ADAM C. SMITH

Senior Biostatistician, Canadian Wildlife Service, National Wildlife Research Centre, Ottawa ON, Canada
Adjunct Professor: Carleton University, Department of Biology, Ottawa ON, Canada
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GitHub: https://github.com/AdamCSmithCWS
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EDUCATION

Carleton University, Ottawa, ON
Ph.D. Biology **2010**
Prioritizing competing conservation and management strategies: with applications in avian landscape ecology

Trent University, Peterborough, ON
M.Sc. Biology **2001**
Home range size, movement, and spatial scale: The American marten (*Martes americana*) in south-eastern Labrador, Canada.

Trent University, Peterborough, ON
B.Sc. Honours Biology **1998**

UNIVERSITY TEACHING EXPERIENCE

Bayesian Statistics – BIOL 5502 **2020 fall term**
Co-instructor with Drs. Tom Sherratt and Roslyn Dakin
Ottawa Carleton Institute of Biology

Ecological analysis using R – BIOL 5501 **2010 fall term**
Developed the course and led teaching, in collaboration with Dr. David Currie
Ottawa Carleton Institute of Biology

STUDENT SUPERVISION

Brandon Edwards, M.Sc.- Co-supervisor
with **Bennett Lab: Dr. Joe Bennett** **ongoing**

Lindsay Daly, M.Sc. - Committee Member
with **Geomatics and Landscape Ecology Lab: Dr. Lenore Fahrig** **ongoing**

Jill Brooks, Ph.D. - Committee Member
with **Fish Ecology and Conservation Physiology Lab Dr. Steve Cooke** **ongoing**

Sean Patterson, M.Sc. - Committee Member
with **Geomatics and Landscape Ecology Lab: Dr. Lenore Fahrig** **ongoing**

Julia Clarke, M.Sc. - Committee Member
with **Genomics of Plants, Pathogens, and Pests Lab Dr. Catherine Cullingham** **ongoing**

Zoe Hillier-Weltman, B.Sc. Honours project - Co-supervisor
with **Dynamic Behavior Lab: Dr. Roslyn Dakin** **ongoing**

Courtney Donkersteeg, B.Sc. Honours project - Co-supervisor
with **Dynamic Behavior Lab: Dr. Roslyn Dakin** **Summer 2020**

Lauren Hepburn, M.Sc. - Co-supervisor
with **Geomatics and Landscape Ecology Lab: Dr. Lenore Fahrig** **completed: 2018**

Lauren Moretto, M.Sc. - Co-supervisor
with **Geomatics and Landscape Ecology Lab: Dr. Lenore Fahrig** **completed: 2018**

Genevieve Perkins, M.Sc. - Co-supervisor
with **Geomatics and Landscape Ecology Lab: Dr. Lenore Fahrig** **completed: 2015**

Alex Dorland, M.Sc. - Committee Member
with **Geomatics and Landscape Ecology Lab: Dr. Lenore Fahrig** **completed: 2012**

ADDITIONAL OINGOING COLLABORATIONS WITH STUDENTS AT CARLETON UNIVERSITY

Anna Tran Nguyen: M.Sc. 2020. Collaboration on in-prep manuscript describing MSc work, Nguyen et al. Effects of forest cover and composition on migrating songbirds.

Allison Binley: PhD. Collaboration on in-prep manuscript during PhD, Binley et al. Comparing population trends between data from the North American Breeding Bird Survey and eBird.

RESEARCH INTERESTS

The development and application of statistical models in ecology, including:
- Estimation of wildlife population status and trends
- Bayesian statistics
- Development of ecological indicators
- Prioritization of conservation and management options

Urban ecology, especially avian ecology and conservation in the city of Ottawa, through my work with the Ottawa Bird Count
Management and conservation of bird populations and communities
Landscape ecology

PROFESSIONAL STATUS

Canadian Wildlife Service (CWS), Environment and Climate Change Canada
Senior Biostatistician **Since 2010**

There are 3 facets to my position:

1- The research and analytical component of my work is at the intersection of statistics, ecology, and conservation. I design and apply statistical models that allow the CWS to monitor and report-on the population status of wildlife (e.g., Smith and Edwards 2021, Smith et al. 2019, Rosenberg et al. 2019, NABCI 2020) and I collaborate with many biologists in the CWS providing quantitative expertise to answer ecological questions (e.g., Smith et al. 2020, Wilson et al. 2019, Drever et al. 2018, Smith et al. 2015).

