

## C. ASHTON DREW

Biodiversity & Spatial Information Center  
USGS-NC Coop. Fish & Wildlife Research Unit  
North Carolina State University  
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### INTERESTS

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landscape ecology; fish and wildlife conservation; habitat and population modeling; conservation planning; expert knowledge applications; adaptive monitoring and management

### EDUCATION

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**PhD, 2006, Marine Science - North Carolina State University, NC**, Department of Marine, Earth & Atmospheric Sciences

- Dissertation: Spatial Ecology of Reef Fish in Back Reef and Reef Habitats
- Advisor: Dr. David B. Eggleston

**MMM, 1996, Marine Management - Dalhousie University, NS**, Marine Affairs Program

- Thesis: Integrated Aquaculture Systems for Atlantic Canada
- Advisors: Drs. Aldo Chircop and Gary F. Newkirk

**BA Magna Cum Laude, 1995, Environmental Science - Beloit College, WI**, including credits from:

- Au Sable Environmental Research Institute, Au Sable, MI
- Boston University Marine Program, Marine Biological Laboratory, Woods Hole, MA
- NSF-Research Experience for Undergraduates, Marine Biological Laboratory, Woods Hole, MA
- Global Project, Independent Study, Belarus and Ukraine
- School for Field Studies, South Caicos, British West Indies

### RESEARCH & PROFESSIONAL EXPERIENCE

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**Biodiversity and Spatial Information Center**, USGS Cooperative Fish and Wildlife Research Unit, Department of Biology, North Carolina State University, Raleigh, North Carolina, USA  
*Research Coordinator, Environmental Decision Analysis (2011 – present)*

- Lead research team developing applications of large-scale spatial data to fine-scale decisions  
*Postdoctoral Research Associate (2006 – 2011)*

- Model vertebrate distribution to support USFWS & USGS Strategic Habitat Conservation
- Field research to validate and improve models in support of adaptive management and monitoring
- Co-develop and teach graduate level special topic courses
- Research program advancement: grant-writing, supervise students and technicians

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### *Research & Professional Experience, continued*

**Eastern Carolina University**, Greenville, North Carolina, USA

*Adjunct Faculty (2011 – present)*

- Serve as thesis committee member for ongoing King Rail population ecology research

**Marine Ecology & Conservation Laboratory**, Marine, Earth & Atmospheric Sciences Department, North Carolina State University, Raleigh, North Carolina, USA

*Graduate Research Assistant & NSF Graduate Research Fellow (2000 – 2006)*

- Investigate behavioral, population, and community level aspects of reef fish spatial ecology
- Field research for international (Bahamas) and local (Florida, North Carolina) projects

*Laboratory Technician (1999 – 2000)*

- Laboratory processing of coastal North Carolina benthic invertebrate samples

**US Environmental Protection Agency** (under contract through the Environmental Careers Organization), Research Triangle Park, North Carolina, USA

*Field Biologist and Crew Supervisor (1998-1999)*

- Create and deliver training program for research interns (GPS navigation, vegetation identification)
- Coordinate and supervise field research crews
- Survey riparian land cover & vegetation characteristics in Neuse River Basin, NC

**AXYS Environmental Consulting Ltd.** Victoria, British Columbia, Canada

*Wildlife Biologist and GIS Technician (1996 – 1998)*

- Inventory species in terrestrial, freshwater, and marine habitats of British Columbia
- Assess quality of habitat for endangered species, aquaculture potential, urban green space
- Mediate stakeholder meetings to negotiate objectives and elicit knowledge
- Write technical reports and produce maps for government and private clients
- Provide science documentation to inform complex policy and management decisions

### RESEARCH GRANTS

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“Vertebrate Biodiversity of Agricultural Fields: A Database and Metrics to Facilitate Conservation Partnerships in Productive Landscapes” (co-PI with J. Collazo, **NC Wildlife Resources Commission**, \$401K, 2013-2016)

“Modeling Impacts of Biomass Production on Landscapes and Wildlife” (co-PI with J. Costanza, J. Collazo, R. Abt, R. Gonzalez, **Biofuels Center of NC**, \$98K, 2012-2013)

“Developing an Outcome-Based Biodiversity Metric in Support of the Field to Market Project” (co-PI with A. McKerrow, J. Collazo, **Keystone Institute & TNC**, \$65K, 2010-2011)

