

Christine A Ward-Paige
PhD (Marine Biology), MSc (Marine Geoscience)



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Location: eOceans; Resident at Volta Labs, Halifax, NS, Canada

EXPERTISE

I am an entrepreneur and scientist. My primary research and business interests are applied and solution driven, working towards sustainable oceans. I work in urban and remote marine, coastal, and connected freshwater systems. I deploy a variety of tools spanning policy, ecology, chemistry, geology, statistics, GIS, and social science. Democratizing science through the use of citizen science is a particular focal area. I found and lead a global program, eOceans, which has received millions of dives from participants in >38 countries which are published in peer-reviewed scientific literature. Through the eOceans platform, which integrates my expertise into the backend, my personal mission is a world where ocean science is conducted in real-time and is accessible to all.

EDUCATION

Pew Postdoctoral Fellowship, Dalhousie University, CA. 2010-11, 2013, 2015-2016.

Spatio-temporal research to advise on: marine conservation strategies; IUCN species listings; species recovery potential.

National Academies Postdoctoral Fellowship, National Oceanic and Atmospheric Administration, US. 2011-2012.

Spatio-temporal research to evaluate the environmental needs of juvenile sharks.

Ph. D., Biology, Dalhousie University, Canada. 2010

Thesis: Monitoring Elasmobranchs using scuba divers: Patterns, trends and potential biases.

Prof: Ransom A Myers

M. Sc., Geography and Earth Sciences, McMaster University, Canada. 2003

Thesis: Extent and history of nutrient loading in the Florida Keys. **Prof:**

Michael J Risk.

B. Sc., Geography and Earth Sciences, McMaster University, Canada. 2001

TEACHING

Applied Field Methods in Fish Ecology; Instructor, Dalhousie University	2013-2015
Urban Freshwater Systems; Instructor, Dalhousie University	2015
Field Studies of Marine Mammals; TA, Dalhousie University	2014

Applied Field Methods in Aquatic Ecology; TA, Dalhousie University	2010
Environmental Programs Field School; TA, Dalhousie University	2007-2008
Diversity of Life; TA, Dalhousie University	2007
Sedimentology; TA, Dalhousie University	2004
Toxicology; Instructor, Georgian College	2003
Environmental Concerns; Instructor, Georgian College	2003
Paleontology; TA, McMaster University	2002
Coral Reefs; TA, McMaster University	2002

Student Supervision

- Assessing leopard seal (*Hydrurga leptonyx*) populations using citizen science observations in Antarctica. Co-supervised with Dr. T. Walker. *K Sora, Masters of Resource and Environmental Science, Dalhousie University, 2016-17
- Delineating priority conservation areas for reef sharks and rays in Thailand using citizen science. *A Westell, Biology BSc, Dalhousie University, 2015-16
- Predicting the occurrence of juvenile sharks in the Gulf of Mexico using habitat suitability modeling; *A Harman, Biology BSc, Dalhousie University, 2014-15
- A comparison of two underwater visual sampling techniques used to estimate tropical reef fish communities. *S Jind, Biology BSc, Dalhousie University, 2011-2012

REVIEWED PUBLICATIONS

- Ward-Paige CA**, Brunnschweiler J, Sykes H. Tourism-driven ocean science for sustainable use: A case study of sharks in Fiji. (in review)
- Ward-Paige CA**, Westell A, Ford-Sing B. (2018) Using eOceans diver data to describe contemporary patterns of marine animal populations: a case study of sharks in Thailand. *Ocean and Coastal Management*. 163: 1-10.
- Ward-Paige CA**, Worm B. (2017) Global evaluation of shark sanctuaries. *Global Environmental Change*. 47: 174-189.
- Hind-Ozan E, Pecl G, **Ward-Paige CA**. (2017) Citizen Science, Communication to the Broader Public and Trust Building. In: Cigliano JA & Ballard HL (eds). *Citizen Science for Coastal and Marine Conservation*, London: Routledge.
- Ward-Paige CA**. (2017) A global overview of shark sanctuary regulations and their impact on shark fisheries. *Marine Policy*. 82: 87-97.
- Bundy A, Will E, Serdyska A, Cook A, **Ward-Paige CA** (2017) Defining and mapping functional groups for fishes and invertebrates in the Scotian Shelf Bioregion. *Can. Tech. Rep. Fish. Aquat. Sci.* 3186: iv + 49 p.
- Ward-Paige CA**, Bundy A (2016) Mapping biodiversity on the Scotian Shelf. Department of Fisheries and Oceans, Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/006. v + 90 p.
- Ward-Paige CA** (2014) The role of the tourism industry. In: Techera EJ & Klein N (eds). *Sharks: Conservation, Governance and Management*. Earthscan, pp. 55-75.
- Ward-Paige CA**, Britten G, Bethea DM, Carlson JK (2014) Characterizing and predicting habitat suitability of six shark species. *Marine Ecology*, 1-13.
- Brunnschweiler J, **Ward-Paige CA** (2014) Shark fishing and tourism: a response to Cisneros-Montemayor et al. *Oryx*, 1-2.
- ¹**Ward-Paige CA**, Davis B, Worm B (2013) Global population trends and human use patterns of manta and devil rays. *PLoS One*, 8(9): e74835.