2- I act as a statistical consultant and educator for CWS biologists, giving presentations, workshops, and advice on study-design and analysis issues.

3- I collaborate with students and researchers at Carleton University, coauthoring research papers and acting as a graduate student supervisor or a committee advisor (e.g., Kadykalo et al. 2021, Hepburn et al., 2021, Martin et al. 2020 and others below).

PUBLICATIONS (Google scholar profile)

Recent publications of particular interest:

Rosenberg, K. V., Dokter, A. M., Blancher, P. J., Sauer, J. R., **Smith, A. C.**, Smith, P. A., Stanton, J. C., Panjabi, A., Helft, L., Parr, M., & Marra, P. P. (2019). Decline of the North American avifauna. *Science*, *366*(6461), 120–124. https://doi.org/10.1126/science.aaw1313
This paper has been cited almost 400 times in 18 months, and has an Altmetric score of 3943 (top 0.001% of all ranked outputs of similar age) https://www.altmetric.com/details/66844566#score

Smith, A. C., & Edwards, B. P. M. (2021). North American Breeding Bird Survey status and trend estimates to inform a wide range of conservation needs, using a flexible Bayesian hierarchical generalized additive model. *Ornithological Applications*, *123*(duaa065). https://doi.org/10.1093/ornithapp/duaa065
This paper is an excellent example of the kinds of statistical models I develop. Sophisticated Bayesian models, firmly grounded in the practical necessities of conservation and species management.

Additional publications: * indicates collaborations with Carleton Biology students and faculty, beyond my own graduate work

* Kadykalo, A. N., Buxton, R. T., Morrison, P., Anderson, C. M., Bickerton, H., Francis, C. M., **Smith, A. C.**, & Fahrig, L. (2021). Bridging research and practice in conservation. *Conservation Biology*, https://doi.org/10.1111/cobi.13732

Lehikoinen, A., Lindström, Å., Santangeli, A., Sirkiä, P. M., Brotons, L., Devictor, V., Elts, J., Foppen, R. P. B., Heldbjerg, H., Herrando, S., Herremans, M., Hudson, M.-A. R., Jiguet, F., Johnston, A., Lorrilliere, R., Marjakangas, E.-L., Michel, N. L., Moshøj, C. M., Nellis, R., **Smith, A. C.**, Turnhout, C. van. (2021). Wintering bird communities are tracking climate change faster than breeding communities. *Journal of Animal Ecology*, https://doi.org/10.1111/1365-2656.13433

* Hepburn, L., **Smith, A. C.**, Zelenski, J., & Fahrig, L. (2021). Bird Diversity Unconsciously Increases People's Satisfaction with Where They Live.

Land, *10*(2), 153. https://doi.org/10.3390/land10020153

Edwards, B. P. M., & **Smith, A. C.** (2020). bbsBayes: An R Package for Hierarchical Bayesian Analysis of North American Breeding Bird Survey Data. *BioRxiv*, 2020.05.27.118901. https://doi.org/10.1101/2020.05.27.118901

* Martin, A. E., Collins, S. J., Crowe, S., Girard, J., Naujokaitis-Lewis, I., **Smith, A. C.**, Lindsay, K., Mitchell, S., & Fahrig, L. (2020). Effects of farmland heterogeneity on biodiversity are similar to—Or even larger than—The effects of farming practices. *Agriculture, Ecosystems & Environment*, *288*, 106698. https://doi.org/10.1016/j.agee.2019.106698

Smith, P. A., McKinnon, L., Meltofte, H., Lanctot, R. B., Fox, A. D., Leafloor, J. O., Soloviev, M., Franke, A., Falk, K., Golovatin, M., Sokolov, V., Sokolov, A., & **Smith, A. C.** (2020). Status and trends of tundra birds across the circumpolar Arctic. *Ambio*, *49*(3), 732–748. https://doi.org/10.1007/s13280-019-01308-5

