

Publications de Christopher I. Keeling

Liste des documents publiés avant le mois de septembre 2017. Consultez la Librairie du SCF pour obtenir la liste des publications parues après cette date. (Disponible en anglais seulement)

Articles publiés dans des revues à comité de lecture et autres publications:

51. Chiu, C.C., **Keeling, C.I.**, Bohlmann, J. (2017) Toxicity of pine monoterpenes to mountain pine beetle. *Scientific Reports* **7**:8858.
50. Fraser, J.D., Bonnett, T.R., **Keeling, C.I.**, Huber, D.P.W. (2017). Seasonal shifts in accumulation of glycerol biosynthetic gene transcripts in mountain pine beetle, *Dendroctonus ponderosae* Hopkins (Coleoptera: Curculionidae), larvae. *PeerJ* **5**:e3284; <https://doi.org/10.7717/peerj.3284>.
49. Robert, J.A., Bonnett, T., Pitt, C., Spooner, L.J., Fraser, J., Yuen, M.M.S., **Keeling, C.I.**, Bohlmann, J., Huber, D.P.W. (2016) Gene expression analysis of overwintering mountain pine beetle larvae suggests multiple systems involved in overwintering stress, cold hardiness, and preparation for spring development. *PeerJ* **4**:e2109; <https://doi.org/10.7717/peerj.2109>.
48. **Keeling, C. I.**, Li, M., Sandhu, H. K., Henderson, H., Yuen, M. M. S., Bohlmann, J. (2016) Quantitative metabolome, proteome and transcriptome analysis of midgut and fat body tissues in the mountain pine beetle, *Dendroctonus ponderosae* Hopkins, and insights into pheromone biosynthesis. *Insect Biochem. Mol. Biol.* **70**:170-183.
47. Warren, R.* , **Keeling, C. I.***, Yuen, M. M. S., Raymond, A., Taylor, G. A., Vandervalk, B. P., Mohamadi, H., Paulino, D., Chiu, R., Jackman, S. D., Robertson, G., Yang, C., Hoffmann, M., Weigel, D., Nelson, D. R., Ritland, C., Isabel, N., Jaquish, B., Yanchuk, A., Bousquet, J., Jones, S. J. M., MacKay, J., Birol, I., Bohlmann, J. (2015) Improved white spruce (*Picea glauca*) genome assemblies and annotation of large gene families of conifer terpenoid and phenolic defense metabolism. *The Plant Journal* **83**:189–212. doi: 10.1111/tpj.12886. (*co-premiers auteurs)
46. De La Torre, A., Birol, I., Bousquet, J., Ingvarsson, P., Jansson, S., Jones, S.J.M., **Keeling, C.I.**, MacKay, J., Nilsson, O., Ritland, K., Street, N., Yanchuk, A., Zerde, P., Bohlmann, J. (2014). Insights into conifer giga-genomes. *Plant Physiology* **116**:1724-1732. doi: 10.1104/pp.114.248708.
45. Pitt, C., Robert, J.A., Bonnett, T.R., **Keeling, C.I.**, Bohlmann, J., Huber, D.P.W. (2014). Proteomics indicators of the rapidly shifting physiology from whole mountain pine beetle, *Dendroctonus ponderosae* (Coleoptera: Curculionidae), adults during

early host colonization. *PLoS ONE* **9**(10): e110673.
doi:10.1371/journal.pone.0110673.

