

EDMUND A. HALFYARD

BSc. (Envs), MSc. (Biol), PhD (Biol)

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FORMAL EDUCATION

Dalhousie University, Halifax, NS **Class of 2014**

PhD (Fish Biology/Ecology)

Thesis – The Estuarine and Coastal Survival of Atlantic Salmon: Estimation, Correlates and Ecological Significance.

Acadia University, Wolfville, NS **Class of 2008**

MSc (Fisheries Biology / Limnology), GPA 3.93 out of 4.0

Thesis – Initial Results of an Atlantic Salmon River Acid Mitigation Program

Acadia University, Wolfville, NS **Class of 2003**

BSc.(Environmental Science), Entrance Scholarships

APPOINTMENTS AND FISHERIES SCIENCE EXPERIENCE

Perennia Research, Bible Hill, NS **April 2016 – Present**

Research Scientist & Project Manager

- Leading a collaborate team to develop watershed-based stewardship plans for aquatic species at risk in Nova Scotia
- Development and delivery of applied conservation programs in support of species-at-risk recovery
- Cross-appointment w/ position below

Nova Scotia Salmon Association, Chester, NS **April 2016 – Present**

Research Scientist & Project Manager: West River Acid Mitigation Project

- Responsible for conceptualization, design, funding and application of applied research on Atlantic Salmon and Brook Trout
- Oversight and management of the West River, Sheet Harbour Acid Mitigation Project: a multi-disciplinary restoration initiative with annual budget now exceeding \$1.5M.
- Staffing and direct supervision of three field staff and several student-led projects

University of Windsor, Windsor, ON **June 2014 – April 2016**

Post-doctorate Research Fellow, Great Lake Institute for Environmental Research

- Independent and collaborative research. Coordinated research between universities, provincial and federal government and international collaborators.
- Several research projects, including: development and optimization of a novel acoustic telemetry transmitter designed to detection predation events, 3-D tracking of predators and prey in relation to individual personalities, evaluation of an international reintroduction program for extirpated deepwater Cisco in Lake Ontario, examination of the interplay between spatial distribution of fish species in the Detroit River as influence by trophic position, habitat quality, localized food-web productivity and seasonal effects.

Fisheries and Oceans Canada, Dartmouth, NS
Biologist, Population Ecology Division

January 2014 – May 2014

- Developed an analytic method to parse migration movements of fish using acoustic telemetry data to assess the role of predation by striped bass on endangered Inner Bay of Fundy Atlantic Salmon. Produced a primary publication.

Fisheries and Oceans Canada, Dartmouth, NS
Biologist, Population Ecology Division

January 2013 – April 2013

- Analyzed data for a recovery potential assessment for Atlantic salmon of the eastern Cape Breton designatable unit. Produced a research document.
- Developed an analytical approach to estimating seasonal (i.e. summer vs. winter) survival for an endangered striped bass population using acoustic telemetry and Cormack-Jolly-Seber Models. Produced a Manuscript.

Fisheries and Oceans Canada, Dartmouth, NS
Biologist, Population Ecology Division

January 2012 – April 2012

- Analyzed acoustic telemetry on endangered Inner Bay of Fundy Atlantic Salmon
- Provided data management and quality control of an acoustic telemetry metadata and database for multiple tagging projects in the Shubenacadie River Watershed
- Analyzed acoustic telemetry data on Striped Bass from a unique lacustrine /anadromous population

Fisheries and Oceans Canada, Dartmouth, NS
Fisheries Technician, Population Ecology Division

January 2010 – May 2010

- Conducted field research at the Morgan's Falls field monitoring station
- Planning for installation of a rotary screw trap (smolt wheel) on the St. Mary's River

Acadia University, Wolfville, NS
Term Instructor, Biology Department

September 2009 – January 2010

- Sole instructor for Ichthyology 5223, a graduate-level class
- Responsible for all aspects of lesson planning, exams and marking

Salmon Smolt Estimation Project, Sheet Harbour, NS
Lead Researcher

April 2007 – June 2015

- Funded by the Nova Scotia Salmon Association
- Installed and operated a rotary screw trap
- Designed, performed and analyzed a stratified mark/recapture for estimation of smolt emigration
- Implementation of a Live Gene Bank program – partnership with DFO Dartmouth

Fisheries Consultant, Halifax, NS
Researcher

June 2007 – Present

- Biological assessments, risk analyses and literature reviews for federal government, provincial governments, private industry and environmental not-for-profit groups
- Provided science advice to resource managers (e.g. Federal DFO, Gulf Region)

