

# Emma J. Hudgins, PhD

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## Research

### Research Experience

- Carleton University**, Postdoctoral Fellow, **PI:** Prof. Joseph Bennett 2020-present  
*The production of rules of thumb for the best invasive pest management strategies, and for the budgetary balance between management and surveillance, informed by Mixed Integer Linear Program-based management optimizations, in collaboration with Natural Resources Canada-Canadian Forest Service (NRCan-CFS).*
- McGill University**, MSc/PhD student, **PI:** Prof. Brian Leung 2015-2020  
*General multispecies models for various stages of United States invasive forest insect and pathogen invasions that are applicable at large scales, including a more descriptive understanding of the initial establishment and dispersal phases of invasions, and delineating the impacts caused by species across space and time.*
- University of Queensland**, Visiting Scholar, **PI:** Prof. Eve McDonald-Madden 2018  
*A 3-month Michael Smith Foreign Study term during which I learned Mixed Integer Linear Programming techniques and developed skills in decision theory as it is applied to conservation planning and invasive species management. This required teaching myself Python.*
- McGill University**, Honours Researcher, **PI:** Prof. Brian Leung 2014-2015  
*The creation of a GLM-based model of spatial predictors of invasive species spread in the U.S., validated through theoretical simulations.*
- Canadian Rivers Institute, University of New Brunswick**, Summer Student (3 NSERC USRAs), **PI:** Prof. R. Allen Curry 2012-2015  
*Field technician for a variety of limnological and fish conservation studies, including a lake classification system for the province of New Brunswick and an impact assessment of a large dam on Atlantic salmon populations.*
- Redpath Museum, McGill University**, Independent study researcher, **PI:** Prof. Anthony Ricciardi 2014  
*A behavioural ecology experiment testing the impact of predator chemical cues on an invasive invertebrate's predatory behaviour.*

## Education

**McGill University**, PhD in Biology 2016-2020  
**Supervisory Committee:** Brian Leung (Supervisor), T. Jonathan Davies, Patrick M. A. James  
**Thesis:** *Predicting biological invasions across species: developing generalized models*

**McGill University**, MSc in Biology 2015-2016  
**Supervisory Committee:** Brian Leung (Supervisor), T. Jonathan Davies, Patrick M. A. James  
*(Fast-tracked to PhD after 1yr)*

**McGill University**, Bachelor of Science, Honours Biology, Minor Environment 2011-2015  
**CGPA:** 3.97/4.0 (First Class Honours, Dean's Honour List)  
**Honours Supervisor:** Prof. Brian Leung  
**Thesis:** *Statistical modelling of forest pest spread across the United States*

## Non-Academic Employment

**Tierra Co.**, Independent Statistical Consultant 2019-2019  
*Developing spatial metrics of crime risk.*

## Funding Earned (total = CAD \$325,233)

### Amount (\$)

90,000	NSERC Postdoctoral Fellowship	2022
90,000	FRQNT B3X Postdoctoral Scholarship	2020
990	McGill Research Travel Award	2018
6,000	NSERC Michael Smith Foreign Study Supplement	2018
105,000	NSERC Alexander Graham Bell CGS-D	2017
755; 988	Quebec Centre for Biodiversity Science Excellence Award	2016; 2018
500	McGill Biology GREAT Travel Award	2016
17,500	NSERC Alexander Graham Bell CGS-M	2015
13,500	NSERC Undergraduate Student Research Award (x3)	2012; 2013; 2014

## Publications

20. Riva, F. Graco-Roza, C., Daskalova, G., **Hudgins, E.J.**, Lewthwaite, J. M. M., Newman, E. A., Ryo, M., & Mammola, S. Towards a cohesive understanding of ecological complexity. *In revision, Science Advances*. Preprint: <https://ecoevorxiv.org/tzy9k/>

19. Palacio, F., Callaghan, C.T., Cardoso, P., **Hudgins, E.J.**, Jarzyna, M., Ottaviani, G., Riva, F., Roza, C., Shirey, V., & Mammola, S. A protocol for reproducible functional diversity analyses. *In revision. Ecography*. Preprint: <https://ecoevorxiv.org/yt9sb/>