44. Janes, J.K., Li, Y., **Keeling, C.I.**, Yuen, M.M.S., Boone, C.K., Cooke, J.E.K., Bohlmann, J., Huber, D.P.W., Murray, B.W., Coltman, D.W., Sperling, F.A.H. (2014) How the mountain pine beetle (*Dendroctonus ponderosae*) breached the Canadian Rockies. *Mol. Biol. Evol.* **31**(7):1803-1815.
43. **Keeling, C. I.**, Chiu, C. C., Aw, T., Li, M., Henderson, H., Tittiger, C., Weng, H.- B., Blomquist, G. J., Bohlmann, J. (2013) Frontalin pheromone biosynthesis in the mountain pine beetle, *Dendroctonus ponderosae*, and the role of isoprenyl diphosphate synthases. *Proc. Natl. Acad. Sci. USA* **110**(47):18838–18843.
42. **Keeling, C. I.**, Henderson, H., Li, M., Dullat, H. K., Ohnishi, T., Bohlmann, J. (2013). CYP345E2, an antenna-specific cytochrome P450 from the mountain pine beetle, *Dendroctonus ponderosae* Hopkins, catalyses the oxidative degradation of pine host odorants. *Ins. Biochem. Mol. Biol.* **43**(12):1142-1151.
41. Robert, J. A., Pitt, C., Bonnett, T., Yuen, M. M. S., **Keeling, C. I.**, Bohlmann, J., Huber, D. P. W. (2013) Disentangling detoxification: Gene expression analysis of feeding mountain pine beetle illuminates molecular-level host chemical defense detoxification mechanisms. *PLoS ONE* **8**(11):e77777.
40. Diaz-Chavez, M. L., Moniodis, J., Madilao, L. L., Jancsik, S., **Keeling, C. I.**, Barbour, E. L., Ghisalberti, E. L., Plummer, J. A., Jones, C. G., Bohlmann, J. (2013) Biosynthesis of sandalwood oil: *Santalum album* CYP76F cytochromes P450 produce santalols and bergamotol. *PLoS ONE* 10.1371/journal.pone.0075053.
39. Hall, D. E., Yuen, M. M. S., Jancsik, S., Lara Quesada, A., Dullat, H. K., Li, M., Henderson, H., Arango-Velez, A., Liao, N. Y., Docking, T. R., Chan, S. K., Cooke, J. E. K., Breuil, C., **Keeling, C. I.**, Bohlmann, J. (2013) Transcriptome resources and functional characterization of monoterpene synthases for two host species of the mountain pine beetle, lodgepole pine (*Pinus contorta*) and jack pine (*Pinus banksiana*). *BMC Plant Biology* **13**:80.
38. Birol, I., Raymond, A., Jackman, S. D., Pleasance, S., Coope, R., Taylor, G. A., Yuen, M. M. S., **Keeling, C. I.**, Brand, D., Vandervalk, B. P., Kirk, H., Pandoh, P., Moore, R. A., Zhao, Y., Mungall, A. J., Jaquish, B., Yanchuk, A., Ritland, C., Boyle, B., Bousquet, J., Ritland, K., MacKay, J., Bohlmann, J., Jones, S. J. M. (2013). Assembling the 20 Gb white spruce (*Picea glauca*) genome from whole-genome shotgun sequencing data. *Bioinformatics* doi: 10.1093/bioinformatics/btt178.
37. **Keeling, C.I.**, Yuen, M.M.S., Liao, N.Y., Docking, T.R., Chan, S.K., Taylor, G.A., Palmquist, D.L., Jackman, S.D., Nguyen, A., Li, M., Henderson, H., Janes, J.K., Zhao, Y., Pandoh, P., Moore, R., Sperling, F.A.H., Huber, D.P.W., Birol, I., Jones, S.J.M., and Bohlmann, J. (2013). Draft genome of the mountain pine beetle,

Dendroctonus ponderosae Hopkins, a major forest pest. *Genome Biology* **14**(3):R27.