Nova Scotia Department of Fisheries and Aquaculture, Inland Fisheries Division

Pictou, NS

Sept. 2007 – Sept. 2008

Fisheries Biologist

- Conducted research on brook trout and brown trout including population assessment, fecundity research and population modelling
- Researched Mercury/Arsenic contamination in relation to historic gold mines
- Assessed early colonization of illegally introduced smallmouth bass

Acid Mitigation Project, West River, Sheet Harbour, NS

April 2005 – Sept. 2009

Lead Researcher, Nova Scotia Salmon Association

- Designed project monitoring regime
- Conducted fish community research -mark/recapture, electrofishing, netting and angling
- Monitored changes in the aquatic invertebrate communities
- Examined periphyton and entire aufwuchs community
- Monitored and analyzed water chemistry
- Monitored hydrology – flow rates and flow regime
- Surveyed aquatic macrophytes

Acadia Center for Estuarine Research, Wolfville NS

May 2003 – June 2007

Biological Researcher – Field Assistant

- Muzroll Lake liming project, Doaktown, NB
 - Installation and maintenance of water chemistry data loggers, insect sampling traps, periphyton traps, core sampling, zooplankton sampling, water chemistry analysis
- Cornwallis River Greencover Riparian Restoration Project, Annapolis Valley, NS
 - Data logger installation and maintenance
- Windsor mudflats project, Windsor, NS
 - Data logger installation and maintenance

Acadia University, Wolfville NS

March 2006 – May 2007

Supervisor

- Immediate supervision of an undergraduate honours student in field and laboratory settings
- Responsible for developing an undergraduate honours project, advertising position, interview process
- Project design and implementation

Acadia University, Wolfville NS

Sept 2005-April 2007

Teaching Assistant

- Aquatic ecology - practical sessions & instruction
- Ichthyology - practical sessions
- Environmental Sciences Field School - practical sessions and instruction

Acadia University, Wolfville NS

Sept. 2006 – March 2007

Supervisor

- Responsible for hiring, training, and supervising two undergraduate technicians working on an aquatic invertebrate monitoring program

OTHER FISHERIES EXPERIENCE

Atlantic Salmon Research Joint Venture, Moncton, NB **Feb. 2016 – Present**

- Co-chair (*beginning Oct. 2019*)
- *Co-lead on multi-agency project examining linkage between freshwater and marine environments*
- Scientific advice on opportunities for collaborative research on Atlantic Salmon

Southern Upland Atlantic Salmon Recovery Working Group, Halifax, NS **Jan. 2013 – Present**

- Member representing academia and ENGOS
- Provide advice on relevant scientific and conservation issues related to restoring Atlantic salmon in the Southern Upland, with specific focus on the issues of marine ecology, acidification and invasive aquatic species

Aquatic Invasive Fish Working Group, Halifax, NS **Jan. 2011 – 2016**

- Co-founder and member of provincial 6-chair group, comprised of representatives from all major provincial fisheries organizations
- Provide external advice to Nova Scotia Dept. of Inland Fisheries on the issue of non-native and invasive aquatic species

Inland Fisheries Advisory Council, Halifax, NS **Jan 2006 - 2014**

- Member of provincial 8-chair council, comprised of representatives from all major provincial fisheries organizations
- Provide external advice to Nova Scotia Dept. of Inland Fisheries regarding all aspect of the freshwater fisheries in Nova Scotia

Sportfish Habitat Fund Board **Jan 2006 – 2014**

- Member of minister of fisheries appointed 6-chair board
- Review proposals and grant funds to not-for-profit organizations for habitat and/or access to fisheries projects

Nova Scotia Dept. of Inland Fisheries **July 2004 - Aug 2006**

- Aided with deployment and operation of gill nets, fyke nets and angling
- Data collection program at smallmouth bass tournaments
- Equipment repair and maintenance (specifically fyke nets)