“Hierarchical Landscape Models for Endemic Unionid Mussels: Building Strategic Habitat Conservation Tools for Mussel Recovery in the South Atlantic Landscape Conservation Collaborative” (co-PI with T. Kwak, G. Cope, T. Augsburger, **USFWS Flex Fund**, \$245K, 2011)

“Designing Manatee Protection Areas in Puerto Rico” (co-PI with Jaime Collazo, **USFWS**, \$48K, 2010-2011)

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### *Research Grants, continued*

- “Linking Site Occupancy, Reproductive Success, and Management Outcomes for Strategic Habitat Conservation of King Rail” (co-PI with J. Collazo, **USFWS** Webless Migratory Game Bird Research Program, \$33K, 2009-2010 & **USFWS** Quick Response Program, \$24K, 2010-2011)
- “Evaluation of Expert-Based Landscape Suitability Models for the King Rail” (coordinate NC component for PI T. Cooper, \$40K **USGS**, 2008-2009)
- “Field Validation of King Rail Habitat Models in the Roanoke-Tar-Neuse-Cape Fear Ecosystem” (co-PI with J. Collazo; \$10K **USGS** Seed Grant, 2007-2009)
- “Development of population and habitat objectives for FWS Trust Resources in the Roanoke-Tar-Neuse-Cape Fear Ecoregion of the South Atlantic Migratory Bird Initiative Project Area” (project implementation and management for PI J. Collazo, \$245K **USGS** SSP Funds, 2006-2009)

## PUBLICATIONS

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### **Text Books**

Perera AH, Drew CA, Johnson CJ (eds) (2012) Expert Knowledge and its Application in Landscape Ecology. Springer, New York.

- Perera AH, Drew CA, Johnson CJ: Experts, expert knowledge and their roles in landscape ecological applications (Chapter 1)
- Drew CA, Collazo J: Expert knowledge as a foundation for management of secretive species and their habitat (Chapter 5)
- Drew CA, Johnson CJ, Perera AH: Elicitation and use of expert knowledge in landscape ecological applications: a synthesis. (Chapter 14)

Drew CA, Wiersma Y, Huettmann FH (eds) (2011) Predictive Species and Habitat Modeling in Landscape Ecology: Concepts and Applications. Springer, New York.

- Wiersma Y, Drew CA, Huettmann FH: Landscape modeling of species and their habitats: history, uncertainty, and complexity (Chapter 1)
- Laurent E, Drew CA, Thogmartin W: The role of assumptions in predictions of habitat availability and quality (Chapter 5)
- Drew CA, Perera AH: Expert knowledge as a basis for landscape ecological predictive models (Chapter 12)
- Drew CA, Wiersma Y, Huettmann FH: The state of habitat and species modeling today (Chapter 15)

### **Research Publications**

Rogers, SL, Collazo JA, Drew CA (2013) Occupancy and abundance of King Rails in fire managed coastal marshes. *Waterbirds*36(2):xx-xx

Hightower, JE, Harris JE, Raabe JK, Brownell P, Drew CA (2012) Habitat suitability models for American shad in southeastern rivers. *Journal of Fish and Wildlife Management* 3(2):184-198

Pijanowski B, Iverson L, Rhemtulla J, Wimberly M, Drew CA, Bartsch A, Bulley H, Peng J (2010) Addressing the interplay between poverty and landscapes: a grand challenge topic for landscape ecologists. *Landscape Ecology* 25:5-16

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### *Publications, continued*

- Drew CA, Eggleston DB (2008) Juvenile fish densities in Florida Keys mangroves correlate with landscape characteristics. *Marine Ecology Progress Series* 362: 233-243
- Drew CA, Eggleston DB (2006) Currents, landscape structure, and recruitment success along a passive-active dispersal gradient. *Landscape Ecology* 21: 917-931
- Hess GR, Rubino MJ, Koch FH, Eschelbach KA, Drew CA, Favreau JM (2006) Comparing the potential effectiveness of conservation planning approaches in central North Carolina, USA. *Biological Conservation* 128: 358-368
- Favreau JM, Drew CA, Hess GR, Eschelbach KA, Rubino MJ, Koch FH (2006) Recommendations for assessing the effectiveness of surrogate species approaches. *Biodiversity and Conservation* 15: 3949-3969
- Horne CA, McClelland J, Valiela I (1994) The growth and consumption of macroalgae in estuaries: the role of invertebrate grazers along a nutrient gradient in Waquoit Bay, Massachusetts. *Biological Bulletin* 187:279-280