Wilgenburg, S. L. V., Mahon, C. L., Campbell, G., McLeod, L., Campbell, M., Evans, D., Easton, W., Francis, C. M., Haché, S., Machtans, C. S., Mader, C., Pankratz, R. F., Russell, R., **Smith, A. C.**, Thomas, P., Toms, J. D., & Tremblay, J. A. (2020). A cost efficient spatially balanced hierarchical sampling design for monitoring boreal birds incorporating access costs and habitat stratification. *PLOS ONE*, *15*(6), e0234494. https://doi.org/10.1371/journal.pone.0234494

* Fahrig, L., Arroyo-Rodríguez, V., Bennett, J. R., Boucher-Lalonde, V., Cazetta, E., Currie, D. J., Eigenbrod, F., Ford, A. T., Harrison, S. P., Jaeger, J. A. G., Koper, N., Martin, A. E., Martin, J.-L., Metzger, J. P., Morrison, P., Rhodes, J. R., Saunders, D. A., Simberloff, D., **Smith, A. C.**, … Watling, J. I. (2019). Is habitat fragmentation bad for biodiversity? *Biological Conservation*, *230*, 179–186. https://doi.org/10.1016/j.biocon.2018.12.026

* Moretto, L., Fahrig, L., **Smith, A. C.**, & Francis, C. M. (2019). A small-scale response of urban bat activity to tree cover. *Urban Ecosystems*, *22*(5), 795–805. https://doi.org/10.1007/s11252-019-00846-w

Roy, C., Michel, N., Handel, C., Van Wilgenburg, S., Burkhalter, J., Gurney, K., Messmer, D., Princé, K., Rushing, C., Saracco, J., Schuster, R., Smith, A., Smith, P., Sólymos, P., Venier, L., & Zuckerberg, B. (2019). Monitoring boreal avian populations: How can we estimate trends and trajectories from noisy data? *Avian Conservation and Ecology*, *14*(2). https://doi.org/10.5751/ACE-01397-140208

Wilson, S., Schuster, R., Rodewald, A. D., Bennett, J. R., **Smith, A. C.**, La Sorte, F. A., Verburg, P. H., & Arcese, P. (2019). Prioritize diversity or declining species? Trade-offs and synergies in spatial planning for the conservation of migratory birds in the face of land cover change. *Biological Conservation*, *239*, 108285. https://doi.org/10.1016/j.biocon.2019.108285

Drever, M. C., **Smith, A. C.**, Venier, L. A., Sleep, D. J. H., & MacLean, D. A. (2018). Cross-scale effects of spruce budworm outbreaks on boreal warblers in eastern Canada. *Ecology and Evolution*, *8*(15), 7334–7345. https://doi.org/10.1002/ece3.4244

Kirk, D. A., Park, A. C., **Smith, A. C.**, Howes, B. J., Prouse, B. K., Kyssa, N. G., Fairhurst, E. N., & Prior, K. A. (2018). Our use, misuse, and abandonment of a concept: Whither habitat? *Ecology and Evolution*, *8*(8), 4197–4208. https://doi.org/10.1002/ece3.3812

Wilson, Scott, **Smith, A. C.**, & Naujokaitis-Lewis, I. (2018). Opposing responses to drought shape spatial population dynamics of declining grassland birds. *Diversity and Distributions*, *24*(11), 1687–1698. https://doi.org/10.1111/ddi.12811

Hudson, M.-A. R., Francis, C. M., Campbell, K. J., Downes, C. M., **Smith, A. C.**, & Pardieck, K. L. (2017). The role of the North American Breeding Bird Survey in conservation. *The Condor*, *119*(3), 526–545. https://doi.org/10.1650/CONDOR-17-62.1

Sauer, J. R., Pardieck, K. L., Ziolkowski, D. J., Jr., **Smith, A. C.**, Hudson, M.-A. R., Rodriguez, V., Berlanga, H., Niven, D. K., & Link, W. A. (2017). The first 50 years of the North American Breeding Bird Survey. *The Condor*, *119*(3), 576–593. https://doi.org/10.1650/CONDOR-17-83.1