36. Andersson, M.N., Grosse-Wilde, E., **Keeling, C.I.**, Bengtsson, J.M., Yuen, M.M.S., Li, M., Hillbur, Y., Bohlmann, J., Hansson, B.S., Schlyter, F. (2013). Antennal transcriptome analysis of chemosensory gene families in tree killing bark beetles, *Ips typographus* and *Dendroctonus ponderosae* (Coleoptera: Curculionidae: Scolytinae). *BMC Genomics* **14**:198.
35. Bonnett, T.R., Robert, J.A., Pitt, C., Fraser, J.D., **Keeling, C.I.**, Bohlmann, J., Huber, D.P.W. (2012) Global and comparative proteomic profiling of overwintering and developing mountain pine beetle, *Dendroctonus ponderosae* (Coleoptera: Curculionidae), larvae. *Ins. Biochem. Mol. Biol.* **42**(12):890-901.
34. **Keeling, C. I.**, Henderson, H., Li, M., Yuen, M., Clark, E. L., Fraser, J. D., Huber, D. P. W., Liao, N. Y., Docking, T. R., Birol, I., Chan, S. K., Taylor, G. A., Palmquist, D., Jones, S. J. M., Bohlmann, J. (2012) Transcriptome and full-length cDNA resources for the mountain pine beetle, *Dendroctonus ponderosae* Hopkins, a major insect pest of pine forests. *Ins. Biochem. Mol. Biol.* **42**(8):525-536.
33. **Keeling, C. I.**, Madilao, L. L., Zerbe, P., Dullat, H. K., and Bohlmann, J. (2011) The primary diterpene synthase products of *Picea abies* levopimaradiene/abietadiene synthase (PaLAS) are epimers of a thermally unstable diterpenol. *J. Biol. Chem.* **286**(24):21145–21153.
32. **Keeling, C. I.**, Weisshaar, S., Ralph, S. G., Jancsik, S., Hamberger, B., Dullat, H. K., and Bohlmann, J. (2011) Transcriptome mining, functional characterization, and phylogeny of a large terpene synthase gene family in spruce (*Picea* spp.). *BMC Plant Biol.* **11**:43.
31. Hall, D., Robert, J. A., **Keeling, C. I.**, Domanski, D., Lara Quesada, A., Jancsik, S., Kuzyk, M., Hamberger, B., Borchers, C., and Bohlmann, J. (2011) An integrated genomic, proteomic, and biochemical analysis of (+)-3-carene biosynthesis in Sitka spruce (*Picea sitchensis*) genotypes which are resistant or susceptible to white pine weevil. *The Plant Journal* **65**: 936-948.
30. Samarasekera, N. G., **Keeling, C. I.**, Bohlmann, J., and Murray, B. W. (2011) Isolation and characterization of EST-derived microsatellite markers for the mountain pine beetle (*Dendroctonus ponderosae* Hopkins). *Mol. Ecol. Res. Perm. Gen. Res. Note.* **11**(3):586-589.
29. Hesse-Orce, U., DiGuistini, S., **Keeling, C. I.**, Wang, Y., Li, M., Henderson, H., Docking, T. R., Liao, N. Y., Robertson, G., Holt, R. A., Jones, S. J. M., Bohlmann, J., and Breuil, C. (2010) Gene discovery for the bark beetle-vectored fungal tree pathogen *Grosmannia clavigera*. *BMC Genomics* **11**:536.

