



**RESEARCH AND  
EDUCATION**  
2024 STATUS UPDATE



# Advancing Waterfowl Management Through Science

Delta delves into issues affecting waterfowl and waterfowl hunters

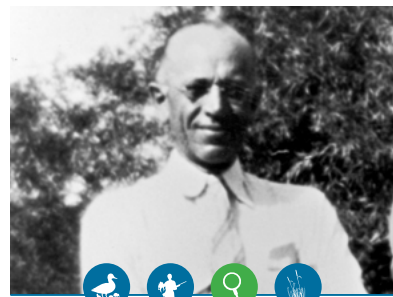
Delta Waterfowl has always believed waterfowl management decisions should be rooted in sound science. This principle has been central to Delta's ethos since H. Albert Hochbaum assumed the role of the organization's first science director in 1938 at Manitoba's Delta Marsh. Over the years, Delta has remained dedicated to conducting critical research on waterfowl throughout North America. Our strategic focus enables the organization to delve into enduring, long-term concerns and emerging issues affecting ducks and duck hunters.

Research serves as a cornerstone for all four of our pillars, including Duck Production, Habitat Conservation, HunteR3, and Research and Education,

while also guiding waterfowl management decisions throughout the continent. Ultimately, all of Delta's research projects align with the organization's overarching mission: to produce ducks and secure the future of duck hunting.

This special report shines a spotlight on our 2024 Research and Education program. As always, please don't hesitate to reach out to me to delve deeper into any of Delta's research endeavors. I'm happy to provide more detailed information on any of the studies summarized in these pages.

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**DELTA WATERFOWL'S LEGACY OF LEADING-EDGE SCIENCE DATES TO THE 1930S, WHEN ALDO LEOPOLD VISITED MANITOBA'S DELTA MARSH.**

This report reflects research design and logistics by Delta Waterfowl staff including J. Brice, J. Bushaw, M. Buxton, M. Chouinard, C. Nicolai, and F. Rohwer.

### 📍 Lower Mississippi Flyway Dabbler Tracking

Determining duck locations during hunting seasons and migration

Daniel Oden, M.S. student, and Dr. Douglas Osborne, University of Arkansas Division of Agriculture

Delta Waterfowl seeks to better understand the migration and wintering ground habits of dabbling ducks in the Mississippi Flyway to determine whether further management strategies are needed.

Employing backpack transmitters powered by miniature solar panels, Delta and the University of Arkansas at Monticello installed backpack-style radios on mallards, green-winged teal, and American wigeon to record movements from 2019 to 2022. Ducks were caught during or after the 2019-2020 and 2020-2021 hunting seasons in Arkansas, and in September 2021 in South Dakota.

Our goals are to understand when and where these ducks migrate, particularly


in the fall, as well as how they respond to hunting pressure and weather events. Oden is focusing on describing the preferred habitats of each species in winter.

### 📍 Strategic Placement of Hen Houses

Using a suite of collected data to optimize Hen House placement and predict usage rates

Evan Yunker, M.S. student and Dr. Bruce Dugger, Oregon State University

Delta has gathered several decades of data about the placement and usage rates of thousands of Hen Houses. A retrospective analysis will use these extensive long-term data to help inform the optimal placement of Hen Houses that maximize mallard hen occupancy and success. These already collected variables include age of the location and structure itself, density of surrounding Hen Houses, wetland conditions and size, breeding-duck pair densities, distance from road, and placement direction. The results will be used to maximize the efficacy of the successful Hen House program by installing future Hen Houses in the very best locations.