- ²Worm B, Davis B, Kettner L, **Ward-Paige CA**, Chapman D, Heithaus M, Kessel S, Gruber S (2013) Global catches, exploitation rates, and rebuilding options for sharks. *Marine Policy*. 40:194-204.
- Chapman DD, Frisk MJ, Abercrombie DL, Safina C, Gruber SH, Babcock EA, Feldheim KA, Pikitch EK, **Ward-Paige CA**, Davis B, Kessel S, Heithaus M, Worm B (2013) Give shark sanctuaries a chance. *Science*. 339: 757.
- Ward-Paige CA**, Keith D, Worm B, Lotze HK (2012) Recovery potential and conservation options for elasmobranchs. *Journal of Fish Biology*. 80: 1844-1869.
- Ward-Paige CA**, Lotze HK (2011) Assessing the value of recreational divers for censusing elasmobranchs. *PLoS ONE*. 6(10): e25609.
- Lotze HK, Coll M, Magera AM, **Ward-Paige CA**, Airoidi L (2011) Recovery of marine animal populations and ecosystems. *Trends in Ecology and Evolution*. 26(11): 595-605.
- 5) **Ward-Paige CA**, Mills Flemming J, Lotze HK (2010) Overestimating fish counts by noninstantaneous visual censuses: consequences for population and community descriptions. *PLoS ONE*. 5(7): e11722.
- ³**Ward-Paige CA**, Mora C, Lotze HK, Pattengill-Semmens C, McClenachan L, Arias-Castro E, Myers RA (2010) Large-scale absence of sharks on reefs in the greater-Caribbean: a footprint of human pressures. *PLoS ONE*. 5(8): e11968.
- Ward-Paige CA**, Pattengill-Semmens C, Lotze HK (2010) Spatial and temporal trends in yellow stingray abundance: evidence from diver surveys. *Environmental Biology of Fishes*. 90:263-76.
- Ward-Paige CA**, and Risk MJ (2005) Bioerosion surveys on the Florida Reef Tract suggest landbased nutrient inputs. *Marine Pollution Bulletin*. 51: 570-579.
- Ward-Paige CA**, Risk MJ, and Sherwood OA (2005) Reconstruction of nitrogen sources on coral reefs: $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ examples from the Florida Reef Tract. *Marine Ecology Progress Series*. 296: 155-163.

***Most Cited Marine Policy Article**

For superscripted numbers, see ASSOCIATED OUTCOMES (below)

OTHER PUBLICATIONS

- Lawrence, AJ, Budziak A, Campbell I, Cornish A, Ender I, Kanstinger P, Macdonald C, Marston J, Stevens G, **Ward-Paige CA** (2017). Responsible shark and ray tourism: A guide to best practice. Gland, Switzerland: WWF, and Rancho Santa Margarita, USA: Project AWARE and Dorset, UK: MantaTrust
- ⁴**Ward-Paige CA** (2016) Even scientists take selfies with wild animals. Here's why they shouldn't. *The Conversation*. 56,000 reads.
- Pais MP, **Ward-Paige CA** (2015) AnimDens NetLogo model.
http://modelingcommons.org/browse/one_model/4408
- Ward-Paige CA** (2014) Global distribution of Manta and Mobula rays - A citizen science project based upon a survey of divers. Version 1 In OBIS Canada Digital Collections. Bedford Institute of Oceanography, Dartmouth, NS, Canada. Published by OBIS, Digital <http://www.iobis.org/>
- Ward-Paige CA** (2011) Divers contributing to shark and ray conservation: A researcher's perspective by Christine Ward-Paige. ProjectAWARE.org
- Ward-Paige CA**, Muir C (2010) Shifting Baseline Syndrome: Are you afflicted? X-Ray magazine and Underwater Australasia, 2010.
- ⁵Muir C, **Ward-Paige CA** (2009) Are Canada's Sharks Going Overboard? Chronicle Herald, Halifax, 2009. <http://thechronicleherald.ca/Opinion/1145240.html>

Ward-Paige CA (2008) Declining shark populations: What can we do? *The Undersea Journal*.
Third Quarter: 44-46.

