



INTERNATIONAL SCIENCE REPORT

HIGHLIGHTS OF DUCKS UNLIMITED
SCIENCE IN FY2020

2020

WHAT SCIENCE MEANS TO DU

Since its founding, Ducks Unlimited has embraced a scientific approach to inform planning and programs to conserve waterfowl populations and their habitats. More recently, DU's application of science has expanded to increase understanding of how our habitat conservation affects ecosystem services (e.g., water quality enhancement, flood mitigation). This scientific approach ensures that plans and conservation actions are those most likely to effectively and efficiently sustain waterfowl populations consistent with our mission and simultaneously provide other benefits to broader segments of society.



DU'S SCIENCE PRIORITIES AND APPROACH

Ducks Unlimited has a choice of where and in what we invest our science capacity. Activities that address our greatest uncertainties, in our most important geographies, and provide the most significant opportunities to advance our conservation mission invariably receive highest priority. Across our 3 organizations, 6 themes have been identified into which DU science activities are assigned: 1) conservation program planning, delivery and adaptation, 2) ecosystem services and human dimensions, 3) sustainable agriculture, 4) implications of climate change for conservation, 5) species of concern, and 6) development and refinement of the International Conservation Plan.

This annual International Science Report highlights the involvement and partnership of DU Inc., DU Canada, and DU de México in scientific efforts during FY2020, reflecting a combination of university-led research, projects conducted internally by DU staff, and other activities in which DU staff are otherwise involved. Just as conservation delivery relies on diverse partnerships and cross-border collaboration for maximum efficiency, so too do our scientific efforts. Paramount among our list of science partners are federal and state agencies, university researchers, non-governmental organizations, foundations, NAWMP Joint Ventures, corporations, private landowners, and our volunteers and donors. The results of DU's science investments will strengthen our continental conservation efforts while contributing to the education and development of our next generation of scientists and conservationists.

DU INC. – SOUTHERN REGION

*COMPARING SPRING MIGRATION STRATEGIES OF NORTHERN PINTAILS FROM WINTERING AREAS ACROSS NORTH AMERICA

Georgina Eccles (PhD student) & Dr. Bart Ballard, Texas A&M Univ.–Kingsville

Understanding factors that influence pintail populations is critical for delivering effective conservation and management. Poor body condition in the Gulf Coast, poor reproductive success in the Prairies, and linkage through “cross-seasonal” mechanisms may be contributing factors. Employing GPS telemetry on 480 female pintails over 3 years, this study will yield information on differences in individual behavior, habitat use, migration strategy, and their relationship to annual survival and productivity.

*MOTTLED DUCK BREEDING ECOLOGY IN SOUTHWESTERN LOUISIANA

Lizzi Bonczek (PhD student) & Dr. Kevin Ringelman, Louisiana St. Univ.

Western Gulf Coast mottled ducks have experienced long-term population declines, yet uncertainty remains about factors responsible for this decline. This study uses GPS telemetry to obtain comprehensive information on the breeding ecology of mottled ducks and its relationship to environmental and habitat variables in southwestern Louisiana.

*MOTIVATIONS AND BARRIERS TO AGRICULTURAL CONSERVATION PRACTICES AND WATERFOWL MANAGEMENT IN THE SOUTHERN UNITED STATES

Taylor Linder (MS student), Dr. Kenneth Wallen, & Dr. Doug Osborne, Univ. of Arkansas-Monticello

This study assessed landowner motivations for enrolling in the Rice Stewardship Partnership operating in Arkansas, Louisiana, and Mississippi, and whether their conservation behaviors continue beyond the incentive period. This information will enable development of conservation programs that better align with landowner interests and yield benefits longer into the future.

*MALLARD BODY MASS VARIATION WITHIN AND AMONG WINTERS IN THE MISSISSIPPI ALLUVIAL VALLEY OF ARKANSAS

John Veon (MS student) & Dr. Brett DeGregorio, Univ. of Arkansas

In partnership with the waterfowl hunting community, this study will determine how body mass of mallards wintering in Arkansas varies across time, land management strategies, and other factors. Historical data will be used to examine patterns of mallard body condition over 5 decades, enabling assessment of how landscape, habitat, and climate trends may affect mallards in winter.

*IDENTIFYING MIGRATION ROUTES, TIMING OF MIGRATIONS AND IMPORTANT BREEDING, STAGING AND WINTERING AREAS FOR BLUE-WINGED TEAL

Bret Leach (MS student) & Dr. Lisa Webb, Univ. of Missouri

Compared to other dabbling ducks, the non-breeding ecology of blue-winged teal is poorly understood. This study is using GPS telemetry to identify spring breeding locations, migration stopover sites, and wintering areas for this species, while also quantifying habitat use, timing and patterns of migration, and other understudied aspects of its annual cycle.

*THE EFFICACY OF MARSH TERRACES FOR RESTORING AND ENHANCING GULF COASTAL WETLANDS

Madelyn McFarland (MS student), Joseph French (MS student), Raul Osario (PhD student), Drs. Brian Davis, Adam Skarke, & Ana Linhoss, Mississippi St. Univ.; Dr. Mike Brasher, DU-NHQ

Marsh terracing is a common restoration technique employed by DU along the Gulf Coast. This interdisciplinary study uses diverse data collection techniques to measure the benefits of marsh terracing, including emergent marsh expansion, shoreline erosion reduction, wave energy attenuation, submerged aquatic vegetation growth, and habitat quality for waterfowl and marsh birds. These data will inform future terrace designs to maximize gains for avian habitat and coastal sustainability.

MISSISSIPPI ALLUVIAL VALLEY WINTER MALLARD BANDING PROGRAM-ARKANSAS

Dr. Doug Osborne, Univ. of Arkansas-Monticello

DU is supporting this winter banding project to help understand harvest distribution patterns, winter homing rates, and enable estimation of seasonal survival rates of mallards in the Mississippi Alluvial Valley. This work also provides outreach and education opportunities by involving local students and volunteers in banding efforts.

USING LIGHT-LEVEL GEOLOCATORS TO MEASURE BREEDING PROPENSITY OF WESTERN GULF COAST MOTTLED DUCKS

Dr. Mike Brasher, DU-NHQ; Dr. Joe Marty, Louisiana Dept. of Wildl. & Fish.

Geolocators are tiny devices that collect data on patterns of daylight and dark, from which geographic location can be determined. When attached to leg bands, these light patterns may also reveal instances of nesting. DU is working with partners along the Gulf Coast to examine the feasibility of using geolocators to measure breeding propensity of mottled ducks, which remains a poorly understood component of this species' breeding ecology.



DU INC. – GREAT LAKES & ATLANTIC REGION

*ESTIMATING BEHAVIORAL MULTIPLIERS TO AMERICAN BLACK DUCK AND LESSER SCAUP RESTING METABOLIC RATE TO BETTER ESTIMATE DAILY ENERGY EXPENDITURE AND CARRYING CAPACITY

Jake McPherson (MS student and DU-GLAR) & Dr. Chris Williams, Univ. of Delaware

This lab-based study measured energy expenditure associated with behavioral activities of black ducks and lesser scaup. These data will help refine bioenergetic models and resulting estimates of habitat conservation needs during autumn–winter.

*ECOLOGICAL ASSESSMENT OF WETLAND MANAGEMENT TECHNIQUES ON RESTORED WETLANDS IN THE MONTEZUMA WETLANDS COMPLEX

Ed Farley (MS student and DU-GLAR) & Dr. Mike Schummer, State Univ. of New York, ESF

This research measured food production and waterfowl use of 3 different wetland management regimes in the Montezuma Wetlands Complex of central New York. Results showed that seed and tuber production from managed wetlands in the northeastern U.S. was comparable to that in other regions, while reinforcing the need for diverse management techniques to meet habitat needs of waterfowl throughout the annual cycle.

*AMERICAN BLACK DUCK BROOD SURVIVAL, HABITAT USE, AND MOVEMENT IN COASTAL NORTH CAROLINA

Daniel Lawson (MS student) & Dr. Chris Williams, Univ. of Delaware

This study will estimate survival, habitat use, and movements of American black duck broods in coastal North Carolina. This information will provide insights into factors limiting population growth of black ducks in the eastern U.S. and aid refinement of habitat conservation priorities.

*EVALUATING WATERFOWL USE AND HABITAT QUALITY FOLLOWING WETLAND RESTORATION IN LAKE ONTARIO COASTAL WETLANDS AT BRADDOCK BAY WILDLIFE MANAGEMENT AREA

Christopher Mitchell (MS student) & Dr. Rachel Schultz, State Univ. of New York, Brockport

Invasion of hybrid cattail and common reed (*Phragmites*) into Great Lakes coastal wetlands reduces habitat values by forming dense stands of monotypic vegetation. This project will measure waterfowl use and wetland characteristics to evaluate a wetland enhancement technique of dredging open water ponds within stands of invasive vegetation. This information is needed to ensure management activities are yielding gains for waterfowl.

*RESPONSE OF WILD BEE DIVERSITY TO MANAGEMENT OF RESTORED WETLANDS IN AN AGRICULTURAL LANDSCAPE

Molly Jacobson (MS student) & Dr. Mike Schummer, State Univ. of New York, ESF

Documenting and understanding the ecological and economic contributions of wetlands beyond benefits to waterfowl is critical for building broader support for wetlands conservation. This study is assessing native bee communities and plant associations among wetland management treatments in central New York.

**LONG-TERM GENETIC EFFECTS OF GAME-FARM MALLARD RELEASES ON WILD MALLARDS IN NORTH AMERICA

Joshua Brown (PhD student) & Dr. Phil Lavretsky, Univ. of Texas El Paso

Current research indicates that $\geq 15\%$ of eastern mallards have originated from released game-farm birds. To help understand factors contributing to the decline of eastern mallards, this study will assess the contribution of game-farm mallards to the genetic composition of mallards across North America and investigate the extent to which it may be causing maladaptation and decreased fitness in wild mallards.

*DETERMINING CAPTURE AND NANOTAG TRACKING TECHNIQUES FOR COMMON GALLINULES AMONG MANAGED MARSHES IN THE LAKE ONTARIO WATERSHED

Jake Chronister (MPS student) & Dr. Mike Schummer, State Univ. of New York, ESF

Understanding how wetland management techniques for waterfowl influence other wildlife is increasingly important as public land managers face greater demands to increase biodiversity beyond game species. This study measured the influence of management techniques on wildlife biodiversity, with an emphasis on rails and other secretive marsh birds.



EXPANSION OF AMERICAN BLACK DUCK DECISION SUPPORT TOOL AND SOUTH ATLANTIC BIOENERGETICS MODELING

Mike Mitchell & Dr. Dale James, DU-SR; Jess Skillman & Dr. John Coluccy, DU-GLAR

DU scientists will collaborate with partners from the Black Duck and Atlantic Coast Joint Ventures to expand the scope of the American Black Duck Decision Support Tool to portions of the midwestern U.S., south Atlantic, and eastern Canada. Once completed, the tool will help prioritize watersheds for habitat restoration and protection across most of the black duck's nonbreeding range.

REFINING TECHNIQUES FOR AUTOMATED NATIONAL WETLANDS INVENTORY MAPPING IN THE GREAT LAKES REGION:

A DATA FUSION APPROACH

Alek Kreiger, Mat Halliday, Rob Paige, & Robb Macleod, DU-GLAR; Jarlath O'Neil-Dunne & Sean MacFadden, Univ. of Vermont

Wetlands are the most difficult land cover type to map due to the temporal changes and diversity of type (open water to forested). Yet, they are one of the most important cover types for waterfowl, fish, other wildlife. Wetland updates using manual methods are extremely expensive for large areas and not likely to happen on a regular basis. This study is investigating the development of an automated method to more efficiently map wetlands and identify their temporal changes in a consistent and repeatable manner.