18. Soto, I., Cuthbert, R.N., Kouba, A., Capinha, C., Turbelin, A., **Hudgins, E.J.**, Diagne, C., Courchamp, F., & Haubrock, P.J. Global economic costs of herpetofauna invasions. *In revision. Science Advances. Preprint:* <https://doi.org/10.21203/rs.3.rs-964112/v1>
17. Hanson, J.O., McCune, J.L., Chadès, I., Proctor, C.A., **Hudgins, E.J.**, & Bennett, J.R., Optimizing ecological surveys for conservation. *In revision. Journal of Applied Ecology.*
16. Edwards, B.P.M, Binley, A.D., English, W.B., **Hudgins, E.J.**, & Snow, S.S.: A highly anomalous Red-winged Blackbird (*Agelaius phoeniceus*) song. *Accepted. Canadian Field Naturalist.*
15. Haubrock, P.J., Ahmed, D.A.A., Cuthbert, R.N., ....**Hudgins, E.J.**, *et al.* (2022). Invasion impacts and dynamics of a European-wide introduced species. *Global Change Biology.* <https://doi.org/10.1111/gcb.16207>.
14. Turbelin, A.J., Diagne, C., **Hudgins, E.J.**, Moodley, D., Haubrock, P.J., *et al.* (2022). Introduction pathways of economically costly invasive alien species. *Biological Invasions.* <https://doi.org/10.21203/rs.3.rs-440305/v1>.
13. **Hudgins, E. J.**, Koch, F.H., Ambrose, M.J., & Leung, B. (2022). Hotspots of pest-induced US urban tree death, 2020-2050. *Journal of Applied Ecology.* <https://doi.org/10.1111/1365-2664.14141/>
12. Ahmed, D.A.\*, **Hudgins, E.J.\***, Cuthbert, R.N.\*, Kourantidou, M., Diagne, C., *et al.* (2022). Managing biological invasions: the cost of inaction. *Biological Invasions.* <https://doi.org/10.1007/s10530-022-02755-0>  
**\*joint first author**
11. Cuthbert, R.N., Diagne, C\*. **Hudgins, E.J.\***, Turbelin, A.J.\*, Ahmed, D. A., Albert, C., Bodey, T.W., Briski, E., Essl, F., Haubrock, P.J., Gozlan, R.E., Kirichenko, N., Kourantidou, M., Kramer, A. M., & Courchamp, F. (2022). Biological invasion costs reveal insufficient proactive management worldwide. *Science of the Total Environment*, 153404. <https://doi.org/10.1016/j.scitotenv.2022.153404>.  
**\*joint second author**
10. Haubrock, P. J., Cuthbert, R. N., **Hudgins, E. J.**, Crystal-Ornelas, R., Kourantidou, M., Moodley, D., Liu, C., Turbelin, A.J., Leroy, B., & Courchamp, F. (2022). Geographic and taxonomic trends of rising biological invasion costs. *Science of the Total Environment*, 152948. <https://doi.org/10.1016/j.scitotenv.2022.152948>
9. Ahmed, D. **Hudgins, E.J.**, Cuthbert, R., Haubrock, P.J., Renault, D., Bonnaud, E., Diagne, C., & Courchamp, F (2021). Modelling the damage costs of invasive alien species. *Biological Invasions.* <https://doi.org/10.1007/s10530-021-02586-5>.
8. Reid, C.H., **Hudgins, E.J.**, Guay, J.D., Patterson, S., Medd, A.M., Cooke, S.J., & Bennett, J.R. The state of Canada's biosecurity efforts to protect biodiversity from species invasions (2021). *FACETS* 6: 1922-1954. <https://doi.org/10.1139/facets-2021-0012>
7. Crystal-Ornelas, R., **Hudgins, E.J.**, Cuthbert, R.N., Haubrock, P.J., Fantle-Lepczyk, J., Angulo, E., Kramer, A., Ballesteros-Mejía, L., Leroy, B., Leung, B., López-López, E., Diagne, C., & Courchamp, F (2021). Economic costs of biological invasions within North America. *NeoBiota* 67,

485-510. <https://doi.org/10.3897/neobiota.67.58038>

6. **Hudgins, E.J.**, Liebhold, A.M., & Leung, B. Comparing generalized to customized models for United States invasive forest pests (2020). *Ecological Applications* 30(1), e01988. <https://doi.org/10.1002/eap.1988>