PRIMARY PUBLICATIONS

16. Lennox, R.J., Alexandre, C.M., Almeida, P.R., Bailey, K.M., Barlaup, B.T., Bøe, K., Breukelaar, A., Gabrielsen, S.-E., Halfyard, E., Hanssen, E.M., Erkinaro, J., Forseth, T., Karlsson, S., Koch, S., Koed, A., Pulg, U., Langåker, R.M., Lo, H., Lucas, M., Mahlum, S., Perrier, C., Sheehan, T., Skoglund, H., Svenning, M., Thorstad, E.B., Velle, G., Whoriskey, F.G., & Vollset, K.W. (*Submitted*). Critical future of Atlantic salmon *Salmo salar* restoration. ICES Journal of Marine Science.
15. Semeniuk, C.A.D., Jeffries, K.M., Li, T., Bettles, C.M., Cooke, S.J., Dufour, B., Halfyard, E., Heath, J.W., Keeshig, K., Mandrak, N., Muir, A., Postma, L. & Heath, D.D. (*Submitted*). Putting Transcriptomics into Action for Freshwater Fish Management & Conservation. Conservation Physiology.
14. Sterling, S. M., Clair, T. A., Halfyard, E.A., Keys, K., Rotteveel, L. and O'Driscoll, N. (*Submitted*). Kejimikujik Calibrated Catchments: a benchmark dataset for long-term impacts of terrestrial acidification. Hydrological Processes.
13. Colborne, S.F., Kessel, S.T., Halfyard, E.A., & Fisk, A.T. (*Submitted*). Habitat use and inter-annual site fidelity of two predatory freshwater fish in a channelized river system. Ecology.
12. Sterling, S. M., MacLeod, S., Rotteveel, L., Hart, K., Clair, T. A., Halfyard, E. A., & O'Brien, N. L. (2020). Ionic aluminium concentrations exceed thresholds for aquatic health in Nova Scotian rivers, even during conditions of high dissolved organic carbon and low flow. Hydrology and Earth System Sciences, 24(10), 4763-4775.
11. Klinard, Natalie V., Jordan K. Matley, Edmund A. Halfyard, Michael Connerton, Timothy B. Johnson, and Aaron T. Fisk. (2020). Post-stocking dispersion, habitat use, and fate of a reintroduced deepwater forage fish in a large lake. Freshwater Biology 65:1073-1085. <https://doi.org/10.1111/fwb.13491>
10. Klinard, Natalie V., Edmund A. Halfyard, Jordan K. Matley, Aaron T. Fisk and Timothy B. Johnson. (2019). The influence of array design and environmental factors on detection efficiency of acoustic transmitters in a large, deep, freshwater lake. Anim Biotelemetry 7: 17. <https://doi.org/10.1186/s40317-019-0179-1>
9. Klinard, N. V., Halfyard, E. A., Fisk, A. T., Stewart, T. J., and Johnson, T. B. 2018. Effects of Surgically Implanted Acoustic Tags on Body Condition, Growth, and Survival in a Small Laterally Compressed Forage Fish. Trans. Am. Fish. Soc. 147(4):749-757. <https://doi.org/10.1002/tafs.10064>
8. Klinard, N. V., Fisk, A. T., Kessel, S. T., Halfyard, E. A., and Colborne, S. F. (2017). Habitat use and small-scale residence patterns of sympatric sunfish species in a large temperate river. Can. J. Fish. Aquat. Sci. (1999), 1-11. <https://doi.org/10.1139/cjfas-2017-0125>
7. Halfyard, Edmund A., D. Webber, J. del Papa, T. Leadley, S.T. Kessel, S.F. Colborne and A.T. Fisk. 2017. Evaluation of an acoustic telemetry transmitter designed to identify predation events. Meth. Ecol. Evol. <https://doi.org/10.1111/2041-210X.12726>

6. Cook, K.V., Hinch, S.G., Drenner, S.M., Halfyard, E.A., Raby, G.D., and Cooke, S.J. 2017. Population-specific mortality in coho salmon (*Oncorhynchus kisutch*) released from a purse seine fishery. *ICES. J. Mar. Sci.* 75(1): 309-318. <https://doi.org/10.1093/icesjms/fsx129>
5. Mumby, J.A., T.B. Johnson, T.J. Stewart, E.A. Halfyard, B.C. Weidel, M.G. Walsh, J.R. Lantry and A.T. Fisk. 2017. Feeding ecology and niche overlap of Lake Ontario offshore forage fish assessed with stable isotopes. 75(5): 759-771. *Can. J. Fish. Aquat. Sci.* <https://doi.org/10.1139/cjfas-2016-0150>
4. Gibson, A.J.F., Halfyard, E.A., Bradford, R.G., Stokesbury, M. and A. Redden. 2015. Effects of predation on telemetry-based survival estimates: insights from a study on endangered Atlantic salmon smolts. *Can. J. Fish. Aquat. Sci.* 72(5): 728-741. <https://doi.org/10.1139/cjfas-2014-0245>
3. Halfyard, E.A., Gibson, A.J.F., Stokesbury, M.J.W., Ruzzante, D.E. and Whoriskey, F.G. 2013. Correlates of estuarine survival of Atlantic salmon post-smolts from the Southern Upland, Nova Scotia, Canada. *Can. J. Fish. Aquat. Sci.* 70(3): 452-460. doi: 10.1139/cjfas-2012-0287
2. Halfyard, E.A., Ruzzante, D.E., Stokesbury, M.J.W., Gibson, A.J.F. and Whoriskey, F.G. 2012. Estuarine Migratory Behaviour and Survival of Atlantic Salmon Smolts from the Southern Upland, Nova Scotia, Canada. *J. Fish Biol.* 81: 1626–1645. doi:10.1111/j.1095-8649.2012.03419.x
1. O’Dor, R., M. Stokesbury, P.G. Amiro and E. Halfyard. 2008. The Ocean Tracking Network – Cutting Edge Technology on a Global Scale. *J. Ocean Tech.* 3(2): 23-26.