DU INC. – WESTERN REGION

THE IMPACT OF INCREASING GOOSE POPULATIONS ON DABBLING DUCK FOOD SUPPLIES IN THE CENTRAL VALLEY OF CALIFORNIA

Dr. Mark Petrie, DU-WR; Mike Casazza, USGS; Dr. Chris Nicolai, Delta Waterfowl; & Cliff Feldheim, California Dept. of Water Resources

Wintering goose numbers in the Central Valley have increased from 1 million birds in the mid-2000s, to nearly 2.5 million birds today. This study examines the current impact of geese on dabbling duck food supplies, especially rice, and the likelihood that goose numbers in the Central Valley will continue to grow.

EFFECTS OF REDUCED WATER SUPPLIES FOR THE KLAMATH BASIN REFUGE COMPLEX

Dr. Mark Petrie, DU-WR; John Vradenburg & Dustin Taylor, USFWS

Refuges in the Klamath Basin once supported the largest concentration of fall staging waterfowl in the Lower 48 States. However, key refuges now receive far less water than they once did. This study examines the impact of reduced water supplies on waterfowl carrying capacity in the Klamath Basin and identifies how to optimally use available water to maximize waterfowl benefits.

THE ROLE OF PUBLICLY MANAGED HABITATS IN SUPPORTING WATERFOWL POPULATIONS IN WASHINGTON'S NORTH PUGET SOUND

Dr. Mark Petrie, DU-WR; Kyle Spragens, Washington Dept. of Fish & Wildl.

North Puget Sound supports the highest density of wintering waterfowl on the U.S. Pacific Coast, but birds are overwhelmingly dependent on agricultural foods in this region, even while the agricultural landscape is rapidly changing. This study is assessing these changes on landscape carrying capacity and the future role of public lands in offsetting effects on waterfowl.

UPDATE OF THE WESTERN REGION'S WATERFOWL HABITAT PLANNING MODEL

Dr. Mark Petrie, DU-WR; Dr. Frank Feng, Univ. of Missouri; Dr. John Coluccy, DU-GLAR; Joel Sartwell, Missouri Dept. of Cons.; Orien Richards, U.S. Fish & Wildl. Service

Over the past 15 years DU's Western Region has used the bioenergetic model TRUEMET to evaluate habitat conditions for migrating and wintering waterfowl and establish habitat objectives. In partnership with researchers at the University of Missouri, the Western Region is working to update and modernize this model.

CONSERVATION PLANNING FOR WATERFOWL AND PEOPLE IN THE CENTRAL VALLEY OF CALIFORNIA

Dr. Mark Petrie, DU-WR; Luke Matthews, California Rice Commission

Waterfowl hunters and rice farmers are critical supporters of waterfowl conservation in the Central Valley of California. This study examines how we can integrate objectives for both waterfowl populations and conservation supporters by identifying actions that can simultaneously meet the needs of waterfowl, waterfowl hunters, and rice producers in the Central Valley.



PACIFIC FLYWAY WATER ANALYSIS

Dr. Mark Petrie, DU-WR; Greg Yarris, Central Valley JV; Dave Smith, Intermountain West JV

The California Central Valley, Great Salt Lake, and Southern Oregon/Northeastern California (SONEC) collectively support 70% of all ducks in the Pacific Flyway. Each of these areas is facing long-term water shortages, and because they share birds throughout autumn-winter, the effects on waterfowl habitats and populations may be compounded. This study will examine the potential consequences of regional water shortages for Pacific Flyway waterfowl and identify conservation strategies to mitigate them.

DU INC. – GREAT PLAINS REGION

*DUCK BROOD USE AND SELECTION OF WETLANDS IN CROPLAND DOMINATED LANDSCAPES IN THE U.S. PRAIRIE POTHOLE REGION

Blake Mitchell (MS student) & Dr. Adam Janke, Iowa St. Univ.

This research will assess contributions of wetlands in heavily cropped landscapes to waterfowl brood production in the PPR of Iowa, Minnesota, North Dakota, and South Dakota. Wetland quality is being measured through various vegetation, aquatic, and fish sampling methodologies. Brood counts obtained from drone-based surveys will provide an index of habitat use and abundance.

*UNMANNED AERIAL SYSTEMS APPLICATIONS TO MONITORING BREEDING DUCKS

Mason Ryckman (MS student) & Dr. Susan Ellis-Felege, Univ. of North Dakota

The goal of this project is to develop effective methodologies by which unmanned aerial systems can monitor and study waterfowl populations. Researchers will collect imagery and behavioral information across the breeding season. Ultimately, we hope to help minimize impacts of surveys on breeding waterfowl and decrease the need for higher risk manned-aerial flights.

UNDERSTANDING THE PERCEIVED IMPACTS OF AN IMMERSIVE PRAIRIE EXPERIENCE

Kaylan Kemink, DU-GPR; Dr. Chris Felege, Univ. of North Dakota

Using concepts from the field of experiential education, we are examining the effectiveness of the long-running program “Ducks University” within the organization. The research will determine if the program provides the perceived value to students 6–12 months beyond completion. Feedback from students will yield constructive criticism for improving the experience for future participants.

*FEASIBILITY OF A GREENHOUSE GAS PROTOCOL FOR RESTORATION AND AVOIDED DRAINAGE OF WETLANDS IN AGRICULTURAL LANDSCAPES OF THE PRAIRIE POTHOLE REGION

Billy Gascoigne & Dr. Ellen Herbert, DU-NHQ; Dr. Sarah Mack, Tierra Resources, Inc.; Dr. Rob Lane, Louisiana St. Univ.; Dr. Steve Ogle & Kyler Sherry (MS student), Colorado St. Univ.

The goal of this effort is to assess the potential for marketable carbon offsets to be derived from the restoration and/or avoided drainage of seasonal wetlands in the Prairie Pothole Region of the U.S., that could then further financial incentive frameworks. The work is being supported by a Conservation Innovation Grant from the USDA.

RADAR DATA AND ITS POTENTIAL CORRELATION WITH MIGRATION COUNT DATA

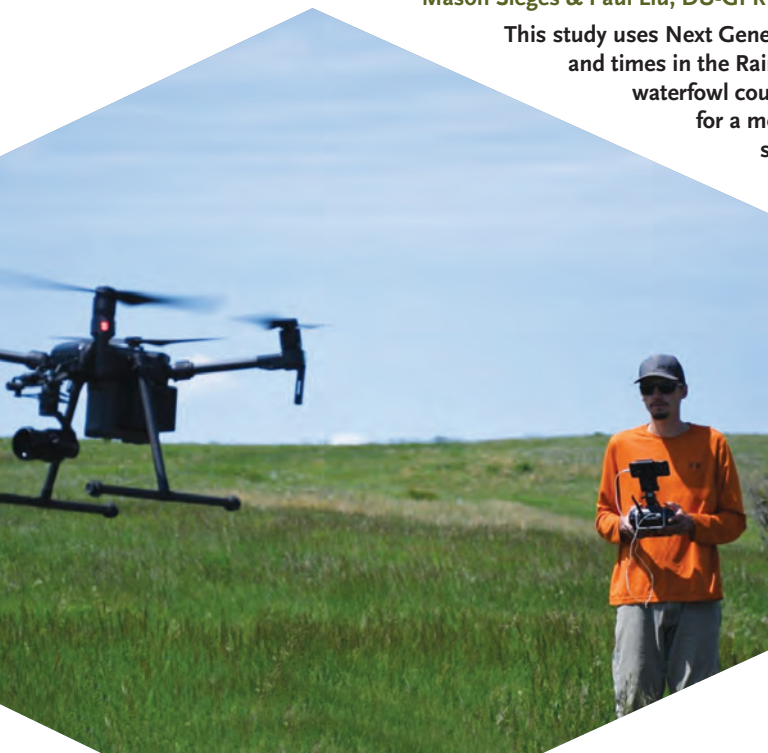
Mason Sieges & Paul Liu, DU-GPR

This study uses Next Generation Weather Radar data (NEXRAD) to identify waterfowl stopover sites and times in the Rainwater Basin. We are attempting to determine if radar data correlate with waterfowl count data from the same time periods. Strong correlation would hold promise for a more efficient method of gathering information about important waterfowl stopover areas.

UND-DU UNDERGRADUATE INTERNSHIP

Univ. of North Dakota, The Nature Conservancy, USGS Northern Prairie Wildlife Research Center, & Enbridge Ecofootprint Grant Program

DU and partners collaborate each summer to develop research skill sets of undergraduate students. Participants develop their own projects and are assisted with identifying appropriate research protocols. Students receive academic credit and present their findings to peers at summer's end, with most ultimately presenting at scientific conferences. Some returning students have continued their research for several years and now have publications in development describing tests of long-standing nest searching and monitoring protocols and revealing new and innovative behavioral data.



*COVER CROPS AND UPLAND NESTING WATERFOWL IN THE PRAIRIE POTHOLE REGION OF SOUTH DAKOTA

William Gallman (MS Student), & Dr. Joshua Stafford, South Dakota St. Univ. and USGS South Dakota Coop. Fish and Wildl. Research Unit

This research is determining the utility of cover crops in South Dakota as nesting cover for waterfowl. Nesting success in cover cropped fields is being monitored and compared to nesting success in paired fields of traditional perennial cover.

ECONOMICS OF THE CONSERVATION RESERVE PROGRAM AND THE WILDLIFE IT SUPPORTS: A CASE STUDY OF UPLAND BIRDS IN SOUTH DAKOTA

Dr. Skip Hyberg, US Dept. of Agriculture; Billy Gascoigne, DU-NHQ; Dr. John Loomis, Dr. Rebecca Hill, & Dr. Michelle Haefele, Colorado St. Univ.

This research project explores the economic influence of Conservation Reserve Program (CRP) lands through the lens of upland birds in South Dakota. Economic values are estimated for various scenarios in which CRP lands decrease/increase as pertinent to policy decision making.

AUTOMATING THE MEASUREMENT OF ANNUAL WETLAND PONDING IN THE PRAIRIE POTHOLE REGION

Dr. Hossein Sahour (post-doctoral researcher) & Dr. Jessica O'Connell, Univ. of Texas Marine Science Institute; Kaylan Kemink, DU-GPR

This project aims to develop a publicly available multi-sensor algorithm that will provide high resolution spatial and temporal wetland data for conservation planners. The methods used in this project will enable examination of shifts in the intra and inter annual dynamics of wetland complexes during the breeding season in the Prairie Pothole Region. Development of this method and its results will enable finer-scale examination of wetland dynamics and their differential effects on productivity of adult and juvenile (e.g., ducklings) obligate wetland birds.

INCORPORATING DYNAMIC PROCESSES INTO CONSERVATION PLANNING

Kaylan Kemink & Dr. Johann Walker, DU-GPR; Dr. Vanessa Adams, Univ. of Tasmania; Dr. Bob Pressey, James Cook Univ.

This project will update current conservation planning tools in the PPR by explicitly incorporating social and ecological processes into decision-making. This will be achieved through the development of multi-scale spatiotemporal models that integrate processes such as land conversion, precipitation, and climate.