### **Teaching & Mentoring Publications**

- Morzilla AT, Hollister JW, Drew CA, Rocca ME, Baker ME, Bossenbroek JM, Mazzarella CM (2008) A young scientist's guide to gainful employment: recent graduates' experiences and successful strategies. *Bulletin of the Ecological Society of America* 89:193-203
- Hess GR, Drew CA (2004) Inquiry Guided Learning through Collaborative Research. In Lee VS (ed.) Teaching and Learning through Inquiry: A Guidebook for Institutions and Instructors. Sterling, VA: Stylus Publishing.
- Drew CA, Hess GR (2003) Online publication enhances integration of current research in the classroom. *Conservation Ecology* 7(1): r12. [online] URL: <http://www.consecol.org/vol7/iss1/resp12>

### **Technical Reports & Book Reviews**

- Drew CA, Collazo JA (In Revision) Bayesian Belief Networks as a framework to step-down and support Strategic Habitat Conservation of data-poor species: A case study with King Rail (*Rallus elegans*) in Eastern North Carolina and Southeastern Virginia
- Drew CA, Alexander-Vaughn LB, Collazo JA, McKerrow A, Anderson J (In Revision) Developing an Outcome-Based Biodiversity Metric in Support of the Field to Market Project: Final Report
- Drew CA, Collazo JA, Alexander LB, Reid JP, Slone DH (In Press) Science Summary in Support of Manatee Protection Area Design in Puerto Rico. Prepared for the US Fish and Wildlife Service, Caribbean Field Office, Boqueron, PR
- Guenard B, Drew CA (2011) Ant Species of MacKay Island and Back Bay National Wildlife Refuges: Results of Opportunistic Sampling in Diverse Habitats in July 2010. Prepared for Back Bay and Mackay Island National Wildlife Refuges, U. S. Fish and Wildlife Service.
- Drew CA, Guenard B (2009) Collection of *Crematogaster atkinsoni* (Wheeler) on Mackay Island National Wildlife Refuge, Knotts Island, North Carolina. Prepared for Mackay Island National Wildlife Refuge, U. S. Fish and Wildlife Service.
- Drew CA (2008) Book Review: 'Age of Complexity' offers opportunity for the multidisciplinary perspective of landscape ecologists. *Landscape Ecology* 23: 629-631

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### *Publications, continued*

- Drew CA, McKerrow AJ, Earsom S (2006) Stepping down regional habitat and population objectives to individual national wildlife refuges: A pilot project in the Roanoke-Tar-Neuse-Cape Fear (RTNCF) Ecosystem. *Gap Analysis Bulletin* 14: 53-61
- Horne CA, Ethier AE (1998) PreField Planning Report for Kaipit Lake Drainage Fish and Fish Habitat Reconnaissance Inventory. Prepared for Canadian Forest Products Ltd., Englewood Division, Woss, BC
- Ethier AE, Kashino R, Horne CA (1997) A Reconnaissance Survey of the Gordon River and Tributaries, Volumes I & II. Prepared for Ministry of Environment, Lands and Parks, Fisheries Inventory Program, Vancouver Island
- Blyth CA, McDonald JW, Canessa RR, Horne CA, Kashino R (1997) Shellfish Culture Capability Appraisal for Johnstone Strait. Prepared for BC Ministry of Agriculture, Fisheries & Food
- Blyth CA, McDonald JW, Horne CA, Canessa RR, Kashino R (1997) Shellfish Culture Capability Appraisal for Jervis Inlet. Prepared for BC Ministry of Agriculture, Fisheries & Food

### UNIVERSITY TEACHING EXPERIENCE

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#### **Climate Change and Conservation Planning 2009**

- Co-development and instruction of new graduate-level special-topics seminar course, with Dr. Jaime Collazo, Dr. Alexa McKerrow, and Adam Terando
- Topics: state and federal planning, climate models, direct and indirect effects, species and habitat threats modeling, ecological services

#### **Hierarchical Species-Habitat Analysis and Conservation 2007 & 2008**

- Co-development and instruction of new graduate-level special-topics laboratory course, with Dr. Jaime Collazo, Dr. Edward Laurent, Dr. Alexa McKerrow, and Steve Williams
- Topics: species and map data collection and management, inductive and deductive modeling approaches, spatial ecology and landscape ecology theory, advanced GIS methods