ASSOCIATED OUTCOMES (see superscripted numbers in Publications)

- ¹ CITES CoP16 in 2013: *Manta* spp. included on Appendix II
- ² CITES CoP16 in 2013: *Carcharhinus longimanus*, *Lamna nasus*, *Sphyrna lewini*, *S. zygaena*, *S. mokarran* included on Appendix II
- ³ Bahamas Shark Sanctuary, 2011: prohibiting commercial shark fishing in 630,000 km²
- ⁴ Academic labs declared to remove scientist-animal selfie's.
- ⁵ Private Member's Bill C-380 proposed by Fin Donnelly to ban the import of shark fins to Canada
- ⁶ Keys Wastewater Plan - to retrofit Monroe County with 2010 compliant wastewater treatment

APPOINTMENTS

CEO, Founder, Lead Scientist, eOceans, 2018.

Assist researchers and organizations in conceiving, developing, implementing, conducting and communicating marine citizen science projects at local, regional and global scales.

Maternity Leave. Feb 2017 - Feb 2018

Biologist, Fisheries and Oceans Canada. 2016-2017.

Conceive, collaborate on and carry out an evaluation of time-area closures to conserve vulnerable species in Atlantic Canada. Data management, spatio-temporal analysis, and write-up of results for peer-review and management use.

Research Associate, Dalhousie University. 2015-2016

Conceive, direct and carry out an evaluation of the success of global shark sanctuaries using a survey of ocean explorers. Website, questionnaire and form creation, develop and launch outreach plan, recruit and engage with participants, literature review, data analysis and write-up for peer-review.

Founder and Principal Scientist, eOceans.org. 2007-2017

Direct, develop, facilitate, coordinate and organize local, regional and global assessments of marine and associated ecosystems using citizen observations (e.g. eShark, eManta, Great Fiji Shark Count, eShark Thailand, eSeal, eShark). Collaborate with international outreach and field teams. Conduct data management, analysis, write-up and presentation. Recruit and supervise students through Dalhousie Universities Marine Biology, GIS and Masters in the School for Resource and Environmental Science programs.

Instructor, Dalhousie University, Canada. 2013-2015

Applied Field Methods in Fish Ecology, Urban Freshwater Systems. Develop curriculum, organize, budget and teach field school, mentor and evaluate students, and consult with Clean Nova Scotia to develop and implement monitoring protocol for restoration initiatives as part of the field school.

Program Coordinator, Clean Foundation, Canada. 2014-2015

Lead research and restoration efforts in watersheds and coastal areas. Innovate and conceive new projects, manage budgets, write reports and grant proposals, build stakeholder relationships, meet education and outreach goals.

Consultant, Department of Fisheries and Oceans, Canada. 2014-2015

Advise on the location of Ecologically and Biologically Significant Areas (EBSAs) and Marine Protected Areas (MPAs) in Atlantic Canada. Manage, analyze and map large spatial and temporal dataset, write-up for peer-review and defend.

Maternity Leave. Oct 2012 – Sep 2013

Postdoctoral Fellow, Dalhousie University. 2012

- 1) Conceive, direct and carry out an evaluation of the global status of manta rays to understand their need for international trade restrictions: website, questionnaire and form creation, develop and launch outreach plan, recruit and engage with participants, literature review, data analysis and write-up for peer-review.
- 2) Evaluate global shark mortality and reproductive rates to understand population trends and extinction risk: Literature review, data analysis, write-up for peer-review.

Postdoctoral Fellow, National Research Council Research Associate,
NOAANMFS Southeast Fisheries Science Center, USA. 2011-2012

Investigated essential habitat of juvenile sharks in the Gulf of Mexico: Meta-analysis, data analysis, and write-up for peer-review.

Postdoctoral Fellow, Dalhousie University. 2010 – 2011

Meta-analysis of the recovery potential of global shark and ray populations: Literature review, data collection and analysis, and write-up for peer-review.

Consultant, Perry Institute of Marine Science, Bahamas. 2007

Benthic specialist responsible for the design and implementation of coral reef monitoring protocols. Develop and deploy underwater field surveys of benthic communities, using bioindicators, to assess eutrophication stress.

Demonstrator, Dalhousie University. 2003-2008

Environmental Programmes Field School, Urban Freshwater Systems, Diversity of Life, Sedimentology, Paleontology.