Crewe, T. L., Taylor, P. D., Lepage, D., **Smith, A. C.**, & Francis, C. M. (2016). Quantifying regional variation in population trends using migrating counts. *The Journal of Wildlife Management*, *80*(2), 245–255. https://doi.org/10.1002/jwmg.1003

Downes, C., Hudson, M.-A., Smith, A., & Francis, C. (2016). The Breeding Bird Survey at 50: Scientists and birders working together for bird conservation. *Avian Conservation and Ecology*, *11*(1). https://doi.org/10.5751/ACE-00855-110108

Michel, N. L., **Smith, A. C.**, Clark, R. G., Morrissey, C. A., & Hobson, K. A. (2016). Differences in spatial synchrony and interspecific concordance inform guild-level population trends for aerial insectivorous birds. *Ecography*, *39*(8), 774–786. https://doi.org/10.1111/ecog.01798

* Patenaude, T., **Smith, A. C.**, & Fahrig, L. (2015). Disentangling the effects of wetland cover and urban development on quality of remaining wetlands. *Urban Ecosystems*, *18*(3), 663–684. https://doi.org/10.1007/s11252-015-0440-1

Smith, A. C., Hudson, M.-A. R., Downes, C. M., & Francis, C. M. (2015). Change Points in the Population Trends of Aerial-Insectivorous Birds in North America: Synchronized in Time across Species and Regions. *PLOS ONE*, *10*(7), e0130768. https://doi.org/10.1371/journal.pone.0130768

* Fahrig, L., Girard, J., Duro, D., Pasher, J., **Smith, A. C,** Javorek, S., King, D., Lindsay, K. F., Mitchell, S., & Tischendorf, L. (2015). Farmlands with smaller crop fields have higher within-field biodiversity. *Agriculture, Ecosystems & Environment*, *200*, 219–234. https://doi.org/10.1016/j.agee.2014.11.018

Gagné, S. A., Eigenbrod, F., Bert, D. G., Cunnington, G. M., Olson, L. T., **Smith, A. C.**, & Fahrig, L. (2015). A simple landscape design framework for biodiversity conservation. *Landscape and Urban Planning*, *136*, 13–27. https://doi.org/10.1016/j.landurbplan.2014.11.006

Smith, A. C., Francis, C. M., & Fahrig, L. (2014). Similar effects of residential and non-residential vegetation on bird diversity in suburban neighbourhoods. *Urban Ecosystems*, *17*(1), 27–44. https://doi.org/10.1007/s11252-013-0301-8

Smith, A. C., Hudson, M.-A. R., Downes, C., & Francis, C. M. (2014). Estimating breeding bird survey trends and annual indices for Canada: How do the new hierarchical Bayesian estimates differ from previous estimates? *The Canadian Field-Naturalist*, *128*(2), 119–134. https://doi.org/10.22621/cfn.v128i2.1565

* Pasher, J., Mitchell, S. W., King, D. J., Fahrig, L., **Smith, A. C.**, & Lindsay, K. E. (2013). Optimizing landscape selection for estimating relative effects of landscape variables on ecological responses. *Landscape Ecology*, *28*(3), 371–383. https://doi.org/10.1007/s10980-013-9852-6

Fernandez-Triana, J., Smith, M. A., Boudreault, C., Goulet, H., Hebert, P. D. N., **Smith, A. C.**, & Roughley, R. (2011). A Poorly Known High-Latitude Parasitoid Wasp Community: Unexpected Diversity and Dramatic Changes through Time. *PLOS ONE*, *6*(8), e23719. https://doi.org/10.1371/journal.pone.0023719

Smith, A. C., Fahrig, L., & Francis, C. M. (2011). Landscape size affects the relative importance of habitat amount, habitat fragmentation, and matrix quality on forest birds. *Ecography*, *34*(1), 103–113. https://doi.org/10.1111/j.1600-0587.2010.06201.x

Smith, A. C., Koper, N., Francis, C. M., & Fahrig, L. (2009). Confronting collinearity: Comparing methods for disentangling the effects of habitat loss and fragmentation. *Landscape Ecology*, *24*(10), 1271. https://doi.org/10.1007/s10980-009-9383-3