PERPETUAL CONSERVATION EASEMENTS IN THE PPR: GUIDING DECISION-MAKING THROUGH RETURN-ON-INVESTMENT ANALYSIS

Kaylan Kemink, DU-GPR; Dr. Vanessa Adams, Univ. of Tasmania; Dr. Bob Pressey, James Cook Univ.; Dr. Johann Walker, Aidan Healey, & Boyan Liu, DU-GPR

Conservation organizations are increasingly turning to return-on-investment analyses to improve allocation of limited resources. This project seeks to address some of the challenges currently faced by these analyses in dynamic systems. We focus on the Small Wetlands Acquisition Program in the US PPR between 2008-2017 as a case study. Results will provide guidelines for conservation planners about trade-offs between conservation objectives and costs.

IMPROVING SOIL HEALTH ON AGRICULTURAL LANDS TO BENEFIT GRASSLAND BIRD HABITAT IN THE PRAIRIE POTHOLE REGION OF SOUTH DAKOTA

Brad Schmidt & Bruce Toay, DU-GPR; National Fish and Wildlife Foundation

This project will provide soil health monitoring assistance through the life of DU cost-share agreements. DU will help producers better understand soil health and the benefits of incorporating soil health practices into their agricultural operations. DU will utilize the best available science to promote conservation practices that not only benefit wildlife, but also produce positive economic outcomes for producers in this landscape.

*PRODUCING BEEF AND BIRDS: IMPACTS OF HIGH INTENSITY SHORT DURATION GRAZING ON GRASSLAND SONGBIRDS

Taylor Linder (PhD student) & Dr. Susan Ellis-Felege, Univ. of North Dakota; Dr. Marissa Ahlering, The Nature Conservancy; Kaylan Kemink, DU-GPR

Cattle ranchers have alternatives in the grazing systems they employ on their land, which often vary in the intensity (i.e., stocking rate) and duration of grazing bouts. This project will evaluate the impacts of high intensity short duration (HISD) grazing practices on the productivity of grassland nesting birds (songbirds, shorebirds, waterfowl and grouse) and investigate motives and attitudes of ranchers towards grassland birds and on-farm conservation actions to help develop best practices.

EFFECTIVENESS OF THE COVER CROP AND LIVESTOCK INTEGRATION PROGRAM FOR IMPROVING WETLAND WATER QUALITY

Kyle Kuechle, Emily Schwartz, & Tanner Gue, DU-GPR; Greg Sandness, ND Dept. of Environmental Quality

DU and conservation partners developed the Cover Crop and Livestock Integration Program (CCLIP) to help producers adopt sustainable agricultural practices that integrate seasonal cover crops and cattle ranching with traditional grain production to improve soil health and generate broader environmental benefits. This study will ascertain benefits of CCLIP to water quality by monitoring wetland nutrient concentrations and hydrology in seasonal and temporary wetlands embedded in CCLIP fields, conventional agriculture, and pastureland.



DU CANADA – NATIONAL

VULNERABILITIES OF CANADIAN WETLANDS IN A CHANGING CLIMATE

Dr. Mark Mallory & Dr. John Brazner, Acadia Univ.; Dr. Cherie Westbrook, Univ. of Saskatchewan; Dr. Paul Keddy (consultant); Dr. Sara Knox, Univ. British Columbia; Dr. Jan Ciborowski, Univ. of Calgary; Dr. Line Rochefort, Univ. Laval; Dr. Pascal Badiou, DUC-IWWR; Dr. Maria Strack, Dr. Rebecca Rooney, Dr. Scott Davidson, & Dr. Courtney Robichaud, Univ. of Waterloo

This project is addressing two significant knowledge gaps: 1) what are the vulnerabilities of Canadian wetlands in a changing climate? and 2) how do current Canadian wetland policies address these emerging vulnerabilities (and what improvements could be made)? These questions are of high importance because the expected impacts of climate change on wetlands are varied, but severe, and will have significant implications for the habitats DUC restores, conserves, and manages.

NATURAL CLIMATE SOLUTIONS IN CANADA—WETLANDS

Dr. Pascal Badiou, DUC-IWWR; Dr. Maria Strack & Dr. Scott Davidson, Univ. of Waterloo; Dr. Gail Chmura, McGill Univ.; Dr. Margot Hensing-Lewis, Hakai Institute

This project aims to assess and advance the potential of Canada's wetlands to help stabilize the global climate through natural climate solutions (NCS) while delivering co-benefits for people and biodiversity such as air and water filtration, soil health, wildlife habitat and climate resilience. NCS include protection of existing natural systems, restoration of those that have been lost or degraded, and improved management of working lands to minimize emissions. This project will promote the value of wetlands as NCSs to policymakers and industry and will support DUC policy and development initiatives.

RESNET: PROMOTING SUSTAINABLE AND RESILIENT ECOSYSTEMS THROUGHOUT CANADA

Dr. Elena Bennett, McGill Univ.; Nic McLellan, DUC-ATL/IWWR, Adam Campbell, DUC-ATL; Dr. Vanessa Harriman, DUC-IWWR/BOR, Dr. Lauren Bortolotti, DUC-IWWR; numerous academic, government, non-profit, and industry partners.

ResNet is a national research network to improve Canada's capacity to monitor, model, and manage working landscapes and the benefits they provide. DUC is involved in multiple sub-projects that combine scientific quantifications of these benefits with human dimensions of management issues. In Atlantic Canada, this project will improve our understanding of the trade-offs between the reinforcement of dykelands and restoration of tidal marshes in the Bay of Fundy. In the Prairies, this project will help us understand how to reduce conflict around wetland management through collaborative decision making.

KEY HABITAT SITES OF NORTH AMERICAN SEA DUCKS (ATLAS)

Sea Duck Joint Venture Partnership (Nic McLellan, DUC-ATL/IWWR)

Information on important areas for sea ducks in North America is lacking. This project is led by the Sea Duck Joint Venture and will compile the most important areas for sea ducks, on a continental scale, that will be a useful tool for conservation planning and habitat protection.

*MODELING WATERFOWL DISTRIBUTION AND ABUNDANCE IN CANADA

Antoine Adde (PhD student) & Steve Cumming, Univ. Laval; Dr. Marcel Darveau, DUC-BOR; Dr. Erin Bayne, Univ. of Alberta; Eliot McIntyre, NRCAN; Dr. Nicole Barker, ECCC

This project builds the first pan-Canada waterfowl distribution models that depict how duck population distributions change in time and space. This information will provide new insights into how much and where habitat must be conserved, especially for boreal regions.



DU CANADA – BRITISH COLUMBIA

PREDICTING HABITAT DISTRIBUTION FOR SEA DUCKS IN BRITISH COLUMBIA

Bruce Harrison, DUC-BC; Danielle Morrison, Nature Trust BC; Kathleen Moore, CWS; Llwellyn Armstrong & Dr. James Devries, DUC-IWWR
Pacific Birds Habitat JV (PBHJV) lacks the ability to inventory and assess waterfowl habitat along the entire 25,000-km BC coastline. This project is developing predictive models to identify key nearshore marine areas for important sea ducks. This product will aid in the assessment and targeting of conservation activity along the BC coast by PBHJV partners.

*EVALUATING PERFORMANCE OF HABITAT PROJECTS IN BRITISH COLUMBIA

Zane Zondervan (MSc student, DUC-BC), Simon Fraser Univ.; Sarah Nathan, Megan Winand, & Bruce Harrison, DUC-BC

DUC has constructed hundreds of habitat projects in BC since the late 1960s but had not conducted a comprehensive biological performance review since the 1990s. In 2019 we evaluated project performance in terms of bird use and habitat structure across BC projects. Coastal projects included evaluation of the effects of new floodplain restoration techniques.

JOINT VENTURE DECISION SUPPORT SYSTEM FOR WETLAND, GRASSLANDS AND RIPARIAN AREAS IN BRITISH COLUMBIA

Dr. Kathleen Moore, CWS; Danielle Morrison, NTBC; Courtney Hamilton & Bruce Harrison, DUC-BC

This project improves the ability of JV partners to standardize techniques used for prioritizing properties for securement and restoration throughout BC. The resulting tool estimates the “ecological value” of wetlands and grasslands while incorporating risks of disturbance/threats.

RESILIENCE OF BC INTERIOR WETLANDS AND COASTAL HABITATS TO CLIMATE CHANGE

Bruce Harrison, DUC-BC; Kathleen Moore, CWS; Andre Breault, CWS; Fred Bunnell, UBC; Tom Reid, Nature Trust BC; Eric Balke, S Coast Conservation Land Management Program

Climate change is a major threat to waterfowl habitat in BC and must be considered in targeting conservation investments. In the Interior, partners are working to understand wetland vulnerability to changes in precipitation and temperature, and on the coast, we are applying predictive sea level rise (SLAMM) models in estuaries. In both areas we wish to model wetland distribution under different scenarios to predict the effects of climate change on waterfowl populations.

DU CANADA – BOREAL

ROADS, PIPELINES, AND SEISMIC LINES... WHAT DO THEY MEAN FOR BOREAL DUCKS?

Dr. Stuart Slattery, Howie Singer, Llwellyn Armstrong, & Susan Witherly, DUC-IWWR; Dr. Vanessa Harriman, DUC-IWWR/BOR

The Western Boreal Forest is changing rapidly due to industrial development. Implications of these changes for waterfowl are unknown. In this study, we are assessing potential effects of roads, pipelines, and seismic lines on waterfowl settling and productivity in the Boreal Plains using aerial surveys. This information is critical to guiding DUC conservation in the boreal forest.

*DOES FOREST HARVESTING APPROXIMATE THE EFFECTS OF WILDFIRE FOR BOREAL-NESTING DUCKS?

Mark Bidwell (PhD student) & Dr. Bob Clark, Univ. of Saskatchewan; Dr. Vanessa Harriman, DUC-IWWR/BOR; Dr. Stuart Slattery, DUC-IWWR

Understanding the degree to which industrial disturbance approximates the effects of natural disturbance in the boreal forest is critical for focusing on the most important disturbances there. This study uses aerial surveys to investigate whether forest harvest emulates effects of fire on duck pair settling and productivity, hence whether conservation action is required.

**WATERFOWL NEST SUCCESS IN THE WESTERN BOREAL FOREST: DOES INDUSTRIAL DEVELOPMENT ALTER PREDATION?

Matt Dyson (PhD student) & Dr. Brad Fedy, Univ. of Waterloo; Dr. Stuart Slattery, DUC-IWWR

Understanding how important industrial activities affect waterfowl in the boreal forest is critical for developing the right conservation actions. This project will help us learn how industrial disturbance influences where waterfowl choose to nest and tests the assumption that linear features reduced nest success by fragmenting the landscape.

* DENOTES A STUDENT-LED PROJECT

** DENOTES A DU FELLOWSHIP STUDENT-LED PROJECT



DU CANADA — BOREAL (CONTINUED)

FOREST MANAGEMENT AND WETLAND STEWARDSHIP INITIATIVE: BEST PRACTICES FOR WETLAND CONSERVATION IN WORKING FORESTS

DU Canada (BOR), Alberta-Pacific Forest Industries Inc., Canfor, the Forest Products Association of Canada (FPAC), Millar Western Forest Products Ltd., Tolko Industries Ltd., West Fraser, and Weyerhaeuser Company

This science-based initiative was formed to advance wetland stewardship in the boreal forest through sustainable forest management. The goal is to develop tools that forest practitioners can use when working in and around wetlands and waterfowl. Main objectives included assessing and mitigating risk of forestry planning and operational practices on waterfowl, their nests and eggs (incidental take) and developing guiding principles for wetland stewardship and forest management based on interpretation of existing knowledge.

