A. Bradley Duthie

I am an evolutionary ecologist and ecological modeller with broad interests in developing theory across the biological and environmental sciences. My research primarily uses mathematical and individual-based models to understand complex interactions in populations, communities, and social-ecological systems. I am especially interested in applying these modelling approaches to questions concerning the evolution and maintenance of biodiversity, and the management of populations under conservation conflict.

Professional Appointments

Lecturer in Environmental Modelling, Nov. 2020 – present
Biological and Environmental Sciences, University of Stirling

Leverhulme Trust Early Career Fellow, Nov. 2017 – Oct. 2020
Biological and Environmental Sciences, University of Stirling

ERC Postdoctoral Research Assistant, Nov. 2016 – Oct. 2017
Biological and Environmental Sciences, University of Stirling

ERC Postdoctoral Research Fellow, Jun. 2013 – Oct. 2016
School of Biological Sciences, University of Aberdeen

A. Bradley Duthie
Ph.D., FHEA
Evolutionary Ecologist
Ecological Modeller
Biostatistician

3B156
University of Stirling
Stirling
FK9 4LA
United Kingdom

(+44) 01786 467787
(+44) 07561 408101
alexander.duthie@stir.ac.uk
brad.duthie@gmail.com
http://bradduthie.github.io
bradduthie

Education

Ph.D. Ecology and Evolutionary Biology, Spring 2013
Graduate Minor: Statistics
Certificate: Graduate Student Teaching Certificate
Iowa State University

B.S. Biology (Magna cum laude), Spring 2007
Specialisation: Ecology, Evolution, Environment
Southern Illinois University Edwardsville

B.S. Philosophy (Magna cum laude), Spring 2007
Minor: Chemistry
Southern Illinois University Edwardsville

Grants and Fellowships

Decision Support Tool: Atlantic Salmon Likely Suspects Framework (Co-PI; 2021)	12,000 GBP
sDiv-CESAB joint call: Coexistence & Stability in High-Diversity Communities (2020)	30,000 EUR
BBSRC-FAPESP-Newton Fund (Co-PI; 2019)	620,956 GBP
Scottish Natural Heritage Tender (Co-PI; 2018)	9,947 GBP
Leverhulme Trust Early Career Fellowship (2017)	88,650 GBP
NSF Postdoctoral Research Fellowship in Biology (2013; award declined)	138,000 USD
NSF Doctoral Dissertation Improvement Grant (2010)	13,411 USD

Biotechnology Graduate Fellowship (ISU; 2007) 20,000 USD

Publications

28. **Duthie, A. B.**, J. Minderman, O. S. Rakotonarivo, G. Ochoa, and N. Bunnefeld. 2021. Online multi-player games as virtual laboratories for collecting data on socio-ecological decision-making. *Conservation Biology*. 35:1051-1053. DOI: 10.1111/cobi.13633

27. Rakotonarivo, O. S., A. Bell, K. Abernathy, J. Minderman, **A. B. Duthie**, S. Redpath, A. Keane, H. Travers, S. Bourgeois, L.-L. Moukagni, J. J. Cusack, I. L. Jones, R. A. Pozo, and N. Bunnefeld. 2021. The role of incentive-based instruments and social equity in conservation conflict interventions. *Ecology and Society*. 26:8. DOI: 10.5751/ES-12306-260208

26. Pozo, R. A., E. LeFlore, **A. B. Duthie**, N. Bunnefeld, I. L. Jones, J. Minderman, O. S. Rakotonarivo, and J. J. Cusack. 2021. A spatiotemporal, multi-species assessment of wildlife impacts on local community livelihoods. *Conservation Biology*. 35:297-306. DOI: 10.1111/cobi.13565

25. Rakotonarivo, O. S., I. L. Jones, A. Bell, **A. B. Duthie**, J. J. Cusack, J. Minderman, J. Hogan, I. Hodgson, and N. Bunnefeld. 2021. Experimental evidence for conservation conflict interventions: the importance of financial payments, community trust and equity attitudes. *People and Nature*. 3: 162-175. DOI: 10.1002/pan3.10155