Smith, A. C., Virgl, J. A., Panayi, D., & Armstrong, A. R. (2005). Effects of a Diamond Mine on Tundra-Breeding Birds. *Arctic*, *58*(3), 295–304. https://www.jstor.org/stable/40512715

Smith, A. C., & Schaefer, J. A. (2001). Home-range size and habitat selection by American marten (*Martes americana*) in Labrador. *Canadian Journal of Zoology*. https://doi.org/10.1139/z02-166

Smith, A. C., & Nol, E. (2000). WINTER FORAGING BEHAVIOR AND PREY SELECTION OF THE SEMIPALMATED PLOVER IN COASTAL VENEZUELA. *The Wilson Bulletin*, *112*(4), 467–472. https://doi.org/10.1676/0043-5643(2000)112[0467:WFBAPS]2.0.CO;2

SELECTED PUBLIC AND GOVERNMENT PUBLICATIONS AND WEBSITES

[NABCI Canada] North American Bird Conservation Initiative Canada. 2020. The State of Canada's Birds, 2019. Environment Canada, Ottawa, Canada. 12 pages. www.stateofcanadasbirds.org **[Contribution: chair of the science committee and the lead statistician**]

Smith, A.C., Hudson, M-A.R. Aponte, V., and Francis, C.M. 2019. North American Breeding Bird Survey - Canadian Trends Website, Data-version 2017. Environment and Climate Change Canada, Gatineau, Quebec, K1A 0H3 **[Contribution: lead statistician**]

Downes, C. M., M.-A. R. Hudson, A. C. Smith, and C. M. Francis. 2016. The Breeding Bird Survey at 50: scientists and birders working together for bird conservation. Avian Conservation and Ecology 11(1):8. http://dx.doi.org/10.5751/ACE-00855-110108 [guest editorial]

[NABCI] North American Bird Conservation Initiative. 2016. The State of North America's Birds 2016. Environment and Climate Change Canada: Ottawa, Ontario. 8 pages. http://www.stateofthebirds.org/2016/. [**Contribution: Co-chair of the tri-national science committee and member of the steering committee**.]

Gendron, M.H., and A.C. Smith. 2019. National Harvest Survey web site. Bird Populations Monitoring, National Wildlife Research Centre, Environment and Climate Change Canada, Ottawa, Ontario. **[Contribution: Lead statistician**]

[NABCI Canada] North American Bird Conservation Initiative Canada. 2012. The State of Canada's Birds, 2012. Environment Canada, Ottawa, Canada. 36 pages. www.stateofcanadasbirds.org **[Contribution: chair of the science committee and the lead statistician**]

CONFERENCE PRESENTATIONS (PRIMARY AUTHOR)

Smith, A.C. and Edwards, B.P.M. 2020. A strategy for integrating observational monitoring data and predictive modeling of population change. Road to Recovery initiative, online.

Smith, A.C. et al., 2020. Evolving the BBS protocol and estimates for tomorrow's conservation needs. North American Ornithological Conference, online.

Smith, A.C., Edwards, B.P.M. 2020. Improved status and trend estimates from the North American Breeding Bird Survey using a hierarchical Bayesian GAM. International Statistical Ecology Conference. Online

Smith, A.C. 2019. Super computing in R: Harnessing the power of the cloud to analyze big-bird-data; or just run your simulations, models, and cross validations faster. Society of Canadian Ornithologists, Quebec City, Canada

Smith, A.C. 2019. The state of ground-nesting grassland songbirds in Canada and beyond. Society of Canadian Ornithologists, Quebec City, Canada

Smith, A.C. et al. 2019. Decline of the North American Avifauna. Society of Canadian Ornithologists, Quebec City, Canada

Smith, A.C. et al. 2019. State of Canada's Birds, 2019. Society of Canadian Ornithologists, Quebec City, Canada

Smith, A.C., Drever, M.C., MacLean, D., Venier, L.A., Sleep, D.J.H. 2018 Multi-scale modeling of forest bird population response to spruce budworm outbreaks. International Statistical Ecology Conference. St. Andrews, Scotland

Smith, A.C. 2016. Do I always want the best model? The conservation implications of alternative models for status and trend estimates from the Breeding Bird Survey. North American Ornithological Conference. Washington D.C., U.S.A.

