

# 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

## 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

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

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## 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

30. Dawson, S., C. Pérez Carmona, M. Gonzalez Suarez, M. Jönsson, F. de Carvalho, M. Mallen-Cooper, Y. Melero, H. Moor, J. Simaika, and **A. B. Duthie**. 2021. The traits of 'trait ecologists': an analysis of the use of trait and functional trait terminology. *Ecology and Evolution*. 11:16434-16445. DOI: 10.1002/ece3.8321.
29. Rakotonarivo, O. S., A. Bell, B. Dillon, **A. B. Duthie**, A. Kipchumba, R. Rasolofoson, J. Razafimanahaka, N. Bunnefeld. 2021. Experimental evidence on the impact of payments and property rights on forest user decisions. *Frontiers in Conservation Science*. 2:661987. DOI: 10.3389/fcsc.2021.661987.
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](http://cfpm.org/jom-emit/2004/vol8/duthie_ab.html).

## Teaching Experience

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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.

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### 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, 2021 (coordinator).
- *Behavioural Ecology – Module Contributor* (BIOU6BE; Undergraduate: 20 credits) University of Stirling. Spring 2019-2021.
- *Biology Field Course – Module Contributor* (SCIU3FB; Undergraduate: 20 credits) University of Stirling. Autumn 2017-2021.
- *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.
- *Stirling Coding Club (SCC)*. Developing and leading fortnightly workshops (13 total) on programming and data analysis at the University of Stirling.

## Student Supervision

**Undergraduate researchers.** 12 Students (2010-2021)

**Doctoral researchers.** Adrian Bach (2018-2022), Théo S. C. Pannetier (2020-2022), John H. Paterson (2020-2021), and Benjamin M. Marshall (2021-2025).

## 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), *Ecological Complexity*, *Environmental Conservation*, *Evolution* (6), *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* (4), *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,  $\text{\LaTeX}$ , 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.

3. **resevol** *v0.2.0.0*. 2021. Simulate Agricultural Production and Evolution of Pesticide. *Written in R and C*.  
R Package link: < <http://CRAN.R-project.org/package=resevol> >  
Website link: < <https://bradduthie.github.io/resevol/> >
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.** 2021. Videogames as virtual laboratories for collecting decision-making data to understand challenging social-ecological problems. **Ecology Across Borders: Joint British Ecological Society and French Society for Ecology and Evolution**, Liverpool, England (virtual attendance and eposter).

**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

British Ecological Society

Association for the Study of Animal Behaviour