24. Nilsson, L., J. Minderman, N. Bunnefeld, and **A. B. Duthie**. 2021. Effects of stakeholder empowerment on crane population and agricultural production. *Ecological Modelling*. 404:109396. DOI: 10.1016/j.ecolmodel.2020.109396

23. **Duthie, A. B.** 2020. Component response rate variation underlies the stability of highly complex finite systems. *Scientific Reports*. 10: 8296. DOI: 10.1038/s41598-020-64401-w

22. Cusack, J. J., **A. B. Duthie**, I. L. Jones, J. Minderman, R. A. Pozo, O. S. Rakotonarivo, S. Redpath, and N. Bunnefeld. 2020. Integrating conflict, lobbying and compliance to predict the sustainability of natural resource use. *Ecology and Society*. 25(2): 13. DOI: 10.5751/ES-11552-250213

21. Minderman, J., J. J. Cusack, **A. B. Duthie**, I. L. Jones, R. A. Pozo, O. S. Rakotonarivo, and N. Bunnefeld. 2019. Decision trees for data publishing may exacerbate conservation conflict. *Nature Ecology and Evolution*. 3:318. DOI: 10.1038/s41559-019-0804-7

20. Cusack, J. J., **A. B. Duthie**, O. S. Rakotonarivo, R. A. Pozo, T. H. E. Mason, J. Månsson, L. Nilsson, R. McKenzie, I. M. Tombre, E. Eythórsson, J. Madsen, A. Tulloch, G. Churchill, J. Shaw, R. D. Hearn, S. Redpath, and N. Bunnefeld. 2019. Time series analysis reveals synchrony and asynchrony between conflict management effort and increasing large grazing bird populations in northern Europe. *Conservation Letters*. 12:e12450. DOI: 10.1111/conl.12450

19. **Duthie, A. B.**, J. J. Cusack, J. Minderman, I. L. Jones, E. B. Nilsen, R. A. Pozo, O. S. Rakotonarivo, B. Van Moorter, and N. Bunnefeld. 2018. GMSE: an R package for generalised management strategy evaluation. *Methods in Ecology and Evolution*. 9:2396-2401. DOI: 10.1111/2041-210X.13091

18. Paine, C. E. T., A. Deasey, and **A. B. Duthie**. 2018. Towards general mechanistic predictions of community dynamics. *Functional Ecology*. 32 (7):1681-1692. DOI: 10.1111/1365-2435.13096

17. Redpath, S. M., Andren, Z. Baynham-Herd, N. Bunnefeld, **A. B. Duthie**, Frank, C. A. Garcia, A. Keane, J. Månsson, L. Nilsson, C. R. J. Pollard, O. S. Rakotonarivo, C. F. Salk, and H. Travers. 2018. Games as tools to address conservation conflicts. *Trends in Ecology and Evolution*. 33 (6):415-426. DOI: 10.1016/j.tree.2018.03.005

16. **Duthie, A. B.**, G. Bocedi, R. R. Germain, and J. M. Reid. 2018. Evolution of pre-copulatory and post-copulatory strategies of inbreeding avoidance and associated polyandry. *Journal of Evolutionary Biology*. 31:31-45. DOI: 10.1111/jeb.13189

15. **Duthie, A. B.**, A. M. Lee, and J. M. Reid. 2016. Inbreeding parents should invest more resources in fewer offspring. *Proceedings of the Royal Society B*. 282:20161845. DOI: 10.1098/rspb.2016.1845

14. **Duthie, A. B.**, and J. M. Reid. 2016. Evolution of inbreeding avoidance and inbreeding preference through mate choice among interacting relatives. *American Naturalist*. 188 (6):651-667. DOI: 10.1086/688919

13. **Duthie, A. B.**, and J. D. Nason. 2016. Plant connectivity underlies plant-pollinator-exploiter distributions in *Ficus petiolaris* and associated pollinating and non-pollinating fig wasps. *Oikos*. 125 (11):1597-1606. DOI: 10.1111/oik.02905