  
**DELTA WATERFOWL'S RESEARCH AND EDUCATION PROGRAM HAS RESULTED IN MORE THAN 950 PEER-REVIEWED STUDIES**

### 📍 Duck Harvest, Survival, and Sex Ratios

Understanding the mechanisms behind changing waterfowl sex ratios

Laura Wallace, M.S. student and Dr. Thomas Riecke, University of Montana

Studies conducted nearly a century ago by Aldo Leopold described a sex ratio in ducks that favored males, and more recent research has indicated that this disparity has continued and increased. Although hunters often specifically target males during the hunting season, females face substantially greater natural risks than males during the breeding season due to the costs of egg production and the risks of incubating a nest and raising a brood. This causes lower overall survival rates for females relative to males, and over the past 20 years, hen survival seems to have further decreased. This has led to sex ratios of even more drakes per hen in several dabbling duck populations breeding in the prairie pothole region. Wallace's work will explore the mechanisms behind these changes, which promises to better inform the monitoring and management of key PPR-nesting species.

### 📍 Spatiotemporal Variation in Duck Demographic Rates

How environmental change influences duck population dynamics

Madeleine Lohman, PH.D student, and Dr. Perry Williams, University OF Nevada-Reno

Waterfowl monitoring has created one of the few extensive multi-species, longitudinal, individual-based data sets in the world. Using these data, Lohman will investigate spatiotemporal variation in demographic rates of dabbling ducks







in the prairie pothole region to help shed new light on the basic biology and conservation needs of widely distributed wildlife populations. This work will focus on spatiotemporal variation in demographic rates, including survival, harvest mortality, and fecundity, and comparing this variation across multiple dabbling duck species. In doing so, it will also examine the responses of these species to changing environmental conditions.

### **🔍 Analyzing Canvasback Production in Relation to Predators, Parasitism, and Local Landscapes**

**What's driving long-term declines in canvasback productivity in southwest Manitoba?**

Michael K. Johnson, PH.D. candidate and Dr. David Koons, Colorado State University

Johnson is working tirelessly to boost canvasbacks, spending multiple field seasons near Minnedosa, Manitoba, in search of the causes of—and solution to—the birds' declining production. The fate of over-water nests depends on the extent of numerous competing pressures that dynamically vary year to year. Canvasback nesting data will be

### **DELTA HAS TRAINED MORE THAN 600 MASTER'S AND DOCTORAL STUDENTS, INCLUDING SOME OF TODAY'S FOREMOST WATERFOWL BIOLOGISTS**

used to assess the impacts of predation and parasitism, simultaneously, on production for two time periods (1983-1990 and 2016-2021) in a local breeding population of canvasbacks. Additionally, Johnson will link the influence of these mechanisms to local habitat variables so that targeted efforts to benefit canvasback production incorporate these considerations into wetland conservation programs.

### **🔍 Identification of Redhead and Canvasback Eggs**

**Using genetics to improve visual identification**

Michael K. Johnson, PH.D. candidate and Dr. David Koons, Colorado State University

Redhead and canvasback eggs are typically quite different in appearance, but characterizing some individual eggs by these species can be problematic.

This is important when we consider that redheads frequently lay their eggs in canvasback nests, resulting in a mixed-species nest of eggs. Biologists have used a number of characteristics, like egg color and texture, in the past to assign eggs to either species. However, this method has never been tested for accuracy. Johnson will collect a number of unhatched eggs and use these visual methods to assign them to either species. He will then use genetics to confirm how accurate this method is.

### **🔍 Graduate Student Retention Survey**

**Gaining an understanding of limitations for trained waterfowl graduate students to stay in the profession**

Dr. Chris Nicolai and Joel Brice, Delta Waterfowl; Dr. Mike Brasher and Diane Eggeman, Ducks Unlimited; Shaun Oldenburger, Texas Parks and Wildlife Department

In concert with the North American Waterfowl Management Plan NAWPEP committee, we designed a series of surveys to gain understanding of factors that limit retention of trained waterfowl graduate students. Over 40



questions were prepared, and in Year 1, we surveyed 881 students who began graduate school studying waterfowl, as identified by professors, theses/dissertations, and presentations at professional meetings. The large number of questions are broad and include a suite of personal and professional topics that may inform limiting factors. Preliminary analyses suggest that the “ability to make a difference” and have “positive professional relationships” are important predictors of waterfowl student retention.

