Cornman RS, Dainat J, de Miranda JR, Doublet V, Emery O, Evans JD, Farinelli L, Flenniken ML, Granberg F, Grasis JA, Gauthier L, Hayer J, Koch H, Kocher S, Martinson VG, Moran N, Munoz-Torres M, Newton I, Paxton RJ, Powell E, Sadd BM, Schmid-Hempel P, Schmid-Hempel R, Song SJ, Schwarz RS, vanEngelsdorp D, and Dainat B. 2016. **The bee microbiome: Impact on bee health and model for evolution and ecology of host-microbe interactions.** mBio. 7(2):e02164-15. [\[LINK\]](#)
10. Kwong WK and Moran NA. 2016. ***Apibacter adventoris* gen. nov., sp. nov., a member of the phylum Bacteroidetes isolated from honey bees.** International Journal of Systematic and Evolutionary Microbiology. 66:1323–1329. [\[LINK\]](#)

9. Kwong WK and Moran NA. 2015. **The evolution of host specialization in gut microbes: the bee gut as a model.** Gut Microbes. 6(3):214–220. [\[LINK\]](#)
8. Kwong WK, Mancenido AL‡, and Moran NA. 2014. **Genome sequences of *Lactobacillus* spp. strains wkB8 and wkB10, members of the ‘Firm-5’ clade, from honey bee guts.** Genome Announcements. 2(6) pii:e01176-14. [\[LINK\]](#)
7. Kwong WK, Engel P, Koch H, and Moran NA. 2014. **Genomics and host specialization of honey bee and bumble bee gut symbionts.** Proceedings of the National Academy of Sciences of the United States of America. 111(31):11509–11514. [\[LINK\]](#) [PNAS Featured Article](#), [Nature Reviews Microbiology Commentary](#)
6. Engel P†, James RR†, Koga R†, Kwong WK†, McFrederick Q†, and Moran NA†. 2013. **Standard methods for research on *Apis mellifera* gut symbionts.** In V Dietemann, JD Ellis, P Neumann (Eds) *The COLOSS BEEBOOK, Volume I: Standard Methods for Apis mellifera Research.* Journal of Apicultural Research. 52(4):doi 10.3896. [\[LINK\]](#)
5. Engel P, Kwong WK, and Moran NA. 2013. ***Frischella perrara* gen. nov., sp. nov., a gammaproteobacterium isolated from the gut of the honey bee, *Apis mellifera*.** International Journal of Systematic and Evolutionary Microbiology. 63:3646–3651. [\[LINK\]](#)
4. Kwong WK and Moran NA. 2013. **Cultivation and characterization of the gut symbionts of honey bees and bumble bees: description of *Snodgrassella alvi* gen. nov., sp. nov., a member of the family *Neisseriaceae* of the *Betaproteobacteria*, and *Gilliamella apicola* gen. nov., sp. nov., a member of *Orbaceae* fam. nov., *Orbales* ord. nov., a sister taxon to the order ‘Enterobacteriales’ of the *Gammaproteobacteria*.** International Journal of Systematic and Evolutionary Microbiology. 63:2008–2018. [\[LINK\]](#) IJSEM Jun. 2013 issue cover, featured by the National Collection of Industrial, Food and Marine Bacteria
3. Yim G\*, Kwong W\*, Davies J, and Miao V. 2012. **Complex integrons containing *qnrB4-ampC* (*blaDHA-1*) in plasmids of multidrug resistant *Citrobacter freundii* from wastewater.** Canadian Journal of Microbiology. 59(2):110–116. [\[LINK\]](#)
2. Tian B, Fadhil NH, Powell JE, Kwong WK, and Moran NA. 2012. **Long-term exposure to antibiotics has caused accumulation of resistance determinants in the gut microbiota of honey bees.** mBio. 3(6):e00377-12. [\[LINK\]](#) [ASM Commentary](#), [mBio Nov./Dec. 2012 issue cover](#), featured by news@JAMA, Voice of America, Science Daily, Science News, Yale Daily News, and 10+ other news outlets
1. Xu H, Miao V, Kwong W, Xia R, and Davies J. 2011. **Identification of a novel fosfomycin resistance gene (*fosA2*) in *Enterobacter cloacae* from the Salmon River, Canada.** Letters in Applied Microbiology. 52(4):427–429. [\[LINK\]](#)

Other:

Azenha S‡, Figueiredo C‡, Kwong WK. 2022. **Leben im Darm.** Deutsches Bienen-Journal. 3/2022. (in German)

Keeling PJ, Boscaro V, Bardell F, Burki F, Cho A, Cooney EC, del Campo J, Fast NM, Fiorito R, Gavelis GS, Gawryluk RMR, George EE, Gomm-Kolisko RN, Grisdale CJ, Heger T, Hehenberger E, Herranz M, Hirakawa Y, Husnik F, Imanian B, Irwin NAT, James ER, Janouskovec J, Karnkowska A, Kolisko M, Kwong W, Leander BS, Mathur V, Nawar F, Okamoto N, Parfrey L, Pittis A, Pan J, Pombert J, Sabetrasekh M, Saldarriaga JF, Sanders R, Singh RA, Smith DR, Strassert JJH, Stephenson I, Syberg-Olsen MJ, Tai V, Tikhonenkov DV, Van Steenkiste NWL, Whalen M, Whelan TA, Wong DK. 2020. **A letter to Denis Lynn.** Aquatic Ecosystem Health & Management. 23:17–18. [\[LINK\]](#)

Kwong WK. 2015. **Evolution and Specialization of the Gut Microbiota of Eusocial Bees.** PhD Dissertation. Yale University. Proquest 10009966. [\[LINK\]](#)