PUBLICATIONS IN PREPARATION

- A. Rotteveel, L., Halfyard, E.A., Keys, K., and Sterling, S. *In Prep.* Preliminary results of a terrestrial liming program to restore acid-impacted soils and streams in Nova Scotia, CAN. Target (Fall 2021): *Science of the Total Environment*.
- B. Kuaia, Y., Wells, M., Fisk, A., Klinard, N., Johnson, T., Webber, D., Halfyard, E.A., and Stephanie Smedbold. *In Prep.* The influence of strong thermal stratification on reduced detection efficiency of acoustic transmitters in a large, deep, freshwater lake. Target (Summer 2021)
- C. Halfyard, E.A., Gibson, A.J.F., Keyser, F. and Whoriskey, F.G. *In Prep.* Within river movements of wild and supportively-reared Atlantic Salmon in the St. Mary’s River, NS, CAN. Target (Fall 2021): *Journal of Fish Biology*.
- D. Halfyard, E.A., Gibson, A.J.F., Keyser, F. and Whoriskey, F.G. *In Prep.* The movement of Atlantic Salmon in search of riverine thermal refugia. Target (Summer 2021): *Canadian Journal of Fisheries and Aquaculture*.
- E. Halfyard, E.A., Gibson, A.J.F., Ruzzante, D.E. and Whoriskey, F.G. *In Prep.* Potential impact of predators on the estuarine survival of anadromous salmonids in Nova Scotia’s Southern Upland. Target (Winter 2021): *North American Journal of Fisheries Management*.

F. Halfyard, E.A. *In Prep.* Shift happens: A review of the impact of ecosystem regime shift on Atlantic salmon. Target (Winter 2021): Reviews in Fish Biology and Fisheries.

G. Broome, J.E., E.A. Halfyard, R.G. Bradford, M.J.W. Stokesbury and A.M. Redden. *In Prep.* Detection range and efficiency of passive acoustic telemetry at a tidal-energy test site: Minas Passage, Bay of Fundy. Target (Winter 2021): Animal Biotelemetry.

OTHER SELECTED LITERATURE

Halfyard, E.A. 2014. The Estuarine and Early Marine Survival of Atlantic Salmon: Estimation, Correlates and Ecological Significance. PhD Thesis. Dalhousie University, Halifax, Nova Scotia, Canada.

Redden, A.M, Broome, J., Keyser, F., Stokesbury, M.J.W., Bradford, R., Gibson, A.J.F., Halfyard, E.A., 2014. Use of animal tracking technology to assess potential risks of tidal turbine interactions with fish. Proceedings of the 2nd International Conference on Environmental Interactions of Marine Renewable Energy Technologies (EIMR2014), 28 April – 02 May 2014, Stornoway, Isle of Lewis, Outer Hebrides, Scotland.

Redden, A.M, Stokesbury, M.J.W., Broome, J., Keyser, F., Gibson, A.J.F., Halfyard, E.A., McLean, M., Bradford, R., Dadswell, M., Sanderson, B. and R. Karsten. 2014. Acoustic tracking of fish movements in the Minas Passage and FORCE demonstration area: pre-turbine baseline studies (2011-2013). Report to the Offshore Energy Research Association of Nova Scotia and the Fundy Ocean Research Centre for Energy. Acadia Centre for Estuarine Research Technical Report 118.

Halfyard, E.A., and Bradford, R.G. 2014. Survival estimates for Shubenacadie River Striped Bass (*Morone saxatilis*) derived from detections of implanted acoustic transmitters. DFO Can. Sci. Advis. Sec. Res. Doc. 201X/nnn. vi + xx p.

Bradford, R.G., Halfyard, E.A., Hayman, T., and LeBlanc, P. 2013. Overview of Bay of Fundy Striped Bass Biology and General Status. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/nnn. vi + xx p.

Gibson, A. Jamie F., Horsman, Tracy L., Ford, Jennifer S. and Halfyard, Edmund A. 2013. Recovery Potential Assessment for Eastern Cape Breton Atlantic salmon (*Salmo salar*): Habitat requirements and availability, threats to populations, and feasibility of habitat restoration. Can. Sci. Advis. Sec. 2013/nnn.