ALBERTA HIGH RESOLUTION WETLAND INVENTORY METHODOLOGY DEVELOPMENT FOR BOREAL AND PRAIRIE LANDSCAPES

Michael Merchant, DUC-BOR; Lyle Boychuk, DUC-SK; Dr. Craig Mahoney, GOA; Emily Jones, Univ. of Lethbridge; Dr. Chris Hopkinson, Univ. of Lethbridge

The goal of this project was to improve our wetland mapping capabilities in boreal and prairie regions while meeting the minimum mapping standards (e.g. accuracy, minimum mapping unit, and class) soon to be released by the Government of Alberta (GoA). The work assessed several novel, high-resolution remote sensing datasets, many of which DUC has not had access to in the past. In particular, this project assessed the mapping capabilities of airborne LiDAR data which was distributed to DUC by the GoA. The results of this project were promising, and has helped position DUC as a leader in provincial wetland mapping.

WETLAND STATUS, CHANGE, AND SEASONAL INUNDATION DYNAMICS FOR ASSESSING THE VULNERABILITY OF WATERFOWL HABITAT WITHIN THE ARCTIC BOREAL VULNERABILITY EXPERIMENT REGION

Michael Merchant & Kevin Smith, DUC-BOR; Dr. Vanessa Harriman, DUC- IWWR/BOR; Dr. Stuart Slattery, DUC-IWWR; Michael Battaglia, Liza Jenkins, Dr. Laura Bourgeau-Chavez & Dr. Nancy French, Michigan Tech Research Institute; Dr. Jennifer Baltzer, Wilfrid Laurier Univ.; Dr. Bruce Chapman, NASA; Dr. Chris Spence, ECCC

This collaboration under the auspices of NASA's Arctic Boreal Vulnerability Experiment (ABoVE) is assessing the utility of newly developed wetland mapping technology to predict changes in boreal waterfowl distributions through space and time. This information may ultimately improve our decision-making around spatial allocation of conservation resources.

HIGH LATITUDE WETLAND DETECTION USING MULTI-DATE AND MULTI-SENSOR EARTH OBSERVATION DATA: A CASE STUDY IN THE NORTHWEST TERRITORIES

Michael Merchant, Rebecca Warren & Rebecca Edwards, DUC-BOR; Claudia Haas, GNWT.

The extent and type of wetlands in Canada's northern regions remains poorly understood, particularly because a comprehensive wetland inventory does not exist. This project helps fill this gap, whereby DUC analysts developed habitat maps of the Dinàgà Wek'èhodi region in the Northwest Territories. This project is a continuation of DUC's efforts to develop a wall-to-wall inventory of the territory and has also helped advance DUC's operational wetland mapping capabilities in the north, via the assessment of machine-learning algorithms and novel remotely sensed datasets (e.g. ArcticDEM).

PROTECTED AREAS GAP ANALYSIS—CONSERVATION AREAS, CARIBOU, & MULTI-SPECIES PLANNING

Lindsay McBlane & Alain Richard, DUC- BOR; Elston Dzus, Sandra Cardinal, Jacob Handel, & Tom Habib, Alberta-Pacific Forest Industries Inc.; Kevin Gillis, Mistik Management Ltd., Kecia Kerr, Ryan Cheng, & Gord Vaadeland, Canadian Parks and Wilderness Society

This project uses GIS modeling to assess how well current protected areas network in northeast Alberta and northwest Saskatchewan represent features of conservation interest, including waterfowl abundance. The goal is to recommend an expanded, more representative network of conservation areas throughout the region, meet forestry certification goals, and contribute towards the Canadian Federal Government's protected areas goals. In so doing, DUC will use this multi-stakeholder project to leverage waterfowl and wetlands conservation.

IMPROVING WATERFOWL HABITAT CONSERVATION IN A MANAGED FOREST. A CASE STUDY ON THE BLACK SPRUCE FOREST MANAGEMENT AREA

Michael Merchant, Darrell Kovacz, Dr. Marcel Darveau, & Al Richard, DUC- BOR; Resolute Forest Products; Dave Thomson, Thomson Environmental; Al Harris, Northern Bioscience; Keith Hautala, Confederation College; Dr. Ashley Thomson, Lakehead University

This collaborative project will improve tools used by forest managers by converting standard forestry maps to DUC's Enhanced Wetland Classification System, and then identifying key waterfowl habitats. The result will be more accurate inclusion of waterfowl needs in ongoing planning and operational decisions on a 13,700 km² (5,290 mi²) forest management area.

DU CANADA – PRAIRIES

CLASSIFYING PRAIRIE WETLAND PERMANENCE USING REMOTE SENSING

Lyle Boychuk, DUC-SK; Dr. Lauren Bortolotti, DUC-IWWR

Prairie wetlands range from being inundated with water for only a few days a year to being permanently flooded, with this permanence affecting wetland suitability as duck habitat and other ecosystem services. This project uses remote sensing methods to classify wetland vegetation communities and is developing a statistical model to predict wetland permanence based on wetland size and vegetation community composition.

FROM WINTERING TO BREEDING—UNDERSTANDING THE IMPORTANCE OF MIGRATORY AND BREEDING HABITAT SELECTION FOR NORTHERN PINTAILS ACROSS NORTH AMERICA

Dr. James Devries, DUC-IWWR; Dr. Bob Clark, ECCC; Dr. Bart Ballard, Texas A&M Univ.

During 2019, this pilot project evaluated the utility of GPS-GSM tags attached to pintail females during winter for identifying subsequent characteristics of breeding sites at both landscape and nest scales. If GPS-GSM tags provide unbiased estimates of habitat selection, this research will provide valuable information on pintail breeding effort and success, nest site habitat selection, landscape-level habitat selection, and cross-seasonal effects on pintail breeding effort. This information will aid in the delivery of habitat conservation efforts for pintails in prairie Canada.

CHANGES IN CLIMATE AND LAND-USE INTERACT TO CREATE AN ECOLOGICAL TRAP IN A MIGRATORY SPECIES (NORTHERN PINTAIL)

Dr. Frances Buderman, Pennsylvania State Univ.; Dr. David Koons, Colorado State Univ.; Dr. James Devries, DUC-IWWR

This project used data from the annual breeding waterfowl survey in the PPR (1955-2011), and climate and land use datasets, to identify an ecological trap for pintails. This study has furthered our understanding of how and where increasing amounts of cropland have impacted pintail reproductive success in prairie Canada. This information can be used to identify regions where conservation efforts will have the most impact on population trajectory.



PRAIRIE CONSERVATION PLANNING “COST TOOL” DEVELOPMENT

Dr. James Devries, Llewellyn Armstrong & Susan Witherly, DUC-IWWR; Dr. David Howerter, DUC-HO; Paul Thoroughgood, DUC-SK; Cynthia Edwards, DUC; various other DUC staff

Developed from many years of field research, the “Cost Tool” incorporates information on waterfowl nest habitat selection and success with costs of habitat conservation to provide a decision support tool predicting return on investment (cost per hatched nest) for all 16mi² grids in prairie Canada. This planning product provides a powerful tool for mapping the relative return on investment of various conservation actions across prairie Canada and is being used by DUC to guide conservation investment decisions.

LAND-USE CHANGE INCREASES CLIMATIC VULNERABILITY OF MIGRATORY BIRDS: INSIGHTS FROM INTEGRATED POPULATION MODELLING

Dr. Qing Zhao (Post doc) & Dr. Mitch Weegman, Univ. of Missouri; Dr. Todd Arnold, Univ. of Minnesota; Dr. James Devries, DUC-IWWR; Dr. Dave Howerter, DUC-HO; Dr. Bob Clark, ECCC

Understanding how land-use change and climatic variability have interacted to affect the population trajectory of northern pintails is an outstanding need to guide conservation of this iconic species. This project examined data on trends in land use and annual wetness on breeding grounds (1961–2014) along with concurrent band recovery survival and banding age-ratio recruitment estimates in an integrated population model to elucidate potential causal relationships.

UNDERSTANDING WETLAND CARBON, NITROGEN, AND PHOSPHORUS SEQUESTRATION POTENTIAL IN AGRICULTURAL LANDSCAPES

Dr. Irena Creed, Univ. of Saskatchewan; Dr. Tim Moore & Dr. Christian von Sperber, McGill Univ.; Dr. Pascal Badiou, DUC-IWWR; Dr. David Lobb, Univ. of Manitoba

Understanding the benefits of waterfowl habitat to society is important for expanding support for conservation. This project focused on how wetlands in agricultural landscapes capture carbon, nitrogen, and phosphorus and improve quality of downstream waters. Monitoring and research efforts focus on vulnerable agricultural landscapes in Alberta, Manitoba, and Ontario.

PRAIRIE ECOSYSTEM SERVICES PROJECT: QUANTIFYING THE CONTRIBUTION OF WETLANDS IN LIVESTOCK PRODUCTION LANDSCAPES TO CLIMATE CHANGE MITIGATION

Dr. Pascal Badiou & Dr. Lauren Bortolotti, DUC-IWWR; Dr. Sara Knox, Univ. of British Columbia; Dr. Aaron Glenn, AAFC; Dr. Kim Ominski, Univ. of Manitoba; and others from AAFC and Univ. of Manitoba

This project will focus on wetlands embedded in grazing lands and cropped fields to understand how land use affects wetland greenhouse gas emissions and carbon sequestration. Information from this project will determine the degree to which wetlands in agricultural landscapes contribute to natural climate solutions and how to manage these systems to maximize benefits.

SEMI-NATURAL LANDSCAPE FEATURES AS BENEFICIAL INSECT RESERVOIRS: ARTHROPOD PREDATOR COMMUNITY COMPOSITION IN PRAIRIE POTHOLE LANDSCAPES

Dr. Paul Galpern, Univ. of Calgary; Dr. James Devries, DUC-IWWR

This project is quantifying the value of wetlands in croplands to pollinating and beneficial insects that may provide value to farmers through improved crop pollination and pest control. Researchers are measuring the abundance and diversity of insects at varying distances from the wetland into the adjacent cropland in prairie agroecosystems of southern Alberta. Understanding the value of wetlands in providing these important ecosystem services to producers provides valuable information supporting the retention of wetland habitat in prairie agroecosystems.

QUANTIFYING TERRESTRIAL ARTHROPOD BIODIVERSITY ALONG A CHRONOSEQUENCE OF WETLAND RESTORATION

Dr. Paul Galpern, Univ. of Calgary; Dr. James Devries, DUC-IWWR

While prairie wetlands are known as biodiversity hotspots for birds, amphibians, and mammals, less is known about the arthropod diversity these habitats support, especially for restored wetlands. In this study, researchers are sampling the community composition of bees, beetles, flies, spiders and harvestmen under wetland retention and restoration scenarios. Information gathered on arthropod biodiversity will be used in DUC communication and policy efforts aimed at protecting and retaining wetlands in prairie agroecosystems.





ASSOCIATION OF LANDSCAPE COMPLEXITY AND CROP YIELDS IN ALBERTA

Dr. Paul Galpern, Univ. of Calgary; Dr. James Devries, DUC-IWWR

The amount of non-cropland landcovers within agroecosystems is expected to increase crop yields given remaining semi-natural habitats support many species of birds and insects that help control crop pests. This project gathered crop yield data from crop-growing districts throughout Alberta and related crop yield to the amount of non-cropland habitat remaining within each district to reveal a measurable positive impact on yield. This information provides further incentive for producers to maintain wetlands and remnant semi-natural habitats on their lands.