12. **Duthie, A. B.**, G. Bocedi, and J. M. Reid. 2016. When does female multiple mating evolve to adjust inbreeding? Effects of inbreeding depression, direct costs, mating constraints, and polyandry as a threshold trait. *Evolution*. 70 (9):1927-1943. DOI: 10.1111/evo.13005

11. Frater, P. N., and **A. B. Duthie**. 2016. Power scaling, vascular branching patterns, and the golden ratio. *Ideas in Ecology and Evolution*. 9:15-18. DOI: 10.4033/iee.2016.9.4.n

10. Reid, J. M., G. Bocedi, P. Nietlisbach, **A. B. Duthie**, M. E. Wolak, E. A. Gow, and P. Arcese. 2016. Variation in parent-offspring kinship in socially monogamous systems with extra-pair reproduction and inbreeding. *Evolution*. 70 (7):1512-1529. DOI: 10.1111/evo.12953

9. Reid, J. M., P. Arcese, G. Bocedi, **A. B. Duthie**, M. E. Wolak, and L. F. Keller. 2015. Resolving the conundrum of inbreeding depression but no inbreeding avoidance: estimating sex-specific selection on inbreeding by song sparrows (*Melospiza melodia*). *Evolution*. 69 (11):2846-2861. DOI: 10.1111/evo.12780

8. **Duthie, A. B.**, K. C. Abbott, and J. D. Nason. 2015. Trade-offs and coexistence in fluctuating environments: evidence for a key dispersal-fecundity trade-off in five nonpollinating fig wasps. *American Naturalist*. 186 (1):151-158. DOI: 10.1086/681621

7. Reid, J. M., **A. B. Duthie**, M. E. Wolak, and P. Arcese. 2015. Demographic mechanisms of inbreeding adjustment through extra-pair reproduction. *Journal of Animal Ecology*. 84 (4):1029-1040. DOI: 10.1111/1365-2656.12340

6. **Duthie, A. B.**, and J. M. Reid. 2015. What happens after inbreeding avoidance? Inbreeding by rejected relatives and the inclusive fitness benefit of inbreeding avoidance. *PLoS One*. 10 (4):e0125140. DOI: 10.1371/journal.pone.0125140

5. Duthie, A. C., and **A. B. Duthie**. 2015. Do music and art influence one another? Measuring cross-modal similarities in music and art. *Polymath: An Interdisciplinary Arts and Sciences Journal*. 5 (1):1-22.

4. Reid, J. M., P. Arcese, L. F. Keller, R. R. Germain, **A. B. Duthie**, S. Losdat, M. E. Wolak, and P. Nietlisbach. 2015. Quantifying inbreeding avoidance through extra-pair reproduction. *Evolution*. 69 (1):59-74. DOI: 10.1111/evo.12557

3. **Duthie, A. B.**, K. C. Abbott, and J. D. Nason. 2014. Trade-offs and coexistence: A lottery model applied to fig wasp communities. *American Naturalist*. 183 (6):826-841. DOI: 10.1086/675897

2. **Duthie, A. B.**, and M. R. Falcy. 2013. The influence of habitat autocorrelation on plants and their seed-eating pollinators. *Ecological Modelling*. 251:260-270. DOI: 10.1016/j.ecolmodel.2012.12.019

1. **Duthie, A. B.** 2004. The fork and the paperclip: A memetic perspective. *Journal of Memetics - Evolutionary Models of Information Transmission*. 8 (1). http://cfpm.org/jom-emit/2004/vol8/duthie_ab.html.

Teaching Experience

As an educator, I take a learning-centred approach to guide students through course material, and I evaluate my teaching as successful when I have evidence that students are thinking actively and effectively about biological concepts. I have experience developing and delivering course content, and in student assessment, in both traditional and online formats. I have additionally developed learning software, specifically for teaching numerical and individual-based ecological modelling to undergraduate students.