#### **Natural Resource Measurements 2003**

- Co-revision and instruction of core College of Natural Resources undergraduate laboratory course, with faculty mentor Dr. George Hess
- Topics: field survey design, field data management, survey methods for plant and animal populations, landscape pattern metrics, professional report writing and presentation

#### **Landscape Ecology 2002**

- Co-development and instruction of new graduate-level laboratory course
- Topics: spatial ecology theory, landscape pattern metrics, modeling landscape processes, spatial data collection and management, spatial statistics, applied case studies

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### SELECTED PARTICIPATION AT PROFESSIONAL MEETINGS

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#### Research Presentations

- “Hierarchical Landscape Models for Endemic Unionid Mussels: Building Strategic Habitat Conservation Tools for Mussel Recovery in the South Atlantic Landscape Conservation Cooperative”, invited oral presentation, *US International Association for Landscape Ecology*, Newport, RI 2012
- “Vertebrate Biodiversity in Agricultural Landscapes: Predicting Impacts of Alternative Row Crop Production Strategies”, poster presentation, *US International Association for Landscape Ecology*, Newport, RI 2012
- “A structured approach to designing protection areas for the Antillean manatee in Puerto Rico”, oral presentation, *International Sirenian Symposium*, Tampa, FL 2011
- “Expert-based BN models to set and update population and habitat objectives” *QUT Symposium on Eliciting Expert Knowledge: Methodology and Applications*, Brisbane, Australia 2011
- “Field validation and updating of an expert-based Bayesian Belief Network model to set population and habitat objectives for King Rail”, oral presentation *US International Association for Landscape Ecology*, Athens, GA 2010
- “Comparing expert model predictions & field data for King Rail: building better management tools for secretive marsh birds”, oral presentation *Waterbird Society Annual Meeting*, Cape May, NJ, 2009
- “From expert-based to data-based decision support for Strategic Habitat Conservation”, invited plenary speaker, *US Fish and Wildlife Service’s Southeast Regional Biologists’ Conference* Callaway Gardens, GA 2009 and invited presentation, *US Fish and Wildlife Service’s Northeast Regional Project Leaders’ and Biologists’ Conference*, Virginia Beach, VA 2009
- “Expert knowledge and landscape applications”, workshop co-organizer with Ajith Perera *US International Association for Landscape Ecology*, Snowbird, UT, 2009
- “From expert-based to data-based adaptive management using Bayesian Belief Networks”, oral presentation, *US International Association for Landscape Ecology*, Snowbird, UT, 2009 and *INTECOL International Wetlands Conference*, Cuiabá, Brazil, 2008
- “Bayesian Belief Network model of King Rail occupancy of marsh habitats”, invited presentation, *Waterbird Society Annual Meeting*, South Padre Island, TX, 2008
- “Landscape ecology and poverty alleviation”, workshop co-organizer with Louis Iverson and Henry Bulley, *US International Association for Landscape Ecology*, Madison, WI, 2008
- “Bayesian Belief Networks: Linking science and management to better step-down national conservation objectives to regional and refuge levels”, oral presentation, *International Partners in Flight*, McAllen, TX, 2008 and *US International Association for Landscape Ecology*, Madison, WI, 2008
- “Stepping-down national population objectives to regional and refuge levels in North Carolina and Virginia”, oral presentation, *National Gap Analysis Program Conference*, Asheville, NC, 2007
- “Expert opinion & model error: when does fine-scale expert opinion improve large-scale regional species distribution models?”, oral presentation, *US International Association for Landscape Ecology*, Tucson, AZ, 2007
- “Defining and modeling species-habitat associations: challenges across landscapes and seascapes”, workshop co-organizer with Yolanda Wiersma and Falk Huettmann, *US International Association for Landscape Ecology*, Tucson, AZ, 2007

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### *Research Presentations, continued*

- “Local juvenile fish densities in Florida Keys mangroves correlate with regional landscape characteristics”, oral presentation, *International Symposium on Mangroves as Fish Habitat*, Miami, FL, 2006
- “Juvenile fish in backreef habitats: a landscape ecology perspective”, oral presentation, Benthic Ecology Meeting, Williamsburg, VA 2005 and *US International Association for Landscape Ecology*, Syracuse, NY, 2005
- “Walk, swim, or drift? Effects of varying dispersal strategy and habitat patchiness on recruitment success”, poster presentation, *International Association for Landscape Ecology World Congress*, Darwin, Australia, 2003
- “Crayons, focal species and inventories”, oral presentation, *The Wildlife Society*, Raleigh, NC, 2003
- “Dispersal and recruitment in terrestrial versus marine environments”, oral presentation, *Marine Benthic Ecology Meeting*, Orlando, FL, 2002