Halfyard, E.A. 2010. A review of options for the containment, control and eradication of illegally introduced smallmouth bass (*Micropterus dolomieu*). Can. Tech. Rep. Fish. Aquat. Sci. 2865:vi +71 p.

Halfyard, E.A., J.L. MacMillan and R. Madden. 2008. Trout Population Parameters of Select Lakes within the Southern Tangier – Grand Lake Wilderness Area. Technical Report. Inland Fisheries Division, Nova Scotia Department of Fisheries and Aquaculture. Pictou, Nova Scotia. 40 pp. <http://www.gov.ns.ca/fish/sportfishing/reports/>

Halfyard, E.A., J.L. MacMillan and R. Madden. 2008. Fecundity and Sexual Maturity in Select Nova Scotia Trout Populations. Technical Report. Inland Fisheries Division, Nova Scotia Department of Fisheries and Aquaculture. Pictou, Nova Scotia. 22 pp. <http://www.gov.ns.ca/fish/sportfishing/reports/>

Leblanc, J.E. and E.A. Halfyard. 2008. Preliminary Report on Mercury and Arsenic Contamination of Fish Tissues and the Influence of Historic Gold Mines in Nova Scotia. Technical Report. Inland Fisheries Division, Nova Scotia Department of Fisheries and Aquaculture. Pictou, Nova Scotia. 44 pp.

Halfyard, E.A., 2007. The West River, Sheet Harbour Acid Mitigation Project. *In* Brylinsky, M. and L. Hinks (Eds), Proceedings from the Acid Rain Mitigation Workshop, Bedford Institute of Oceanography, Nova Scotia, Canada, May 26-27, 2007. p: 83-89.

SELECTED PROFESSIONAL PRESENTATIONS (2011-present only)

Atlantic Salmon Recovery and Conservation Forum, Bergen, Norway	2019
Atlantic Salmon Ecosystems Forum, Quebec, PQ	2019
Atlantic Salmon Ecosystems Forum, Bangor, ME	2018
Dalhousie Biology 'FISH' Seminar Series	2018
Project 'SHARE' Salmon Habitat Enhancement Forum	2018
St. Francis Xavier University Biology Departmental Seminar, Antigonish, NS	2018
Fisheries and Aquaculture Ministers Conference Plenary	2018
[Keynote] American Fisheries Society, Atlantic International Chapter AGM, White Point, NS	2017
Canadian Conference for Freshwater Fisheries Research, Montreal, PQ	2017
DFO Atlantic Salmon Advisory Committee Ministerial Meetings	2017
Great Lakes Fisheries Commission, Ann Arbor, Michigan, USA	2016
Biotelemetry Training Workshop [co-lead] Ontario Ministry of Natural Resources and Forestry, Glenora, ON	2016
International Fish Telemetry Conference, Halifax, Ont.	2015
Canadian Conference for Freshwater Fisheries Research, Ottawa, Ont.	2015
American Fisheries Society, AGM, Quebec, PQ	2014
Ocean Tracking Network Canada Symposium, Ottawa, Ont.	2014
Guest Lecturer, Applied Field Methods in Fish Ecology (Dalhousie U.)	2014
Acadia University, Biology Lecture Series, Wolfville, NS	2013
Guest Lecturer, Aquatic Ecology (Acadia U.)	2013
Guest Lecturer, Applied Field Methods in Fish Ecology (Dalhousie U.)	2013
Ocean Tracking Network Canada Symposium, Halifax, NS	2012
American Fisheries Society, AGM, Seattle, WA, USA	2011
Acadia University, Biology Lecture Series, Wolfville, NS	2011

Additionally: 10-30 public lectures annually, including ENGO meetings, AGMs, working group meetings, industry groups, chamber of commerce meetings, outdoor sporting shows, etc.

ADDITIONAL QUALIFICATIONS / ACHIEVEMENTS

Computing platforms: R, MARK, and most standard Microsoft programs	Current
Electrofishing certification – Malaspina University, Nanaimo, BC	Current
Current Canadian Council on Animal Care Fish Stream Certified	2009
Slocum sea glider pilot training	2008

MANUSCRIPT REVIEW

Canadian Journal of Fisheries and Aquatic Sciences (5), Environmental Biology of Fishes (2), Animal Biotelemetry (1), Journal of Fish Biology (2), North American Journal of Fisheries Management (2).

PROFESSIONAL REFERENCE CONTACTS

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Executive Director – The Ocean Tracking Network

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Dr. Mike Stokesbury

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