Professional Development:

- **Fellow of the Higher Education Academy**
- Principles of Learning and Teaching in Higher Education programme. University of Aberdeen.
- Preparing Future Faculty (PFF) Program: Iowa State University. PFF Associate.
- Graduate Student Teaching Certificate (GSTC) Program (PFF Track): Iowa State University.

University Instruction:

- *Statistical Techniques – Module Coordinator* (SCIU4T4; Undergraduate: 20 credits) University of Stirling. Spring 2021.
- *Evolution and Genetics – Module Contributor* (BIOU3EG; Undergraduate: 20 credits) University of Stirling. Autumn 2020.
- *Behavioural Ecology – Module Contributor* (BIOU6BE; Undergraduate: 20 credits) University of Stirling. Spring 2019, 2020, 2021.
- *Biology Field Course – Module Contributor* (SCIU3FB; Undergraduate: 20 credits) University of Stirling. Autumn 2017-2020.
- *Introduction to Ecological and Environmental Modelling – Module Contributor* (BI 4803; Undergraduate: 15 credits). University of Aberdeen. Spring 2015, 2016.
- *Biology for Undergraduates (BUGS) – Tutorial Session ZOO-4* (BI 1006; Undergraduate: 7.5 credits). University of Aberdeen. Autumn 2014.
- *Biological Evolution* (BIOL 315; Undergraduate: 3 credits). Iowa State University. Summer 2011, 2012*, Spring 2013*. *Distance Learning Course (online).

University Teaching Assistantships:

- *Biological Evolution* (BIOL 315; Undergraduate: 3 credits). Iowa State University. Spring 2011-2012.
- *Principles of Biology Laboratory I* (BIOL 211L; Undergraduate: 1 credit). Iowa State University. Autumn 2008, 2012.
- *Principles of Biology Laboratory II* (BIOL 212L; Undergraduate: 1 credit). Iowa State University. Autumn 2009-2011, Spring 2008-2010.

Workshops:

- *Exploring the power of 'R Shiny' and 'R Markdown'* (Workshop leader for later year PhD students). IAPETUS Doctoral Training Partnership Induction Event. University of Stirling. 22 NOV 2018.
- *Version control for reproducible science* (Workshop leader for later year PhD students). IAPETUS Doctoral Training Partnership Event. Scottish Centre for Ecology and the Natural Environment. 16 JAN 2020.

Student Supervision

Undergraduate researchers. 12 Students (2010-2021)

Doctoral researchers. Adrian Bach (2018-2022), Théo S. C. Pannetier (2020-2022), and John H. Paterson (2020-2021).

Leadership

Associate Editor: Journal of Animal Ecology (2021-present)

Manuscript reviewer: *Acta Oecologica*, *American Naturalist*, *Annals of Human Biology*, *Arthropod-Plant Interactions*, *Behavioral Ecology*, *Behavioral Ecology and Sociobiology*, *Biology Letters* (5), *BMC Evolutionary Biology*, *Ecology and Evolution* (4), *Environmental Conservation*, *Evolution* (5), *Evolutionary Ecology* (3), the *Journal of Animal Ecology*, the *Journal of Applied Ecology* (3), the *Journal of Theoretical Biology* (3), *Landscape Ecology*, *Molecular Ecology* (2), *Oikos*, *PLoS One*, *Proceedings of the National Academy of Sciences USA* (2), *Proceedings of the Royal Society B* (2), *Royal Society Open Science*, *Scientific Reports*, and *Symbiosis*

Grant reviewer: National Science Foundation (USA), Université Bourgogne – Franche-Comté (UBFC), Centre for Interdisciplinary Research in Animal Health (CIISA), and L'Agence nationale de la recherche (ANR)

Conference organiser: Midwest Ecology and Evolution Conference at Iowa State University (2010)

Workshop organiser: European Congress of Conservation Biology in Jyväskylä, Finland (2018)

Representative: Biological and Environmental Sciences Library (UoS; 2019), Post-doctoral researchers (organiser at UoS; 2017-2019), Graduate and Professional Student Senate (Senator at ISU; 2011-2013), and Graduate Research in Evolutionary Biology and Ecology (Vice President at ISU; 2009-2010)

Computer Skills

Experience in statistical analysis, mathematical & individual-based modelling, genetic algorithms, and computer programming in C and R

Use of Linux, git, and high performance computing clusters

Knowledge of HTML, Markdown, LaTeX, and MS Office Suite

Course design and instruction in Blackboard and Canvas

Software Developed

All listed software is publicly available on the Comprehensive R Archive Network (CRAN) and on GitHub.