28. Zulak, K. G., Dullat, H. K., **Keeling, C. I.**, Lippert, D., and Bohlmann, J. (2010) Immunofluorescence localization of levopimaradiene/abietadiene synthase in methyl jasmonate treated stems of Sitka spruce (*Picea sitchensis*) shows activation of diterpenoid biosynthesis in cortical and developing traumatic resin ducts. *Phytochemistry* **71**:1695–1699.
27. Aw, T., Schlauch, K., **Keeling, C. I.**, Young, S., Bearfield, J. C., Blomquist, G. J., and Tittiger, C. (2010). Functional genomics of mountain pine beetle (*Dendroctonus ponderosae*) midguts and fat bodies. *BMC Genomics* **11**:215.
26. **Keeling, C. I.**, Dullat, H. K., Yuen, M., Ralph, S. G., Jancsik, S., and Bohlmann, J. (2010) Identification and functional characterization of monofunctional *ent*-copalyl diphosphate and *ent*-kaurene synthases in white spruce (*Picea glauca*) reveal different patterns for diterpene synthase evolution for primary and secondary metabolism in gymnosperms. *Plant Physiol.* **152**:1197-1208.
25. Hamberger, B., Hall, D., Yuen, M., Oddy, C., Hamberger, B., **Keeling, C. I.**, Ritland, C., Ritland, K., and Bohlmann, J. (2009). Targeted isolation, sequence assembly and characterization of two white spruce (*Picea glauca*) BAC clones for terpenoid synthase and cytochrome P450 genes involved in conifer defence reveal insights into a conifer genome. *BMC Plant Biology* **9**:106.
24. Jones, C. G., **Keeling, C. I.**, Ghisalberti, E. L., Barbour, E. L., Plummer, J. A., and Bohlmann, J. (2008). Isolation of cDNAs and functional characterisation of two multi-product terpene synthase enzymes from sandalwood, *Santalum album* L. *Arch. Biochem. Biophys.* **477**(1):121-130.
23. Bohlmann, J. and **Keeling, C. I.** (2008). Terpenoid Biomaterials. *The Plant Journal* **54**(4):656-669.
22. **Keeling, C. I.**, Weisshaar, S., Lin, R. P. C., and Bohlmann, J. (2008). Functional plasticity of paralogous diterpene synthases involved in conifer defence. *Proc. Natl. Acad. Sci. USA* **105**(3):1085-1090.
21. Bearfield, J.C., Box, C.D., **Keeling, C.I.**, Young, S., Blomquist, G.J. and Tittiger, C. (2008). Isolation, endocrine regulation and transcript distribution of a putative primary JH-responsive gene from the pine engraver, *Ips pini* (Coleoptera: Scolytidae). *Ins. Biochem. Mol. Biol.* **38**(2):256-267.
20. **Keeling, C. I.** and Bohlmann, J. (2008). Plant Terpenoids, in *Wiley Encyclopedia of Chemical Biology*, ed. Begley, T. P. (John Wiley & Sons).
19. Ginzel, M. D., Bearfield, J. C., **Keeling, C. I.**, McCormack, C. C., Blomquist, G. J., and Tittiger, C. (2007). Antennally mediated negative feedback regulation of pheromone production in the pine engraver beetle, *Ips pini*. *Naturwissenschaften* **94**:61-64.

18. **Keeling, C. I.**, and Bohlmann, J. (2006). Diterpene resin acids in conifers. *Phytochemistry* **67**: 2415-2423.
17. **Keeling, C. I.**, and Bohlmann, J. (2006). Tansley Review: Genes, enzymes, and chemicals of terpenoid diversity in the constitutive and induced defence of conifers against insects and pathogens. *New Phytologist* **170**(4):657-675.
16. Bearfield, J. C., **Keeling, C. I.**, Young, S., Blomquist, G. J., and Tittiger, C. (2006). Isolation, endocrine regulation and mRNA distribution of the 3-hydroxy-3-methylglutaryl coenzyme A synthase (HMG-S) gene from the pine engraver, *Ips pini* (Coleoptera: Scolytidae), *Ins. Mol. Biol.* **15**(2):187-195.
15. **Keeling, C. I.**, Bearfield, J. C., Young, S., Blomquist, G. J., and Tittiger, C. (2006). Effects of juvenile hormone on gene expression in the pheromone-producing midgut of the pine engraver beetle, *Ips pini*, *Ins. Mol. Biol.* **15**(2):207-216.
14. Ro, D.-K., Ehlting, J., **Keeling, C. I.**, Lin, R.P.C., Mattheus, N. and Bohlmann, J. (2006). Microarray expression profiling and functional characterization of AtTPS genes: Duplicated *Arabidopsis thaliana* sesquiterpene synthase genes At4g13280 and At4g13300 encode root-specific and wound-inducible (Z)- \square -bisabolene synthases, *Arch. Biochem. Biophys.* **448**(1-2):104-116.
13. **Keeling, C. I.**, and Slessor, K. N. (2005). A scientific note on the aliphatic esters in queen honey bees. *Apidologie* **36**:559-560.
12. **Keeling, C. I.**, Blomquist, G. J., and Tittiger, C. (2004). Coordinated gene expression for pheromone biosynthesis in the pine engraver beetle, *Ips pini* (Coleoptera: Scolytidae). *Naturwissenschaften* **91**:324-328.
11. Eigenheer, A., **Keeling, C. I.**, Young, S., and Tittiger, C. (2003). Comparison of gene representation in the midguts from two phytophagous insects, *Bombyx mori* and *Ips pini*, using expressed sequence tags. *Gene* **316**:127-136.
10. Hoover, S. E. R., **Keeling, C. I.**, Winston, M. L., and Slessor, K. N. (2003). The effect of queen pheromones on worker honey bee ovary development. *Naturwissenschaften* **90**:477-480.
9. **Keeling, C. I.**, Slessor, K. N., Higo, H. A., and Winston, M. L. (2003). New components of the honey bee (*Apis mellifera* L.) queen retinue pheromone. *Proc. Natl. Acad. Sci. USA* **100**(8):4486-4491.
8. **Keeling, C. I.**, Otis, G. W., Hadisoesilo, S., and Slessor, K. N. (2001). Mandibular gland component analysis in the head extracts of *Apis cerana* and *Apis nigrocincta*. *Apidologie* **32**:243-252.