*DIVERSITY AND ABUNDANCE OF BEES IN CANADIAN PRAIRIE AGROECOSYSTEMS: UNDERSTANDING THE ROLE OF REMNANT AND RESTORED HABITAT IN SUPPORTING NATIVE BEE POPULATIONS

Samantha Morrice (MSc student), Univ. of Saskatchewan; Dr. James Devries, DUC-IWWR; Dr. Sean Prager, Univ. of Saskatchewan

This project is examining the diversity and abundance of native bees associated with wetlands and field edges in croplands and grasslands in the parkland agroecosystem of central Saskatchewan. Quantifying the abundance and diversity of these species provides valuable information on the potential of remnant semi-natural habitats to provide pollination services in prairie agroecosystems. Quantifying ecosystem services provided by wetlands and other habitats supports DUC communication and policy efforts to conserve these important habitats.

PRAIRIE WATER: ENHANCING RESILIENCE FOR PRAIRIE COMMUNITIES

Dr. Chris Spence, ECCC; Jared Wolfe & Dr. Emily Cavaliere, Univ. of Saskatchewan; Dr. Bob Clark, ECCC; Dr. Lauren Bortolotti & Dr. James Devries, DUC-IWWR; Dr. Vanessa Harriman, DUC-IWWR/BOR; and others from ECCC and Birds Canada

Understanding the combined effects of wetland drainage and climate change is key to planning the amount and type of conservation delivery needed to sustain waterfowl populations into the future. This project uses the Cold Regions Hydrologic Model to quantify how these forces will affect waterfowl abundance and broader bird biodiversity.

THE VALUE OF WETLANDS AND REMNANT LANDSCAPES FOR SUSTAINABILITY IN CANADIAN AGRICULTURE

Ian Glass, Dr. James Devries, & Dr. Pascal Badiou, DUC-IWWR

A literature review of the value of wetlands and remnant natural and semi-natural habitats to agriculture in North America. This effort was conducted at the request of several of DUC's agricultural industry partners interested in understanding the value to agriculture obtained from maintaining wetlands and other non-cropland habitat in agroecosystems. Increasing support from the agricultural industry for including wetland and remaining habitats as part of their sustainable agricultural practice is intended to support DUC conservation efforts.

DOES PROXIMITY TO ROADS AFFECT PAIR DENSITY OF CANVASBACKS AND REDHEADS?

Dr. Michael Anderson & Llewellyn Armstrong, DUC-IWWR

Many waterfowl surveys in the PPR were established along grid roads, generally spaced a mile apart, where indicated pairs were typically counted 0.25 mi to either side of the roadway. A necessary assumption when extrapolating such estimates to larger landscapes is that roads do not bias results and produce inaccurate estimates of population size. This project is using data collected near Minnedosa, MB in 1983-1990, to evaluate whether numbers of canvasback and redhead pairs and broods counted along grid roads are representative of entire landscapes.



DU CANADA – PRAIRIES (CONTINUED)

SHIFTING FROM SPRING WHEAT TO WINTER WHEAT: A POTENTIAL CONSERVATION STRATEGY FOR GRASSLAND SONGBIRDS IN CULTIVATED LANDSCAPES?

Dr. Stephen Davis, CWS; Dr. David Kirk, Aquila Conservation and Environment Consulting; Llwellyn Armstrong & Dr. James Devries, DUC-IWWR; Dr. Ryan Fisher, Univ. of Regina

DUC research has previously shown that winter wheat has high productivity for nesting waterfowl, but it is not known if the characteristics that make it productive for waterfowl translate into benefits for other birds species. To answer this question, point-count surveys were conducted in fields of winter wheat, spring wheat, summer fallow, planted grassland and native grassland to determine 1) the relative benefits of winter wheat to songbirds, 2) the extent to which cropland suitability changes over the breeding season, and 3) the extent to which the surrounding landscape influences songbird abundance. This information is needed to provide a broader understanding of winter wheat as an environmentally sustainable agricultural practice.

DELTA MARSH RESTORING THE TRADITION—WATERFOWL RESPONSE

Dr. Lauren Bortolotti, Dr. Dale Wrubleski, Bob Emery, Paige Kowal & Llwellyn Armstrong, DUC-IWWR; Dr. Vanessa Harriman, DUC-IWWR/BOR; Dr. Michael Anteau, USGS; Frank Baldwin, ECCC; Cameron Meuckon, Government of Manitoba

This study uses a multi-pronged approach to assess the response of waterfowl to the restoration of Delta Marsh. It leverages historical waterfowl and submersed aquatic vegetation surveys and new data on waterfowl abundance, vegetation response, waterfowl distribution within the marsh, and nutrient acquisition by diving ducks to provide a holistic evaluation of the success of the restoration and value of the marsh as habitat for migratory waterfowl.

DELTA MARSH RESTORING THE TRADITION—FISHERIES RESPONSE

Dr. Dale Wrubleski, Bob Emery, Paige Kowal, & Llwellyn Armstrong, DUC-IWWR; Doug Watkinson, Dr. Amanda Caskenette, DFO

A ten-year research and monitoring program was undertaken to determine how temporary exclusion screens could be used to exclude invasive common carp while minimizing impacts to the native fish assemblage at Delta Marsh. A combination of sampling methods was used to study changes in the fish assemblage pre- and post-exclusion, and inside and outside the carp exclusion zone in the marsh. This information is essential for assessing how the exclusion of carp to restore Delta Marsh is affecting other fish species.

DELTA MARSH RESTORING THE TRADITION—FISHERIES METHODS

Dr. Amanda Caskenette, Dr. Eva Enders, Ricky Di Rocco, & Doug Watkinson, DFO; Dr. Dale Wrubleski, Bob Emery, Paige Kowal, DUC-IWWR

Fisheries monitoring for the Delta Marsh restoration project provided an opportunity to work with Canadian federal government staff to develop or improve fish sampling methods for large wetlands. This project is the first to develop fish length-width relationships that will be useful for selecting screen size for fish passage or exclusion projects where only length data is available. This study also determined methods for correcting gillnet selectivity bias in a habitat in which gillnets are not commonly used. This project is also likely the first to use trail cameras to monitor fish movement under different environmental conditions at common carp exclusion structures.



*STABLE ISOTOPE MASS BALANCE MIXING MODELS TO QUANTIFY INDIVIDUAL DELTA MARSH WATER BALANCE COMPONENT CONTRIBUTIONS

Marija Glavonjic (MSc student), Dr. Tricia Stadnyk, & Dr. Shawn Clark, Univ. of Manitoba

The objective of this study is to better understand where water in Delta Marsh comes from (e.g. agricultural run-off, direct precipitation, ground water, Lake Manitoba, etc.). Stable water isotopes will be used with weather data, water level data and potential outputs (water flux) from a new hydrologic model. This information will verify recently developed hydrologic models for the marsh and the role of the surrounding watershed on water inputs. This information will then be combined with nutrient data to model nutrient loading to the marsh.

APPLYING A GENE-SUITE APPROACH TO EXAMINE THE PHYSIOLOGICAL STATUS OF WILD-CAUGHT WALLEYE

Dr. Jennifer Jeffrey (Post doc), Hunter Carlson, Jason Treberg, & Dr. Ken Jeffries – Univ. of Manitoba; Dr. Eva Enders, DFO; Dr. Dale Wrubleski, DUC-IWWR

A non-lethal technique was used to determine the physiological condition of large walleye held in Delta Marsh during the summer months by the common carp exclusion screens developed by DUC and partners to restore duck habitat. Gill tissue samples were analyzed for the expression of genes linked to heat stress and anaerobic metabolism. The longer fish were held in the marsh, the more apparent was the expression of these genes. Based on this information, the temporary exclusion screens are being lifted earlier in the summer to reduce stress to fish held in the marsh.

*HISTORICAL LOADING AND CURRENT SORPTION CAPACITY OF PHOSPHORUS IN THE SEDIMENTS OF DELTA MARSH

Chris Hope (MSc student) & Dr. Gordon Goldsborough, Univ. of Manitoba; Dr. Pascal Badiou, DUC-IWWR

This study examined the sediments of Delta Marsh to determine their historic rates of phosphorus accumulation and their current ability to bind phosphorus. This information tells us how nutrient levels in the marsh have changed over time and whether current surface sediments help reduce water-borne nutrients. Results indicate that although the marsh sediments continue to remove phosphorus, they cannot match inputs, and so the increasing levels of phosphorus in the marsh place it at risk for algal blooms on the west side.

EFFECTS OF LANDSCAPE COMPOSITION AND CLIMATE ON DUCK NEST SUCCESS IN THE CANADIAN PRAIRIES

Dr. Lauren Bortolotti, Bob Emery, & Llewellyn Armstrong, DUC-IWWR; Dr. David Howerter, DUC-HO

This study gathered data from over 5,000 upland-nesting duck nests over 9 years, spanning gradients of landscape composition, climate, and waterfowl density in the Canadian Prairies. Results will improve our understanding of factors limiting prairie ducks and the long-term capability of prairie landscapes to support waterfowl to refine conservation planning.

*INFLUENCE OF WETLAND PESTICIDE POLLUTION ON WATERFOWL DISTRIBUTION, ABUNDANCE AND PRODUCTIVITY IN THE PRAIRIE POTHOLE REGION

Tyler Bryan (MSc student), Univ. of Saskatchewan; Dr. Christy Morrissey, Univ. of Saskatchewan; Dr. James Devries, DUC-IWWR

This project examines the hypothesis that waterfowl presence, abundance and composition will decrease in relation to increasing rate of pesticide pollution because of impacts on aquatic invertebrate communities. Understanding the relationship between incidence of pesticide pollution and changes in the waterfowl community using prairie potholes will help DUC engage the agricultural industry and landowners in adopting environmentally sustainable agricultural practices.

LINKING LANDSCAPE-SCALE CONSERVATION TO REGIONAL AND CONTINENTAL OUTCOMES FOR A MIGRATORY SPECIES (NORTHERN PINTAIL)

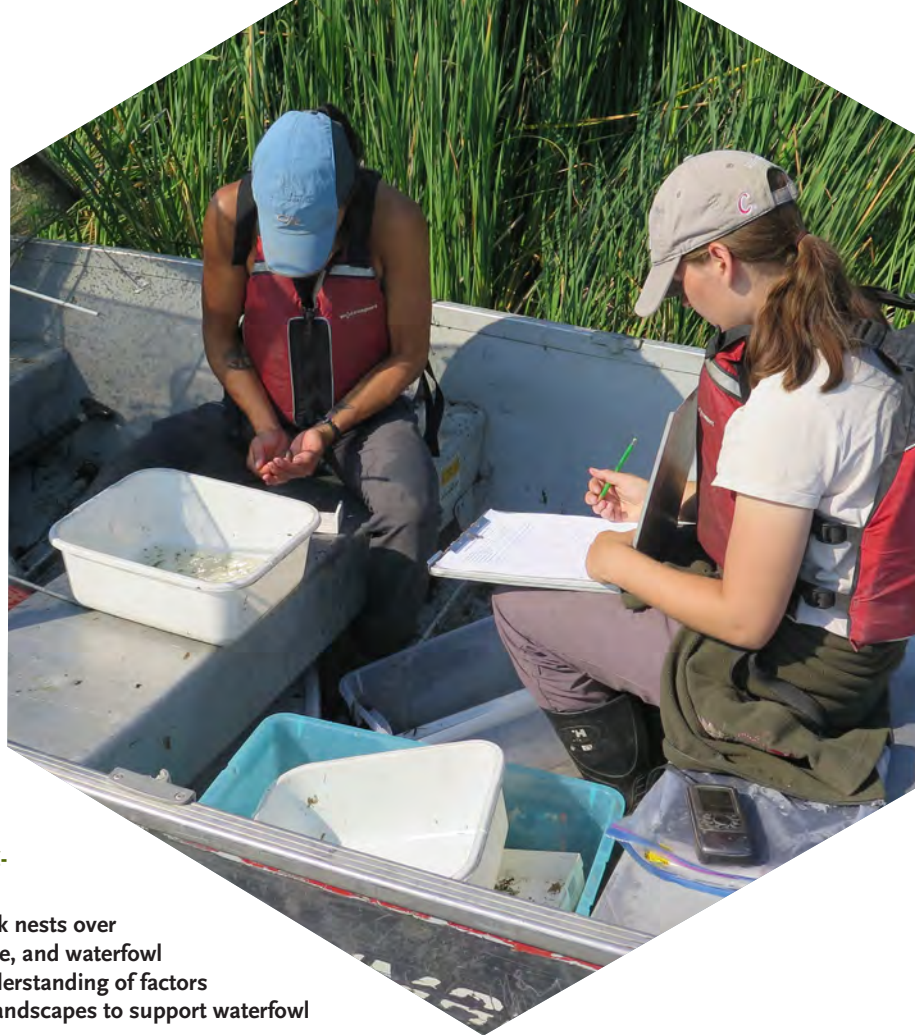
Dr. Brady Mattsson, Univ. of Natural Resources and Life Sciences, Austria; Dr. James Devries, DUC-IWWR; Dr. Jim Dubovsky, USFWS; Dr. Darius Semmens, USGS; Dr. Wayne Thogmartin, USGS; Dr. Jonathan Derbridge & Dr. Laura Lopez-Hoffman, Univ. of Arizona