5. Leung, B., **Hudgins, E.J.**, Potapova, A., & Ruiz-Jaen, M. A new baseline for countrywide  $\alpha$ -diversity and species distributions: illustration using >6000 plant species in Panama. (2019). *Ecological Applications* 29(3): e01866. <https://doi.org/10.1002/eap.1866>

4. **Hudgins, E.J.**, Liebhold, A.M., & Leung, B. (2018). Corrigendum: Predicting the spread of all invasive forest pests in the United States. *Ecology Letters* 21(11): 1752-1754. <https://doi.org/10.1111/ele.13149>

3. **Hudgins, E.J.**, Liebhold, A.M., & Leung, B. (2017). Predicting the spread of all invasive forest pests in the United States. *Ecology Letters* 20(4): 426-435. <https://doi.org/10.1111/ele.12741>

2. Iacarella, J.C., **Hudgins, E.J.**, Dick, J.T.A., & Ricciardi, A. (2017). Predatory behaviour of an invasive amphipod in response to the presence of conspecifics and predation risk. *Canadian Journal of Fisheries and Aquatic Sciences* 75(1): 131-140. <https://doi.org/10.1139/cjfas-2016-0417>

1. Hudgins, J., **Hudgins, E.J.**, Ali, K., & Mancini, A. (2017). Citizen science surveys elucidate key foraging and nesting habitat for two endangered marine turtle species within the Republic of Maldives. *Herpetology Notes* 10: 463-471.

## Selected Presentations

### Oral presentations

**Hudgins, E.J.\***. New perspectives in forest pest management for a resilient urban canopy. Presented at the Invasive Species Centre's Annual Symposium. Feb 3, 2022. Invited presentation.

**Hudgins, E.J.\***. Optimal control of emerald ash borer (*Agrilus planipennis*) spread across the United States. Presented at the Forest Pest Management Forum (Canadian Federal-Provincial-Municipal-NGO meeting). Dec. 9, 2021.

Crystal-Ornelas, R., **Hudgins, E.J.\***, Cuthbert, R.N., Haubrock, P.J., Fantle-Lepczyk, J., Angulo, E., Kramer, A., Ballesteros-Mejia, L., Leroy, B., Leung, B., López-López, E., Diagne, C., & Courchamp, F. Economic costs of biological invasions within North America. Presented at the Invasive Species Council of British Columbia's annual meeting, Oct. 6, 2021. Invited presentation.

**Hudgins, E.J.\***, Koch, F.H., Ambrose, M.J., & Leung, B. Urban tree deaths from invasive alien forest insects in the United States, 2020-2050. Presented at the International Association for Landscape Ecology – North America conference, April 12, 2021, in the organised symposium "Forecasting Biological Invasions".

**Hudgins, E.J.\***, Koch, F.H., Ambrose, M.J., & Leung, B., *Estimating the economic damages of United States invasive forest pests*. Presented at the World Conference on Natural Resource

Modelling, May 23<sup>rd</sup>, 2019. Winner – Best Student Presentation.

**Hudgins, E.J.\***, Liebhold, A.M., & Leung B. *General versus species-specific models for the spread of United States invasive forest pests*. Presented at the Quebec Centre for Biodiversity Science Symposium, December 12<sup>th</sup>, 2018.

**Hudgins, E.J.\***, Liebhold, A.M., & Leung B. *Customized versus generalized models of forest insect and pathogen spread*. Presented at the Ecological Society of America Annual Meeting, August 8<sup>th</sup>, 2018.

**Hudgins, E.J.\***. Optimal invasive forest pest management in the United States. Presented at the Mathematics of Biological Systems Management conference, University of Melbourne, April 6<sup>th</sup>, 2018.

**Hudgins, E.J.\***. Optimal control of the spread of invasive forest pests in the United States. Presented at the University of Queensland's Centre for Biology and Conservation Science's weekly seminar series, March 20<sup>th</sup>, 2018. Invited seminar.

**Hudgins, E.J.\***, Liebhold, A.M., & Leung B. *Comparing generalized to customized models for United States invasive forest pests*. Presented at the Quebec Centre for Biodiversity Science Symposium, December 15<sup>th</sup>, 2017.