Smith, A. C., Hudson, M. A., Francis, C. M. 2014. What happened in the 80's? North American aerial insectivore species share common change points in their population trends. American Ornithologists Union. Estes Park, Colorado, U.S.A.

Smith, A. C. 2014. Go North young birder! The BBS frontier highlights the need for a discussion on what we want from published estimates of status and trend (and the need for more data). American Ornithologists Union. Estes Park, Colorado, U.S.A.

Smith, A.C. 2014. Bayesian modeling to identify and map multi-species change points in the North American population trends of avian aerial insectivores. International Statistical Ecology Conference. Montpellier, France.

Smith, A.C. 2013. Revisions to BBS analyses for the northern part of the continent, and their potential for broader application. American Ornithologists Union. Chicago, U.S.A.

Smith, A.C. 2011. The BBS in Canada: Adjustments to the scale of hierarchical Bayesian estimates of annual indices. The Wildlife Society's 18th annual conference, Waikoloa, Hawaii, U.S.A.

Smith, A.C., Dickey, C., and Fahrig, L. 2009. Amateur naturalists and complex data collection protocols: If you teach them, they will come. Ecological Society of America, Albuquerque, New Mexico, U.S.A.

Smith, A.C., Koper, N., Francis, C., and Fahrig, L. 2009. Embracing multicollinearity in comparing the effects of habitat loss and fragmentation. Ecological Society of America, Albuquerque, New Mexico, U.S.A.

Smith, A.C., Francis, C., and Fahrig, L. 2008. Ranking landscape management recommendations for bird conservation in BCR 13. American Ornithologist's Union Annual Meeting, Portland, Oregon, U.S.A. [Poster]

Smith, A.C., Blancher, P., Francis, C., and Fahrig, L. 2007. Change in human population density does not predict change in avian species richness in Ontario. American Ornithologist's Union Annual Meeting, Laramie, Wyoming, U.S.A. [Poster]

Smith, A.C., Francis, C., and Fahrig, L. 2007. Relative and independent effects of habitat amount, fragmentation, matrix quality, and road density on forest bird diversity. International Association of Landscape Ecology, World Congress, Wageningen, Netherlands.

Smith, A.C. and Schaefer, J.A. 2005 Domains of scale in the movements and habitat use of American marten. Ecological Society of America Annual Meeting. Montreal, Quebec, Canada.

PUBLIC OUTREACH, EDUCATION, AND VOLUNTEER ACTIVITIES

Selected Recent Media Appearances:
North America has lost 3 Billion Birds: Quirks and Quarks, CBC radio, Toronto Star, and others.
State of Canada's Birds: Canadian Press Article carried by many outlets, and numerous radio interviews related to the report
Explore by the Seat of Your Pants: Adam Smith Data Science for Conservation

The Ottawa Bird Count, www.ottawabirds.ca
Founder and Lead Scientist **2007-ongoing**
The Ottawa Bird Count is a scientifically rigorous, volunteer-based survey of bird populations in the city of Ottawa. It is a registered charity, focused on ecological research and public education. I lead the analysis of the data to produce maps, graphs, and data visualizations, and regularly consult with public, NGO, and city staff to raise awareness of our program and to solicit feedback on the relevance of our data-products for management and conservation.

Chirps, Tweets, and Trills
Instructor **2009-ongoing**
Chirps, Tweets, and Trills is an annual, six-week course on bird-song identification. It is attended by ~100 people annually.

CBC Radio – In Town and Out (Host: Michael Bhardwaj)
Regular bird correspondent **2008-2011**
I appeared on the Saturday morning radio show 3-4 times/year to discuss birds, birding, and bird-conservation in Ottawa.

AWARDS AND GRANTS (grants are not relevant in my current position with the federal government)

NSERC Scholarship - PGSD3	2005 – 2008
Baillie Fund - $2,500, Bird Studies Canada: seed grant for Ottawa Bird Count	2007 – 2008
Mountain Equipment Co-op, Environment Grant - $5,000	1999 – 2000