Quantifying the impact of regional conservation program delivery and population response has always been problematic given the complexity of scaling response from individuals to populations. This project linked regional models of pintail habitat selection and reproductive success to a continental model of pintail population dynamics to elucidate the influence of habitat conservation actions on population trajectory. Linking regional conservation activity to continental population response provides a powerful tool to understand the impact of various conservation alternatives.

SOURCES AND DYNAMICS OF INTERNATIONAL FUNDING FOR WATERFOWL CONSERVATION IN THE PRAIRIE POTHOLE REGION OF NORTH AMERICA.

Dr. Brady Mattsson, Univ. of Natural Resources and Life Sciences, Austria; Dr. James Devries, DUC-IWWR; Dr. Jim Dubovsky, USFWS; Dr. Darius Semmens, USGS; Dr. Wayne Thogmartin, USGS; Dr. Jonathan Derbridge & Dr. Laura Lopez-Hoffman, Univ. of Arizona

International funding for waterfowl conservation in the Prairie Pothole Region (PPR) of North America is multi-faceted and complex. This analysis provides a detailed look at the sources and trends in various conservation funding streams into the US and Canadian PPR during 2007-2016. Understanding these flows provides a basis for their future management and stewardship.



DU CANADA — CENTRAL CANADA

*CONSERVATION AND MANAGEMENT OF WATERFOWL AND OTHER AQUATIC BREEDING HABITATS UNDER CLIMATE CHANGE IN EASTERN CANADA

Antoine Adde (PhD student), Clara Casabona i Amat (MSc student), Alexandra Gélinas (MSc student), Dr. Roberto Quezada Garcia (Postdoc), Dr. Steve Cumming, Dr. Nancy Gélinas, & Dr. Marc Mazerolle, Univ. Laval; Dr. Marcel Darveau, DUC-BOR; Dr. Diana Stralberg, BAM-Univ of Alberta; Travis Logan, Ouranos; Christine Lepage, ECCC

This multifaceted project investigates potential effects of climate change on eastern Canadian breeding waterfowl and cranes, specifically researching: (1) Where will climatic refuges for eastern waterfowl occur, (2) How might we adapt forest management to ensure persistence of black ducks, (3) What is the colonisation pattern of the Sandhill Crane, a species rapidly expanding to Quebec and damaging crops, and (4) Developing a socio-economic approach to evaluate scenarios of adaptation of waterfowl management to climate change.

SUSTAINABLE MANAGEMENT OF LAKE SAINT-PIERRE: MULTI-DISCIPLINARY CENTRE OF EXPERTISE

Gilbert Cabana, Raphaël Proulx, Julie Ruiz, & Stéphane Campeau, UQTR; Valérie Gravel & Philippe Séguin, Univ. of McGill; Monique Poulin, Lota Tamini, & Anne Vanasse, Univ. Laval; Bernard Fillion, DUC-QC

The Quebec government established a multidisciplinary center of expertise in sustainable management of the Lake Saint-Pierre floodplain in 2018. The mandate of this Centre is to propose a science-based intervention strategy favoring establishment of sustainable agriculture that is adapted to and respectful of the ecosystem of Lake Saint-Pierre. This effort will advance waterfowl conservation by reducing habitat impacts of traditional agriculture and supporting restoration of priority environments.

*QUANTIFYING THE VALUE AND RISK OF RESTORING WETLAND HABITATS IN AGRICULTURAL LANDSCAPES

Dr. Sarah French (Post doc) & Dr. Rebecca Rooney, Univ. of Waterloo; Dr. Dale Wrubleski & Dr. James Devries, DUC-IWWR; David McLachlin, DUC-ON

This project is assessing how the invertebrates, wildlife and water quality of restored wetlands are influenced by surrounding land use and cover. Special attention is focused on land use effects on pesticide loading. This information will help DUC understand impacts of land use adjacent to our projects, especially those receiving surface water runoff from agricultural lands.

IMPLEMENTING BIOLOGICAL CONTROL OF INTRODUCED PHRAGMITES AUSTRALIS IN ONTARIO

Dr. Michael McTavish (Postdoctoral Research Fellow), Smith Forest Health Lab and AAFC; Dr. Rob Bouchier, AAFC; Dr. Sandy Smith, Univ. of Toronto; Erling Armson, DUC-ON

Introduced *Phragmites australis* (common reed) is considered one of the most invasive plants in North America, displacing native species and threatening wetland biodiversity. Mechanical and chemical management have proved costly and ineffective for larger populations. As an alternative, nearly 20 years of research has identified the stem-boring noctuid moths as suitable biocontrol agents, and a petition for their release in Canada has recently been approved. This project is part of a larger initiative that will determine the impact of the stem-boring noctuid moths on introduced and native *Phragmites* and survival of the moths at all life stages.

DETERMINING THE NUTRIENT RETENTION CAPACITY OF NEWLY RESTORED WETLANDS IN SOUTHWESTERN ONTARIO

Bryan Page, Dr. Pascal Badiou, & Shane Gabor, DUC-IWWR; Owen Steele, DUC-ON

Restored wetlands have been identified as natural infrastructure with the potential to reduce phosphorus loads entering streams and rivers across the working landscape of southwestern Ontario and ultimately reduce phosphorus loading to Lake Erie. This project studied restored edge-of-field wetlands to determine their ability to remove nutrients from agricultural runoff. Results indicate that restored wetlands can effectively reduce nonpoint source nutrients entering Lake Erie. This information will help DUC promote restoration of small wetlands in Ontario.





***EFFECTS OF POND TYPE AND HUMAN DISTURBANCES ON BREEDING OCCUPANCY AND NESTING SUCCESS OF THE WATERFOWL IN THE ABITIBI CLAY BELT**

Émilie Desjardins (MSc student), Mariano Feldman (PhD student), Dr. Louis Imbeau, Dr. Nicole Fenton, & Dr. Philippe Marchand, UQAT; Dr. Marcel Darveau, DUC-BOR; Dr. Marc Mazerolle, Univ Laval

We are assessing the use of natural and mining tailing ponds by waterfowl in the southern and northern boreal landscapes of the Abitibi Clay Belt. Results will help evaluate core assumptions of DUC's Eastern Boreal program and improve BDJV population models.

***NETWORK ANALYSIS OF UMBRELLA AND INDICATOR SPECIES: ASSESSING THE INTEGRITY OF NORTHERN ECOSYSTEMS**

Alexandre Terrigeol (PhD student) & Dr. Daniel Fortin, Univ. Laval; Dr. Marcel Darveau, DUC-BOR; Dr. Christian Hébert, NRCan

This project assesses consequences of human development and global change on bird communities in the taiga of Ontario and Québec, and will identify indicator species of ecosystem integrity under climate change that could be used in future conservation and monitoring efforts.

***INTEGRATING SUSTAINABLE FOREST MANAGEMENT OBJECTIVES TO CONSERVE WETLAND/RIPARIAN HABITATS IN QUÉBEC**

Diego Farina (BSc student), Gabrielle Filteau (MSc student), Chanèle Poirier (MSc student), Jonathan Ricard (MSc student), & Jérôme Cimon-Morin, Univ. Laval; Dr. Marcel Darveau, DUC-BOR; Louis Imbeau, UQAT; Geneviève Labrecque & Marie-Ève Sigouin, Rayonier A.M. Canada S.E.N.C.

This project aims to improve wetland/riparian management in Quebec by improving wetland mapping, riparian zone delineation, road network design to minimize wetland crossings, and the contribution of large forest retention patches for conserving riparian zones. This information will influence voluntary forest certification schemes and new provincial regulations, benefitting waterfowl habitats at the landscape scale.

DU CANADA – ATLANTIC

ANNUAL MOVEMENT PATTERNS OF AMERICAN COMMON EIDERS (SOMATERIA MOLLISSIMA DRESSERI)

Dr. Mark Mallory & Molly Tomlik, Acadia Univ.; Dr. Rob Ronconi, ECCC; Brad Allen, State of Maine; Chris Dwyer, USFWS; Stéphane Lair, CCWHC; Dr. Conor Mallory, Gov. of Nunavut; Nic McLellan, DUC-ATL/IWWR; Randy Milton & Glen Parsons, Prov. of NS; Lucas Savoy, BRI

This project combines satellite telemetry data for 46 American common eiders from three regions in the southern part of their breeding range and investigates annual movement patterns. As a sub-species with growing population concerns, this work allows a better understanding of threats faced by identifying key locations and migratory corridors.

ESTIMATING POPULATION GROWTH AND RECRUITMENT RATES OF AMERICAN COMMON EIDER

Dr. Jean-François Giroux & Martin Patenaude-Monette, Univ. du Québec à Montréal; Randy Milton, Prov. of NS; Scott Gilliland, CWS; Nic McLellan, DUC-ATL/IWWR

This project uses banding data from female American common eiders throughout their range to estimate population growth and recruitment rates. This project helps identify regions where there are declines and where conservation efforts should be focused.

*APPLICATION OF PALEOLIMNOLOGICAL TOOLS FOR ASSESSING THE TRANSFER OF MARINE-DERIVED NUTRIENTS TO FRESH WATER SYSTEMS, NOVA SCOTIA, CANADA: FOCUS ON ALOSA PSEUDOHARENGUS WITHIN THE GASPEREAU LAKE WATERSHED

Lauren Muzak Ruff (MSc student), Dr. Ian Spooner, & Mark Mallory, Acadia Univ.; Nic McLellan, DUC-ATL/IWWR

This project explores the use of paleolimnology to detect historic changes in marine-derived nutrients transferred into freshwater ecosystems that contain potential barriers (hydroelectric dams) to fish passage. The transfer of marine nutrients is important in coastal ecosystems and this project will help elucidate the importance of fish passage to wetland project management.

ASSESSING AND IMPROVING ALEWIFE FISH PASSAGE AT DUC FISHWAYS IN ATLANTIC CANADA

Dr. Mike Stokesbury & Dr. Aaron Spares, Acadia Univ.; Dr. Mike van den Heuvel & Dr. Sean Landsman (PhD student), Univ. of Prince Edward Island; Nic McLellan, DUC ATL/IWWR; Jonathan Platts, DUC-ATL

This long-term project uses PIT tagging technology to assess and improve passage efficiency of migratory fish species, including alewife, rainbow smelt and brook trout at DUC wetlands with fishways in coastal habitat of Atlantic Canada. This improved connectivity should increase the health and productivity of both freshwater and marine environments.