**Hudgins, E.J.\***, Liebhold, A.M., & Leung B. *A comparison between general and species specific spread models for United States invasive forest pests*. Presented at the Ecology and Evolution Lunches series, Nov 23<sup>rd</sup>, 2017.

**Hudgins, E.J.\***, & Leung B. *The effect of host diversity on the establishment of United States invasive forest pests*. Presented at the McGill Conservation, Ecology, Evolution and Behaviour retreat, April 8<sup>th</sup>, 2017.

**Hudgins, E.J.\***, Liebhold, A.M., & Leung B. *Forecasting United States forest invaders: A general predictive model for pest spread*. Presented at the Quebec Centre for Biodiversity Science Symposium, December 16<sup>th</sup>, 2016.

**Hudgins, E.J.\***, Liebhold, A.M., & Leung B. *A general predictive model for forecasting United States invasive pest spread*. Presented at the Ecological Society of America Annual Meeting, August 11<sup>th</sup>, 2016

**Hudgins, E.J.\*** *Modelling invasive forest pest spread across the United States*. Presented at McGill's Honours Symposium, April 15<sup>th</sup>, 2015.

**\* presenting author**

## **Poster Presentations**

**Hudgins, E.J.\***, Davies, T.J., Leung, B. *A unifying phylogenetic model for the effect of host phylogenetic diversity on invasive pest establishment*. Poster presented at the British Ecological Society Festival of Ecology. Dec 14-18<sup>th</sup>, 2020.

**Hudgins, E.J.\***, Koch, F.H., Ambrose, M.J., Leung, B., *Estimating the economic damages of United States invasive forest pests*. Poster presented at Natural Resources Canada's Forest Pest Management Forum, December 3-5<sup>th</sup>, 2019.

**\* presenting author**

## Media coverage

CBC Quirks and Quarks. March 19, 2022. The urban tree canopy is facing a worst-case scenario in the near future. <https://www.cbc.ca/radio/quirks/mar-19-a-sabretooth-hypercarnivore-pack-hunting-spiders-urban-trees-and-invasive-insects-and-more-1.6388365> Coverage of publication #13

LePage, M. *Many US cities will lose nearly all ash trees by 2060*. May 6, 2021. The New Scientist. <https://www.newscientist.com/article/2276885-many-us-cities-will-lose-nearly-all-ash-trees-by-2060/#ixzz7CuDAOcyD>. Coverage of publication #13 as a preprint.

Reid, C.H., **Hudgins, E.J.**, Guay, J.D., Patterson, S., Medd, A.M., Cooke, S.J., & Bennett, J.R. *How well is Canada prepared to manage current and future invasive species threats to biodiversity?* Medium. <https://medium.com/facets/how-well-is-canada-prepared-to-manage-current-and-future-invasive-species-threats-to-biodiversity-a43b0f817fc5>. Coverage of publication #8.

## Research Skills

**Programming Languages:** R (excellent), Python (very good), bash/shell (very good), STAN (very good), CSS (good), (R)Markdown (good), LaTeX (good), MATLAB (good), SAS (good), C/C++ (basic).

**Software:** GUROBI, QGIS/ArcGIS, RStudio, SAS, MATLAB, SPSS, Git(Hub), Open Science Framework

**Quantitative methods:** Routine use of GLMM, GAM, boosted regression trees, Bayesian methods, simulation modelling, Latin Hypercube sampling, Nelder-Mead methods, genetic algorithms, neural networks, mixed-integer linear programming (MILP). I deploy many of my algorithms in a parallel-processing framework.

**Field Techniques:** Tropical ecology field course in Barbados, Limnology field course at Mont-Ste-Hilaire, QC, 4 years of limnological/fisheries field experience.