Instructor, Georgian College, Canada 2003 Develop curriculum and teach
Environmental Concerns (year 1) and Toxicology (year 3). **Teaching Assistant**,

McMaster University. 2001-2003. Develop, lead and mark various laboratory exercises.

Consultant, Florida Marine Research Institute (FMRI) and Coral Reef Evaluation
and Monitoring Project, USA, 2001.

Develop rapid assessment field and sampling protocols of benthic fauna to evaluate the extent and history of eutrophication on reefs. Performed hundreds of underwater visual transects and sampled boring sponges for isotope analysis, ran isotope analysis on mass spectrometer, performed data analysis and write-up for peer-review.

Research Assistant, Caribbean Marine Research Center, Bahamas, 2000

Assisted in data collection for estimated green turtle carrying capacity in the Caribbean. More than 300 hours underwater sampling seagrass, performing benthic transects, running hydrometer for sediment analysis, collecting sediment samples.

Independent research, Louisiana Universities Marine Consortium, 2000

Developed and carried out project using video footage of sea urchins to assess species specific behaviours.

SCIENTIFIC ADVISORY COMMITTEES

Technical Advisory Group for the Development of Global Best Practice Guidelines for Shark and Ray Based Ecotourism. 2015-2016
DFO Canada, Science Advice for Updating offshore Ecologically and Biologically Significant Areas in the Scotian Shelf Bioregion (2014) Nova Scotia, Canada
PEW Science Advisors, Shark conservation CITES (2012) Bimini, Bahamas
PEW Science Advisors, Manta ray Conservation CITES (2012) Bimini, Bahamas
PEW Science Advisors, Shark Conservation (2008) Washington, DC, USA

CONTRIBUTED PRESENTATIONS

- Ward-Paige CA, Cigliano J** (2018) Symposium lead: "Citizen Science for science: charting a path forward for collaborative efforts". *5th International Marine Conservation Congress, Making Marine Science Matter*.
- Ward-Paige CA**, (2018) Exploring for marine conservation: making opportunistic crowd-sourced observations and insights matter. *5th International Marine Conservation Congress, Making Marine Science Matter*.
- Ward-Paige CA** (2016) One step forward, two steps back: assessing citizen science data quality when technology exceeds capacity. *4th International Marine Conservation Congress, Making Marine Science Matter* (Invited).
- Westell A, Lotze HK, **Ward-Paige CA** (2016) Crowd-sourcing to conservation: using divers' observations to delineate priority conservation areas for reef sharks and rays. *4th International Marine Conservation Congress, Making Marine Science Matter*.
- Hind E, **Ward-Paige CA**, Pecl G (2016) Building marine citizen science trust in marine citizen science projects using communication. *4th International Marine Conservation Congress, Making Marine Science Matter*.
- Ward-Paige CA**, Westell A, Howe D (2016) You've collected messy crowd-sourced data – now what? Lessons learned from a continuously evolving, decade-long marine citizen science project. *13th International Coral Reef Symposium* (accepted).
- Ward-Paige CA** (2016) Assessing the potential for best-practices in urban design to mitigate hydroecological degradation in urban streams. *Canadian Meteorological and Oceanographic Society's 50th Congress*.
- Ward-Paige CA** (2016) Conservation beneath the waves – assessing aquatic ecosystem conservation needs and successes, and deploying a global network of citizen scientists. Invited seminar: Department of Biology, Queens University, Canada.
- Ward-Paige CA**, Bundy A (2014) Mapping biodiversity on the Scotian Shelf. Nova Scotia, Canada. Ecologically and Biologically Significant Areas in the Scotian Shelf Bioregion.
- Ward-Paige CA**, Lotze HK (2011) Using recreational scuba divers for monitoring shark and ray populations. *2nd International Marine Conservation Congress*. British Columbia, Canada.
- Ward-Paige CA**, Mora C, Lotze HK, Pattengill-Semmens C, McClenachan L, Arias-Castro E, Myers, RA (2010) Relative success of management in Florida for the preservation of shark populations. Florida Keys: Linking Science to Management. Florida, US.
- Ward-Paige CA**, Mora C, Lotze HK, Pattengill-Semmens C, McClenachan L, Arias-Castro E, Myers, RA (2010) Patterns of shark occurrence on reefs in the greater-Caribbean: A footprint of human exploitation. American Elasmobranch Society Meeting, Providence. **Ward-Paige CA**,