### **Teaching & Mentoring Presentations**

- “Job hunting experiences of recent graduates”, invited panelist, *US International Association for Landscape Ecology*, Tucson, AZ, 2007
- “Using Models to Step-down National Population and Habitat Objectives”, guest lecture and lab, Population & Community Ecology class, Mars Hill College, NC, 2007
- “Inquiry-guided learning through collaborative research”, oral presentation, *Biennial Conference on University Education in Natural Resources*, Flagstaff, AZ, 2004

### PROFESSIONAL SERVICE ACTIVITIES

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#### **Graduate Student Committees**

*Technical Advisor:* Samantha Rogers (NCSU, MS 2011); Kara Dziwulski (NCSU, MS 2015)  
*Committee Member:* Carol Brackett (ECU, MS 2013)

#### **Organizational Leadership & Service**

USFWS Eastern North Carolina – Southeastern Virginia Strategic Habitat Conservation Team (2006-present); Recipient of 2009 Regional Director’s Strategic Habitat Conservation Leadership Award

US International Association of Landscape Ecologists: Executive Advisory Committee (2008-present); Student Representative on Executive Committee (2003-2005); Best Student Presentation Judge (2006-present)

NCSU-Marine Earth & Atmospheric Sciences Graduate Student Association Secretary and Webmaster (2001-2003); Marine Conservation and Ecology Lab Webmaster (2001-2006)

Coastal Zone Canada: Executive Planning Committee (1997-1998)

The Beloit Biologist: Managing Editor (1995-1996)

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### **Working-Group Participation**

USFWS Waterbird Habitat Monitoring Protocols: Wading Bird Sub-Group (2010)  
NCWRC Integrating Climate Change into the Wildlife Action Plan (2010)  
USFWS Priority Information Needs for Rails and Snipes: A Funding Strategy (2008-2009)

### **Community Outreach & Service**

*Presentations & Data Sharing:* Friends of Mackay Island NWR; NC Natural Heritage Program; Mackay Island NWR; Back Bay NWR; VA Department of Game & Inland Fisheries; VA Department of Conservation and Recreation; Albermarle-Pamlico National Estuary Program;  
*Student Mentor & Tutor:* Wolfpack Women in Science; NCSU-MEAS Grad-Undergrad Mentor Program; Wake County Readers to Achievers Program; North Carolina Ocean Science Bowl; Beloit Girls and Women in Science; NCSU Expanding Your Horizons in Math, Science and Technology

### **Manuscript Peer-Review**

Landscape Ecology; Marine Ecology Progress Series; Wetlands; Estuarine Coastal and Shelf Science; Partners-in-Flight Proceedings; Hydrobiologia; Estuaries and Coasts; Ecography

### **Professional Affiliations**

International Association of Landscape Ecologists; The Wildlife Society; Ecological Society of America; Society for Conservation Biology; American Fishery Society

## ACADEMIC GRANTS & AWARDS

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**NASA-MSU** Professional Enhancement Award (\$300; 2005)  
**NSF** Graduate Research Fellowship (DGE-0237090; \$79K; 2002-05)  
**North Carolina State University** Graduate Alumni Scholarship (\$1000; 2000)  
**Dalhousie Graduate** Scholarship (\$5000; 1996)  
**Phi Beta Kappa** Scholarship & Honor Society 1995  
**Association of American University Women** Award 1995  
**Beloit College** Ericsson Chemistry Scholarship 1994

## CERTIFICATIONS & TRAINING

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Workshop on Structured Decision Making and Adaptive Management (2012)  
Elicitor & Probability Elicitation through Scenario Analysis (2011)  
Modeling Patterns and Dynamics of Species Occurrence Workshop (2007)  
Model Based Inference in the Life Sciences Workshop (2007)  
ArcGIS and Spatial Analyst (2006); Introduction to Arc/Info (1999)  
First Aid and CPR Certification, various agencies (1995-present)  
Enriched Air Nitrox Diver, International Association of Nitrox & Technical Divers (2000)  
National Undersea Research Center Diver Certification (2000)  
Electrofishing Crew Supervisor, Malaspina University College (1998)  
Essential Wilderness First Aid, Wilderness First Aid and Safety Association of BC (1998)  
PADI Advanced Open Water Diver (1993); PADI Open Water Diver (1988)