*DETECTING AND QUANTIFYING MARINE-DERIVED NUTRIENTS TRANSFERRED BY ALEWIFE

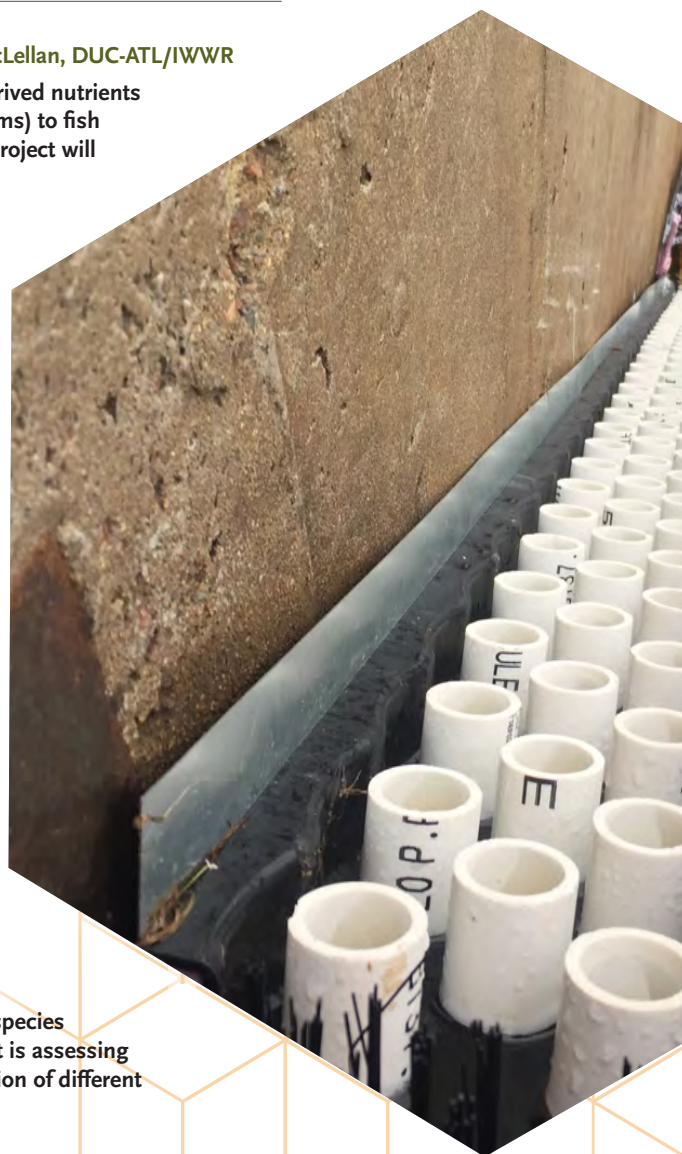
Jill Hunt (MSc student) & Dr. Mike Stokesbury, Acadia Univ.; Nic McLellan, DUC-ATL/IWWR

This project uses stable isotope analyses to detect marine-derived nutrients in freshwater ecosystems during alewife migration. It also quantifies nutrient inputs by individual alewife, enabling estimation of total nutrient input during a spawning migration. This project also allows us to relate improved fish passage to wetland productivity.

*ASSESSING AND IMPROVING AMERICAN EEL PASSAGE AT DUC WATER CONTROL STRUCTURES

Brandon Nilsen (MSc student) & Dr. Mike Stokesbury, Acadia Univ.; Nic McLellan, DUC-ATL/IWWR

DUC manages water control structures in coastal areas where young American eels, a species of growing conservation concern, migrate to freshwater habitats to mature. This project is assessing and improving American eel passage at DUC water control structures with the installation of different enhancement structures (e.g. ramps).



A MANAGED REALIGNMENT IN THE UPPER BAY OF FUNDY: COMMUNITY DYNAMICS DURING SALT MARSH RESTORATION OVER 8 YEARS IN A MEGATIDAL, ICE-INFLUENCED ENVIRONMENT

Spencer Virgin, Allen Beck, Laura K. Boone, Allison K. Dykstra, & Dr. Myriam Barbeau, Univ. of New Brunswick; Dr. Jeff Ollerhead, Mount Allison Univ.; Nic McLellan, DUC-ATL/IWWR

This project investigates the ecological and physical processes of salt marsh restoration in a unique environment. The successful restoration of salt marsh provides an important buffer from the tide to a dyke system protecting human infrastructure at risk of sea level rise. Additionally, because of historic loss of salt marsh in the Bay of Fundy, the importance of this habitat for waterfowl, and the other ecological benefits it provides, salt marsh restoration is a conservation priority for DUC.

*AQUATIC INVERTEBRATES AS INDICATORS FOR ECOSYSTEM SENESENCE OF WETLAND IMPOUNDMENTS IN THE UPPER BAY OF FUNDY

Jacob Demers (MSc student), Dr. Josh Kurek, & Dr. Dave Leiske, Mount Allison Univ.; Dr. Al Hanson, CWS; Nic McLellan, DUC-ATL/IWWR

This project explores the aquatic invertebrate communities of DUC wetland impoundments in relation to age and water chemistry parameters. This work will improve understanding and management related decisions to maintaining long-term productivity of wetlands.

*EFFECTS OF COMMERCIAL FOREST HARVESTING ON THE DISTRIBUTION OF THE AMERICAN BLACK DUCK (ANAS RUBRIPES) DURING THE BREEDING PERIOD IN NEW BRUNSWICK, CANADA

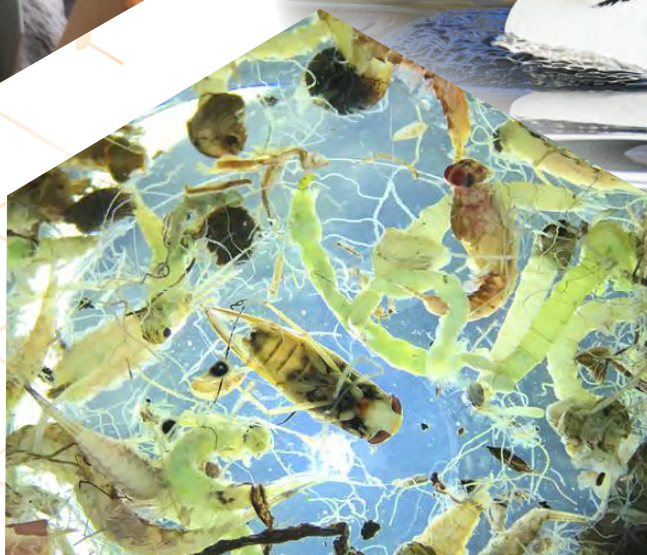
Kelly McLean (MSc student) & Dr. Joe Nocera, Univ. of New Brunswick; Nic McLellan, DUC-ATL/IWWR; Bruce Pollard, CWS

There are growing concerns over potential impacts of long-term, large-scale commercial forestry in New Brunswick. This project used GIS analyses to explore commercial forest harvest and the distribution of breeding American black ducks over time. It also investigated potential edge effects from forestry practices and nest predation, as well as relationships among the distribution of American black duck broods and forest management. This project will help inform future waterfowl management and conservation efforts in forested environments.

*NESTING HABITAT USE AND AVAILABILITY FOR CAVITY-NESTING DUCKS IN THE LOWER SAINT JOHN RIVER FLOODPLAIN, NEW BRUNSWICK

Heidi Harding (MSc student) & Dr. Joe Nocera, Univ. of New Brunswick; Nic McLellan, DUC-ATL/IWWR

There is evidence that common goldeneye have experienced regional population declines in New Brunswick, and some have attributed this to a decline in natural cavity availability. This project investigates whether natural cavity availability has changed over time along the lower St. John River, the regional impact of a long-term nest box program, and whether site characteristics can inform cavity or nest box usage by waterfowl species. This information will help inform nest box programs and conservation for cavity nesting waterfowl.



DUCKS UNLIMITED DE MÉXICO

SEAGRASS STUDY IN THE LAGUNA MADRE DE TAMAULIPAS

Dr. Leonardo Arellano & Dr. Arturo Mora, Tamaulipas State Univ.

In 1996 DUMAC and the Tamaulipas State University conducted the first seagrass biomass study at Laguna Madre Tamaulipas. In 2019, the study was replicated to determine contemporary shoalgrass biomass, a critical food resource for redheads, and compare to earlier findings from the 1970s. This information will help determine trends in seagrasses and guide development of policies at state and federal levels to conserve this important habitat for migratory and resident waterfowl species.

WETLANDS INVENTORY AND CLASSIFICATION IN MEXICO

Eduardo Carrera, Gabriela de la Fuente, Norma Rangel, & Diana Sánchez, DUMAC-NHQ

The lack of a wetlands inventory in Mexico and associated data related to wetland characteristics and extent motivated DUMAC to initiate in 1991 the Mexico National Wetlands Inventory and Classification. Since then, DUMAC has been working regionally to complete what represents the first wetlands inventory to include all Nearctic and Neotropical wetland types in Mexico. Completed in 2020, this information will be available through a web-based map server for all institutions and agencies to support their wetlands conservation initiatives in Mexico.

COASTAL DIGITAL CHANGE DETECTION ANALYSIS IN SINALOA AND SONORA

Gabriela de la Fuente, Eduardo Carrera, Carlos Salinas, & Norma Rangel, DUMAC-NHQ

Coastal wetlands along the upper Pacific coast (UPC) of Mexico support 38% of migratory waterfowl wintering in Mexico. Prior to 1987, the most important threats for these coastal wetlands was agricultural expansion and resulting runoff of agrochemicals and fertilizers, causing the uncontrolled growth of cattail at important intertidal areas for waterfowl and shorebirds. After 1987, intensive shrimp farming began in Sinaloa and Sonora and became the primary cause of the loss and degradation of mangrove forests in this region. This study, initiated in 2016, measured the amount and distribution of mangrove forest loss due to shrimp farm growth. This information will serve as a visual tool to show local and federal authorities the damages of the shrimp farm industry to mangrove forests within the coastal wetlands ecosystems of the UPC. These wetlands provide the most important habitat for migratory waterfowl in this region, while supporting a great diversity of other waterbirds, wildlife, and fisheries. These findings will help inform public policy to guide the management, restoration, and conservation of these important habitats.

WATERFOWL SURVEYS OF MEXICO: A MULTI-ORGANIZATIONAL COLLABORATION

Metropolitan Univ.; Biopicture A.C.; Birds.mx; National Commission of Natural Protected Areas; Biodiversity Conservation of Central Mexico, A.C.; Municipality of Almoloya de Juárez; Mexico State Univ.; Chihuahua State Government; Chihuahua Municipality Government; ITZAMNA, A.C.; Aguascalientes Environmental Movement, A.C.; Wildlife Management Unit at Chiconahuapan Lagoon and Los Golodrinós, ASOCIES, A.C.; PROFAUNA; Secretary of Urban Development and Environment of Yucatan; Secretary of Environment and Territorial Planning of the State of Guanajuato; Secretary of Environment and Natural Resources of the States of Mexico, Durango and Zacatecas; Black Forest A.C.; Secretary of Environment and Territorial Development of Durango, Society for Research and Use of Wildlife; Forest and Wildlife Services; Morelos State Univ.; Sinaloa State Univ.; Zacatecas State Univ.; Queretaro State Univ., Michoacán State Univ.; U.S. Fish and Wildlife Service; and DUMAC.