2. **GMSE** *v0.3.1.9*. 2017. Generalised Management Strategy Evaluation Simulator. *Written in R and C.*
   R package link: < http://CRAN.R-project.org/package=GMSE >
   Website link: < https://confoobio.github.io/gmse/ >

1. **gamesGA** *v1.1.3.2*. 2017. Genetic Algorithm for Sequential Symmetric Games. *Written in R and C.*
   R package link: < http://CRAN.R-project.org/package=gamesGA >

Presentations

‡Denotes invited talk, *Denotes undergraduate author

Cusack, J., **A. B. Duthie**, R. Pozo, S. Redpath, and N. Bunnefeld. 2019. Non-compliance and biased management decisions predict population trends of harvested species. **International Society for Ecological Modelling 2019**, Salzburg, Austria.

Dawson, S., **A. B. Duthie**, M. Gonzalez-Suarez, M. Jönsson, C. Pérez Carmona, F. Chichorro de Carvalho, M. Mallen-Cooper, Y. Melero, H. Moor, and J. Simaika. 2019. A survey on the interpretation and application of the terms 'trait' and 'functional trait' among ecologists. **Ecological Society of America 2019**, Louisville, Kentucky, USA.

‡**Duthie, A. B.**, J. J. Cusack, O. S. Rakotonarivo, and N. Bunnefeld. 2019. Generalised Management Strategy Evaluation: modelling biodiversity and food security. **Centre for Biodiversity Dynamics Seminar** at the Norwegian University of Science and Technology, Trondheim, Norway.

Duthie, A. B. 2018. Ecological inference from functional traits. **Fifth European Congress of Conservation Biology** in Jyväskylä, Finland.

‡**Duthie, A. B.** 2018. When, why, and how to avoid, prefer, or tolerate inbreeding. **Institute of Evolutionary Biology Seminar** at the University of Edinburgh, Edinburgh, Scotland.

‡**Duthie, A. B.** 2017. GMSE: a general tool for management strategy evaluation. **Mathematics and Statistics Group Seminar** at the University of Stirling, Stirling, Scotland.

‡**Duthie, A. B.** 2017. Introduction to genetic algorithms, and their potential to link complex games to real-world behaviour in conservation conflicts. **Workshop: "Behavioural games and conflict"** at Grimsö Wildlife Research Station, Grimsö, Sweden.

Duthie, A. B., G. Bocedi, and J. M. Reid. 2015. Evolution of polyandry and inbreeding avoidance: a genetically-explicit finite population model. **Population Genetics Group Meeting 49** at the University of Edinburgh, Edinburgh, Scotland.

Duthie, A. B., G. Bocedi, and J. M. Reid. 2015. Should females mate multiply to avoid inbreeding? Insights from a computational modelling approach. **The Scottish Informatics and Computer Science Alliance (SICSA) workshop on Computational Ecology** at the University of Edinburgh, Edinburgh, Scotland.

Duthie, A. B. and J. M. Reid. 2014. Evolution of inbreeding and inbreeding avoidance among multiple relatives. **Workshop: "Evolution of Mating Systems"** at the Konnevesi Research Station of the University of Jyväskylä, Konnevesi, Finland.

Duthie, A. B., Lim*, C., and J. D. Nason. 2013. The effects of life history characteristics on male dimorphism frequency in two species of non-pollinating fig wasps. **Ento '13 International Symposium and Annual National Science Meeting** at the University of Saint Andrews, Saint Andrews, Scotland.