- Mills Flemming J, Lotze HK (2010) Overestimating density and biomass of sharks on reefs by non-instantaneous visual censuses. Sharks International meeting, Cairns.
- Ward-Paige CA**, Myers RA, Pattengill-Semmens C (2009) Assessing the value and precision of volunteer divers. Canadian Society for Ecology and Evolution, Halifax.
- Ward-Paige CA**, Myers RA, Pattengill-Semmens C (2008) Counting elasmobranchs. American Elasmobranch Society Meeting, Montreal.
- Ward-Paige CA** (2008) Shark Populations and The Global Shark Assessment. Asian Dive Expo, Singapore.
- Ward-Paige CA** (2007) Shark Populations and The Global Shark Assessment. Diving Equipment and Management Association show, Orlando, Florida.
- Ward-Paige CA**, Myers RA, Pattengill-Semmens C (2006) Decline in Yellow Stingray (*Urobatus jamaicensis*) in the Florida Keys National Marine Sanctuary, USA. American Elasmobranch Society Meeting, New Orleans.
- Ward-Paige CA**, Risk MJ (2003) Nitrogen isotopes and bioerosion surveys on the Florida Reef Tract suggest widespread land-based stress on the reefs. Ontario Ecology and Ethology Conference, Hamilton, Ontario.
- Sherwood, OA, **Ward-Paige CA** (2003) $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ from the skeletal protein of gorgonian corals as oceanographic monitors: Examples from the Florida Keys and the Gulf of Maine. Geological Society of America- Northeastern section, 38th annual meeting, Halifax, Nova Scotia.

REFEREE SERVICE

Journals: Fish and Fisheries, Molluscan Research, BioScience, Endangered Species Research, Fisheries, Aquatic Biology, Marine Biology, Marine Ecology Progress Series, Environmental Biology of Fishes, Journal of Experimental Marine Biology and Ecology, PLoS ONE, Biological Conservation, Reviews in Fish Biology and Fisheries

VOLUNTEER SERVICE

Supervisor, Co-supervisor, Reader, Dalhousie University - 2014-present - Biology, Masters of Marine Management, School for Resource and Environmental Science

eShark Global, 2007-2016: Establishing baselines of sharks, rays, jellyfish, turtles, seahorses, whales, dolphins, ghost fishing gear, marine debris through event-based citizen science contributions. Monthly summaries are provided to regional stakeholders and the data are used to describe marine animal populations, for marine spatial planning exercises, to support student projects including undergraduate and graduate theses, GIS projects and to advise governments on marine management design and priorities. **eShark Thailand, 2012-2017:** >13,000 records, >14 shark and ray species on 185 sites **eShark Great Fiji Shark Count, 2011-2017:** >28,000 records submitted, >10 shark and ray species on >600 sites **eShark Indonesia, 2015-2017:** >2,000 records submitted, >6 shark and ray species and 15 sites. **eSeal Antarctica, 2016:** meta-analysis of existing data, 900+ records.

OTHER SKILLS & CERTIFICATIONS

Computing: R, GIS, SAS, Excel, Python, Visual Basic, Oracle, Remote Sensing

Certifications: Project Management certified with Canadian Aquatic Biomonitoring Network (CABIN); Canadian Council on Animal Care (CCAC) – Fish (2013-005)

Environmental monitoring: marine mega-fauna, fish, water quality, seagrass, turtles, sedimentation and bioerosion, visual censuses, mark-recapture, fin clipping, muscle biopsies and coring of colonial animals (e.g. sponge, coral), isotope analyses, benthic invertebrate identification, rock outcrop mapping;

Associations: Society for Conservation Biology; Canadian Geophysical Union; Canadian Meteorological and Oceanographic Society; Audubon Society; American Elasmobranch Society

Other relevant skills: First Aid/CPR; Rescue Diver (PADI); Enriched Air Nitrox Diver (IANTD); 500+ logged dives in cold and tropical water; Small vessel operations

OTHER RELEVANT COURSES

Business: **Maritime Blue** (WeWork Labs -- Seattle): 4-month maritime focused accelerator; LEAP: 6 month intensive training for acceleration; **Volta Academy**: 11-week training program for building scalable solutions; **Centre for Entrepreneurship Education and Development (CEED)**: 40-week business training program.

R-INLA: Integrated Laplace Approximation for Bayesian *New Brunswick. 2017.*

Program Evaluation: Evaluation of Programs, Policies and Processes for Government and Notfor-profit Organizations. *K Chaytor, Nova Scotia. 2015.*

Esri GIS: Learning ArcGIS Desktop; Working with Coordinate Systems in ArcGIS; Address Geocoding with ArcGIS ; Basics of Map Projections of Raster Data.