**Languages:** English (native) and French (conversational)

**Certifications:** PADI Open Water Diver, WHMIS, Pleasure Craft Operator's Card, Backpack Electrofishing Certificate

## Teaching

### Lecturing

<b>Course lecturer (co-Instructor of Record)</b> ENSC 2002, Environmental Methods and Analysis, Carleton University	2021
<b>Teaching Assistant</b> , BIOL 373, Biometry (5 semesters), McGill University	2015-2019
<b>Teaching Assistant</b> , ENVR 202, The Evolving Earth (4 semesters), McGill University	2015-2019
<b>Undergraduate Teaching Assistant</b> , BIOL 308, Ecological Dynamics, McGill University	2015

## Supervision

<b>PhD committee member</b> , Ana Hernández De la Riva, Carleton University	2022
<b>Honour's thesis Supervisor</b> , Marie Wright, Carleton University	2021-2022
<b>Research associate co-supervisor</b> , Yuyan Chen, McGill University	2021
<b>High school student mentor</b> , Sarah Duguay, Talaria Summer Internship Program for marginalized students	2021
<b>Independent Study Supervisor</b> , ENSC 4901, Directed Studies (Chibudom Orji, Shujin Chen), Carleton University	2020-2021
<b>Mentor</b> , BIOL 5512, Advances in Applied Ecology, Carleton University	2020

## Service

### Faculty and student governance

<b>Carleton Biology Department Board</b> , Postdoc rep.	2021-2022
<b>Geomatics and Landscape Ecology Laboratory Friday Discussions</b> , Journal club coordinator (mailing list of >350)	2021-2022
<b>Carleton Biology Department Board</b> , Alternate postdoc rep.	2020-2021
<b>McGill Biology Graduate Students Association</b> , Social media rep.	2019-2020
<b>Faculty of Science Committee on Equity and Climate, McGill University</b> , Graduate student rep.	2019-2020
<b>Postgraduate Students Society of McGill University Equity Committee</b> , Biology graduate student rep.	2017-2020
<b>Biology Department Day and Equity Workshop (3 events)</b> , Co-organizer	2017-2019
<b>STEMM Diversity @ McGill</b> , Volunteer	2017
<b>Equity in STEMM Working Group</b> , Co-founder	2016-2019
<b>McGill Biology Graduate Students Association</b> , Equity and diversity rep.	2017-2019

## Peer review

### Reviewer for:

Applied Vegetation Science, Biological Invasions, Diversity and Distributions, Ecology Letters, Forests, Journal of Applied Ecology, Journal of Biogeography, Journal of Ecology, Journal of Forestry, Management of Biological Invasions, Nature Conservation, Royal Society Open Science, Urban Forestry & Urban Greening

### Editorial Duties:

Frontiers in Insect Science – Invasive Insect Species (Review Editor)

## Workshop organization

**Project-based workflows with GitHub.** Two-hour training co-delivered with fellow postdoc Courtney Robichaud to Waterloo University Biology students Feb 16<sup>th</sup>, 2022.

**A new perspective on forest pest management conventional wisdom.** Two-day virtual workshop co-organized by myself, Joseph R. Bennett (Carleton University) and Brian Leung (McGill University). January 17-18, 2022 with 15 experts across disciplines.

**Equitable Cities for Healthy People and Nature.** Rapporteur, support person, web app developer, organized by Rachel Buxton virtually at Carleton University. September 2 and 29, 2021. (~50 virtual attendees, <https://carleton.ca/naturalcities/>)

**Promoting GitHub use in EcoEvo Workshop.** Co-organized with Rob Crystal-Ornelas and 5 others. July 12, 2021. Part of the Society for Open, Reproducible, and Transparent Ecology and Evolution (SORTEE) 2021 Conference.

## Workshop attendance and committee membership

Carleton Geomatics and Landscape Ecology Laboratory Friday Discussion Group	2020-present
Carleton Student Development Theory in Higher Education Workshop	2021
Carleton Cross-Cultural Competency Workshop	2021
Carleton Effective Communication and De-Escalation Skills Workshop	2021
Carleton Responding to Disclosures of Sexual Violence Workshop	2021
Carleton Indigenous Cultural Awareness Workshop	2021
InvaCost Workshop	2019
QCBS R Markdown Workshop	2019
McGill Conservation, Ecology, Evolution, and Behaviour Discussion Group	2017-2019
McGill Organismal Seminar Series	2015-2020
MARXAN Decision Support Tool Workshop	2018
Gender Summit North America	2017
Statistics and Biology Exchange Group	2015-2017
Joint NIMBioS-MBI-CAMBAM Summer School	2017
IGSF Feminist Pedagogy Workshop	2017
Quebec Centre for Biodiversity Science Data Visualization Workshop	2016