### 📍 Evaluating Styles of Radio Attachments

**An assessment of radio attachment methods to understand transmitter impacts on mallards**

Kelsie Huss, PH.D student, Dr. Karen Machin and Dr. Mitch Weegman, University of Saskatchewan; Blake Bartzan, Canadian Wildlife Service; Paul Link, Louisiana Department of Wildlife and Fisheries; Dr. Matt Dyson, Ducks Unlimited Canada; Dr. Chris Nicolai, Delta Waterfowl

Radios have been used for decades to understand the movements, harvest rates, survival, and a number of other demographic rates for ducks. An underlying assumption is that the

attachment of radios does not bias these demographic rates. Several studies have shown subtle or detrimental effects of different attachment methods. Begun in 2022, Delta will again attach 75 radios on female mallards caught in Manitoba, North Dakota and South Dakota in late summer. The goal is to use 25 radios for each of the four following attachment methods: 1-strap backpacks, 2-strap backpacks, implants, and sub-dermal. We will also compare these data to standard leg-mounted geolocators and standard leg-banded ducks in an overall contemporary assessment of attachment style.

### 📍 Saskatchewan Nest and Brood Success

**Development of a rapid duckling production assessment tool for upland-nesting ducks in Saskatchewan**

Grant Rhodes, PH.D candidate and Dr. Kevin Ringelman, Louisiana State University; Hannah Sabatier, M.S. student and Dr. Ben Sedinger, University of Wisconsin-Stevens Point

Dr. Chris Nicolai, Delta Waterfowl Delta has expanded its Predator Management research in Saskatchewan, and we are now developing projects

to further assess the effectiveness of our trapping efforts in this additional jurisdiction. This project will expand beyond monitoring nest success to simultaneously measure brood survival and the total number of ducklings produced across three trapped and three non-trapped study blocks. The use of drones, VHF radios/receivers, and “nasal saddles” attached to incubating hens are allowing us to explore new techniques to measure demographic rates that have traditionally been very difficult to measure. The hope is to use new technology to provide new methods to monitor brood production following management actions.

### 📍 Habitat Variables, Predation, and Nest Success

**How does habitat selection influence predation events and nest survival?**

Grant Rhodes, PH.D candidate and Dr. Kevin Ringelman, Louisiana State University; Hannah Sabatier, M.S. student and Dr. Ben Sedinger, University of Wisconsin-Stevens Point

The level of influence that predators have on duck nest success in a particular area is complex, difficult to measure, and influenced by numerous variables. For example, the quality of the grassland





habitat, and whether it's fragmented or expansive, may cause predation pressure to vary over time. We are exploring these habitat variables further in areas with differing predator densities by measuring nest success on three trapped and three non-trapped blocks in Saskatchewan. Breeding habitat selection may also influence where nests are initiated. Historically, the prairie pothole region offered expansive grasslands to breeding ducks, but the modern landscape is likely forcing paired ducks to select lower quality habitat with poorer outcomes for nest survival. Since predation is the leading cause of duck nest failure, it is our goal to fine tune our understanding of how habitat influences predation and ultimately, duck production.

### **📍 California Hen Houses**

**Testing the success of Hen Houses in the Intermountain West**

Evan Yunker, M.S. student and Dr. Bruce Dugger, Oregon State University

Hen Houses have shown great success in other parts of North America, but a thorough assessment of their success has not been studied in the Intermountain West's wetlands. In 2023, Yunker installed and monitored 200 Hen Houses in three regions of California on federal, state, and private wetlands. He will continue to monitor their use in 2024. Additionally, he will collect data on potential reasons why their success may vary from prairie-installed Hen Houses.