Duthie, A. B., K. C. Abbott, and J. D. Nason. 2013. A fluctuating environment drives coexistence in five non-pollinating fig wasps. **XIV Conference of the European Society for Evolutionary Biology** at the University of Lisbon, Lisbon, Portugal.

Lim*, C., **A. B. Duthie**, and J. D. Nason. 2012. Violence inside the fig: Sexual selection among two species of non-pollinating male fig wasps. **Symposium on Undergraduate Research and Creative Expression** at Iowa State University, Ames, Iowa.

Duthie, A. B., K. C. Abbott, and J. D. Nason. 2012. Does the storage effect maintain coexistence in non-pollinating fig wasp communities? **Nineteenth Annual GREBE Spring Symposium** at Iowa State University, Ames, Iowa.

Duthie, A. B. 2010. Turn-taking in habitat patch selection can be evolutionarily stable. **Midwest Ecology and Evolution Conference** at Iowa State University, Ames, Iowa.

Day, K., **A. B. Duthie**, and J. D. Nason. 2009. Cryptic parasites and their effects on the fitness and evolutionary stability of the fig-pollinator mutualism. **Evolution** at the University of Idaho, Moscow, Idaho.

Duthie, A. B. and M. Falcy. 2009. Spatial heterogeneity promotes coexistence in a mutualist/exploiter community. **Sixteenth Annual GREBE Spring Symposium** at Iowa State University, Ames, Iowa.

Duthie, A. B. and J. D. Nason. 2008. Dynamics of a Sonoran fig wasp community: A graphical modeling approach. **Evolution** at the University of Minnesota, Minneapolis, Minnesota.

Duthie, A. B. and J. D. Nason. 2008. Graphical modeling and the community dynamics of a sonoran desert fig, its pollinator, and exploiter wasps. **Fifteenth Annual GREBE Spring Symposium** at Iowa State University, Ames, Iowa.

Duthie, A. B. and M. Smith. 2007. Environmental effects on achenes of *Boltonia decurrens*, a threatened floodplain species: Age, mass, germination, and viability. **Illinois State Academy of Sciences Annual Meeting** at the Illinois State Museum, Springfield, Illinois.

Duthie, A. B.. 2006. This brain owns itself: How things like us project a unified agent **First Annual Undergraduate Philosophy Conference** at Southern Illinois University Edwardsville, Edwardsville, Illinois.

Posters

Duthie, A. B. 2019. Component response rate variation underlies the stability of complex systems. **International Society for Ecological Modelling 2019**, Salzburg, Austria.

Duthie, A. B., and J. M. Reid. 2015. The effect of relatedness structure and sexual conflict on the evolution of inbreeding avoidance and preference **XV Conference of the European Society for Evolutionary Biology** in Lausanne, Switzerland.

Duthie, A. B., K. C. Abbott, and J. D. Nason. 2012. Does the storage effect maintain coexistence in non-pollinating fig wasp communities? **Evolution** in Ottawa, Canada.

Duthie, A. B., K. C. Abbott, and J. D. Nason. 2011. Coexistence in fig wasp communities: A lottery model. **Workshop 5: Coevolution and the ecological structure of plant-insect communities** at the Mathematical Biosciences Institute in Columbus, Ohio.

Duthie, A. B., and M. R. Falcy. 2011. Spatial heterogeneity promotes coexistence in a mutualist/exploiter community. **Workshop 5: Coevolution and the ecological structure of plant-insect communities** at the Mathematical Biosciences Institute in Columbus, Ohio.

Selected Awards

Iowa State University Teaching Excellence Award (top 10% of TAs; 2010)

Donal G. Myer Outstanding Student Award (SIUE; awarded to one science student; 2007)

Ober Honours Award in Philosophy (SIUE; awarded to one philosophy student; 2007)

Phi Kappa Phi (Collegiate Honour Society; 2006)

Chancellor's Scholarship (SIUE; full tuition for undergraduate education; 2003-2007)

Professional Affiliations

Society for Conservation Biology

European Society for Evolutionary Biology

Association for the Study of Animal Behaviour