7. Ledoux, M. N., Winston, M. L., Higo, H., **Keeling, C. I.**, Slessor, K. N., and LeConte, Y. (2001). Queen and pheromonal factors influencing comb construction by simulated honey bee (*Apis mellifera* L.) swarms. *Insectes Sociaux* **42**:14-20.
6. **Keeling, C. I.**, Ngo, H. T., Benusic, K. D., and Slessor, K. N. (2001). Preparative chiral liquid chromatography for enantiomeric separation of pheromones. *J. Chem. Ecol.* **27**(3):487-497.
5. **Keeling, C. I.** and Nelson, D. E. (2001). Changes in the intramolecular stable carbon isotope ratios with age of the European cave bear (*Ursus spelaeus*). *Oecologia* **127**(4):495-500.
4. Lindgren, B. S., Hoover, S. E. R., MacIsaac, A. M., **Keeling, C. I.**, and Slessor, K. N. (2000). Lineatin enantiomer preference, flight periods, and effect of pheromone concentration and trap length on three sympatric species of *Trypodendron* (Coleoptera: Scolytidae). *Can. Entomol.* **132**(6):877-887.
3. Hoover, S. E. R., Lindgren, B. S., **Keeling, C. I.**, and Slessor, K. N. (2000). Enantiomer preference of *Trypodendron lineatum* (Olivier) (Coleoptera: Scolytidae), and effect of pheromone dose and trap length on its response to lineatin-baited traps in interior British Columbia. *J. Chem. Ecol.* **26**(3):667-677.
2. **Keeling, C. I.**, Koeniger, G., Koeniger, N., Slessor, K. N., and Punchihewa, R. W. K. (2000). Quantitative analysis of the mandibular gland components of the dwarf honey bee (*Apis florea* Fabricius). *Apidologie* **31**(2):293-299.
1. **Keeling, C. I.**, Nelson, D. E. and Slessor, K. N. (1999). Stable carbon isotope measurements of the carboxyl carbons in bone collagen. *Archaeometry* **41**(1):151-164.

Contributions non-arbitrées:

Journal articles:

1. Bohlmann, J., Breuil, C., Hamelin, R., Huber, D.P.W., **Keeling, C.I.**, Murray, B.W. (2012). Using genomic data to understand the mountain pine beetle epidemic. *BC Forest Professional* **19**(4):12-13.

Chapitres de livre:

4. **Keeling, C.I.** (2016) Bark beetle research in the post-genomic era. *Adv. Insect Physiol.* **50**:265-293.
3. **Keeling, C. I.** and Bohlmann, J. (2012). Plant Terpenoids, in *Natural Products in Chemical Biology*, ed Civjan, N., (Wiley, Mississauga) 121-142.
2. Tittiger, C., **Keeling, C. I.**, and Blomquist, G. J. (2005). Some insights into the remarkable metabolism of the bark beetle midgut, in *Chemical Ecology and*

Phytochemistry of Forest Ecosystems, ed Romeo, J. Recent Advances in Phytochemistry (Elsevier Science, Toronto), Vol. 39, 57-78.

1. **Keeling, C. I.**, Plettner, E., and Slessor, K. N. (2004). Hymenopteran Semiochemicals, in *The Chemistry of Pheromones and Other Semiochemicals I*, ed. Schulz, S. Topics in Current Chemistry (Springer-Verlag, Heidelberg) Vol. 239, 133-177.