Effective conservation and management of migratory waterfowl populations requires an understanding of their ecology and distribution throughout the annual range. In recognition of this, the U.S. Fish and Wildlife Service began collaborating with Mexican biologists in 1937 to conduct aerial surveys of the distribution of wintering waterfowl across major wetland complexes in Mexico. Resource constraints and logistical considerations became increasingly challenging in the early 2000s, ultimately leading to discontinuation of the survey after 2006. DUMAC is using a diverse coalition of partners to renew the Mexico mid-winter waterfowl surveys, thus providing a critical data stream for understanding contemporary trends in waterfowl populations and guiding conservation efforts in Mexico. DUMAC has been working with current and retired USFWS biologists for the aerial surveys and train pilots and observers following the protocols used in the original mid-winter waterfowl surveys. The renewed survey was flown annually during January 2018-2020, providing a foundation from which to resume Mexico mid-winter waterfowl surveys.





SHOREBIRD SURVEYS OF MEXICO: A MULTI-ORGANIZATIONAL COLLABORATION

Alberto Lafon, PROFAUNA; José Juan Flores, ASTERESI, AC; Héctor Garza, Tamaulipas St. Univ.; Ignacio González, Alina Olalla & Adrian Varela, Nuevo Leon St. Univ.; Hugo Corzo, Veracruz St. Univ.; Cesar Tejeda, UNICACH; Juan Manuel Koller & Stefan Louis Arriaga, Tabasco St. Univ.; Jorge Correa, ECOSUR; Juan Chablé, Yucatan St. Univ.; Javier Sosa, CEGES; Jesús Vargas, Campeche St. Univ.; Moisés Rosas, José Hernández, Edwin Chay, Rene Kantun, Cristobal Cáceres & César Romero, National Commission of Natural Protected Areas; Alejandro Meléndez, Metropolitan Univ.; Ruben Pineda, Queretaro St. Univ.; Tiberio Monterrubio, Michoacan St. Univ.; Fernando Urbina, Morelos St. Univ.; Lucía B. Ramírez, Chiapas St. Univ.; Miguel Angel Díaz & Manuel Macias, Secretariat of Environment and Natural Resources; Jonathan Hiley, York Univ.; Mario Marín, Erika Maldonado & Antonio Martínez, Sinaloa State Government; Humberto Almanza & Salvador Hernández, Univ. of Guadalajara; Mireya Carrillo & Mateo Ruíz, ECOSUR; Eduardo Carrera, Gabriela de la Fuente, David Colón, DUMAC-NHQ; Jorge Cerón and David Canul, DUMAC-SERO; Aurea Estrada, DUMAC- CRO

After the conclusion in 2006 of the National Strategy for the Conservation and Management of Shorebirds, which followed similar documents developed for Canada and the USA, it became clear that the limited data on shorebirds in Mexico hindered effective prioritization and conservation of the most important wetlands for this group of birds. In response, DUMAC collaborated with professionals from partner organizations and universities to design and conduct a national shorebird survey for Mexico between 2010 and 2017. The survey was divided into 3 regions: Gulf Coast, Pacific Coast, and Northern and Central Highlands. The data gathered was used to help update the National Strategy and identify the most important areas for shorebirds in Mexico. This information will support management decisions and help focus additional resources and conservation efforts on priority habitats shared with migratory waterfowl.

DU FELLOWSHIP SUPPORT

*HABITAT SELECTION BY BREEDING SCOTERS IN THE BOREAL FOREST OF THE NORTHWEST TERRITORIES

Moriah Tanguay (MSc student) & Dr. Kirsty Gurney, Univ. of Saskatchewan

North American breeding populations of scoters, which breed predominantly in the rapidly changing boreal forest, remain below historical levels, yet habitat needs for these sea ducks remain poorly documented. To help predict impacts of ongoing environmental change in northern areas and prioritize key habitats for conservation of these species, this research will identify wetland and landscape characteristics that predict breeding scoter abundance and examine the relative importance of foraging and nesting habitat for wetland selection by scoters.

*EVALUATING THE PHYSIOLOGICAL RESPONSE OF SUB-LETHAL INFECTIONS OF SPHAERIDIOTREMA SPP. AND CYATHOCOTYLE BUSHIENSIS TREMATODES IN CAPTIVE LESSER SCAUP

Cheyenne Beach (MSc student) & Dr. Christopher Jacques, Western Illinois Univ.

Since 1998, tens of thousands of lesser scaup have died while migrating through the Upper Midwest, owing to trematode infections which occur when scaup consume invasive faucet snails, the intermediate host of the trematodes. This research seeks to address gaps in our understanding of the physiological response of scaup to sub-lethal trematode infections, thus improving our knowledge of factors potentially contributing to scaup population declines.

*SPATIOTEMPORAL VARIATION IN MALLARD DEMOGRAPHIC RATES

Madeleine Lohman (PhD student) & Dr. Perry Williams, Univ. of Nevada, Reno

Population dynamics and distributions of waterfowl shift over time and space. Elucidating the mechanisms behind these changes will enable us to better predict the effects of environmental change. This study involves the development and implementation of mathematical models to assess the effects of precipitation and land use on survival, harvest mortality, and fecundity for mallards in the Prairie Pothole Region from 1961–2015. These models will help inform how and where to direct management efforts in light of changing climate and land use.

*INVESTIGATING THE POST-FLEDGING MOVEMENT AND ECOLOGY OF HATCH-YEAR MALLARDS IN THE DAKOTAS

Cynthia Anchor (MSc student), South Dakota St. Univ.; Dr. Joshua Stafford, South Dakota St. Univ. and USGS South Dakota Coop. Fish and Wildl. Research Unit; Dr. Aaron Pearse, USGS Northern Prairie Wildl. Research Center

During the post-fledging period, young mallards are learning new skills, exploring their environment, and preparing for migration. Although some studies suggest that their behavior may be different than adults at this time, this remains a relatively understudied aspect of waterfowl ecology. This research uses GPS telemetry to study behaviors, movements, and migration patterns of post-fledging mallards in the PPR. These data will help identify the potential influence of habitat characteristics, hunting disturbance, fall territory prospecting, and weather on local, regional, and migratory movements.

*A MULTI-SPECIES ANALYSIS OF LANDSCAPE EFFECTS ON INDIVIDUAL DECISION-MAKING AND FITNESS IN WETLAND-DEPENDENT MIGRATORY SHOREBIRDS

Sarah Clements (PhD student) & Dr. Mitch Weegman, Univ. of Missouri

Migratory species are affected by habitat and climate over broad geographic ranges, and it can be difficult to monitor individuals and populations over a full annual cycle. This project is using GPS-acceleration tracking devices to make inferences about habitat use and productivity of shorebirds without needing to resight or recapture the marked individuals. Tracking three wetland-dependent shorebird species (American avocet, black-bellied plover, Hudsonian godwit), ranging from short- to long-distance migrants, this project will provide information on habitats used by this group of migratory birds and how its quality may influence survival and productivity.



***SEED-BASED WETLAND RESTORATION FOLLOWING PHRAGMITES REMOVAL:
HARNESSING SEED TRAITS AND SYSTEMS MODELING TO REESTABLISH LOST AVIAN
HABITAT**

Emily Tarsa (PhD student) & Dr. Karin Kettenring, Utah St. Univ.

One of the greatest threats to wetland conservation and waterfowl habitats across North America is the invasion of *Phragmites australis*. Recent research highlighted effective control strategies for *Phragmites*, but natural recolonization of native plants needed to support waterfowl habitat has been limited. This research is focusing on how to effectively revegetate wetlands following *Phragmites* removal by identifying functional traits that drive seed and seedling life stage transitions for native species.

***PRODUCTIVITY OF BREEDING WATERFOWL ON WORKING LANDS IN A FLOOD-
IRRIGATED SYSTEM**

Casey Setash (PhD student) & Dr. David Koons, Colorado St. Univ.

In the Intermountain West, effective water management is essential for both agricultural production and waterfowl habitat, and is more pressing than ever due to drought, climate change, and growing human demands for water. This project is evaluating waterfowl production (nest survival, nest density, duck abundance) before and after irrigation infrastructure improvements in the North Platte Basin of Colorado. Results from this study will be used to inform best management practices benefitting both agricultural producers and waterfowl managers.

***RELATING PREDATOR COMMUNITY COMPOSITION AND DUCK NEST SURVIVAL IN EASTERN SOUTH DAKOTA**

Samantha Fino (PhD student), South Dakota St. Univ.; Dr. Joshua Stafford, South Dakota St. Univ. and USGS South Dakota Coop. Fish and Wildl. Research Unit; Dr. Aaron Pearse, USGS Northern Prairie Wildl. Research Center

Grasslands are an important but diminishing habitat for waterfowl, and grassland losses likely influence the dynamics of nest predation. This research is examining predator movements and duck nest success as related to characteristics of grassland patches. The goal is to help identify factors that lead to reduced predator use and higher nest success. Results of this study will provide a better understanding of how grassland characteristics influence predators and will assist conservation organizations in developing habitat-patch-size recommendations that benefit waterfowl productivity.





DUCKS UNLIMITED AT THE 2019 NORTH AMERICAN DUCK SYMPOSIUM

Once every 3 years, waterfowl scientists and managers assemble at the North American Duck Symposium to share and discuss the latest scientific findings on waterfowl ecology, habitat conservation, and population management. The preeminent conference for waterfowl conservationists in North America, the 8th Duck Symposium was held August 2019 in Winnipeg, Manitoba. Ducks Unlimited Canada co-hosted the conference, and staff had key roles on the organizing committee and were responsible for numerous preparatory, hosting, and post conference duties. In addition, DUC IWWR staff, accounting, IT, marketing and communications, and Oak Hammock Marsh Interpretive Centre staff made vital contributions to a successful conference. As a family of organizations, Ducks Unlimited was well-represented at the Symposium in both attendance and presentations.



DUCKS UNLIMITED INC.

- 30 DUI staff attended.
- DUI staff were lead or co-authors on 20 oral and 8 poster presentations.
- DUI staff delivered 8 general session presentations.
- DUI staff delivered 3 plenary presentations:
 - T. Moorman, M. Brasher, D. Humburg, et al. – Nonbreeding distribution dynamics of waterfowl: are patterns changing in the 21st Century
 - D. James and E. Herbert – Advancing waterfowl conservation through ecosystem services
 - D. Humburg et al. – Waterfowl hunting and harvest: perceptions, reality, and somewhere in between
- DUI-supported research accounted for an additional 5 oral and 5 poster presentations.

DUCKS UNLIMITED CANADA

- 40 DUC staff attended.
- DUC staff were lead or co-authors on 26 oral and 7 poster presentations.
- DUC staff delivered 8 general session presentations.
- DUC staff delivered 4 plenary presentations:
 - D. Howerter, M. Brasher, and M. Anderson – Closing thoughts: building momentum through adaptive learning
 - P. Badiou – Why losing waterfowl habitat is a concern for all
 - B. Page – Implementing a standardized wetland monitoring protocol to assess the nutrient retention capacity of newly restored wetlands in southwestern Ontario
 - L. Bortolotti, J. Devries, P. Badiou, et al. – Impact of climate change on wetland density and waterfowl production in prairie Canada
- DUC and fellowship-supported research accounted for an additional 12 oral and 4 poster presentations.

DUCKS UNLIMITED SCIENCE AND PLANNING CONTACTS

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OUR MISSION

Ducks Unlimited conserves, restores and manages wetlands and associated habitats for North America's waterfowl. These habitats also benefit other wildlife and people.