### **📍 Manitoba Canvasback Brood Survival**

**Using drones to monitor canvasback broods; Evaluating the impact of Predator Management on canvasback brood survival using marked hens and drone technology**

Rich Cain, M.S. student and Dr. Kevin Ringelman, Louisiana State University

Canvasback populations are being limited by lagging production. Therefore, improving nest success and brood survival is of paramount importance to waterfowl managers and duck hunters. However, multiple years of Predator Management research in the Minnedosa, Manitoba, region—a prime location for breeding canvasbacks—have netted mixed results for canvasback nest success.

Much more promisingly, however, the number of canvasback broods have proven consistently higher in areas where Predator Management techniques are applied, suggesting a latent effect not captured by traditional nest monitoring. This is quite encouraging because the abundance and survival of broods are ultimately the determinants of how many juvenile canvasbacks fly south in the fall.

Until recently, studying brood abundance and survival was extraordinarily difficult, because broods are difficult to detect and identify across surveys. However, Delta's third generation drones equipped with multi-spectral cameras have finally made the research of brood ecology feasible at scale.

So, this drone setup will be used to study canvasback brood abundance

when Predator Management is applied on active and control sites. We will mark individual, brood-attending hens with nasal saddles, which will allow broods to be tracked and identified, while also enhancing our understanding of detection rates across different periods during the breeding season. Additionally, this data will extend our long-term dataset on canvasback pair counts and nest survival at Minnedosa.

### **📍 Hot Spot Trapping in Various Grass Densities to Improve Dabbler Production**

**Comparing the impact of a new Predator Management technique on dabbler nest success when it's applied in abundant versus sparse upland nesting habitat**

Jack Johnson, M.S. student and Dr. Ben Sedinger of University of Wisconsin-Stevens Point

Some duck nest monitoring studies show a positive relationship between nest success and the amount of grass on the landscape. Given this information, Delta has traditionally focused Predator Management efforts in areas with high densities of breeding ducks and low densities of nesting cover—where we felt we could most efficiently boost production of mallards, pintails, and gadwalls. However, some areas with high breeding duck densities and relatively abundant grass are still showing low nest success rates, below the threshold required for ducks just to “break even” and prevent population decline.

So, if there's high breeding duck densities and good grass cover, are

predators so severely overabundant in these areas that even quality habitat can't turn the tide? And could Predator Management be a boon for duck production in these areas by giving breeding ducks a fighting chance?

In 2024 we will initiate an assessment of nest success in South Dakota on Predator Management sites and control sites, both of which will offer varying availabilities of upland nesting cover. This project will begin with a pilot year in 2024 and expand to a full-scale project in 2025 and 2026.

### 📍 Predator Management in Parkland Alberta

**A contemporary assessment of the assessment of mesopredators on duck nest success**

Professor and graduate student TBD

Southern Alberta has always been a critical region for breeding waterfowl. However, while its mix of prairie and parkland habitat once had high wetland densities and large expanses of grass nesting cover, the modern landscape looks much different due to agriculture. While Alberta still has the mega predators such as brown bears and wolves in the mountains, meso-predators such as striped skunks, raccoons, and ravens have thrived on the agriculture dominated parkland and prairies to enhanced population sizes and even expanding their ranges into areas where they didn't formerly exist.

This research project seeks to provide a contemporary assessment of the impacts of meso-predators on duck nest success in all-important Alberta. We will accomplish this by collecting information on nest success across three 25 square-mile sites where Predator Management trapping is applied and comparing these results to three 25-square-mile control sites.

A pilot study begun by Delta staff during the 2024 nesting season will be advanced by a graduate student and professor in 2025 and 2026.

### 📍 Using Stable Isotopes to Identify Duck Origins

**Establishing origins of Atlantic Flyway dabbling duck harvest using stable isotope and banding vector techniques**

Graduate student TBD and Dr. Michael Schummer, State University of New York College of Environmental Science and Forestry

Breeding densities of waterfowl in eastern Canada are low but may contribute to Atlantic Flyway harvest more than detected by annual surveys or banding. Portions of northern Quebec are potentially under-represented in breeding population surveys. Breeding waterfowl from eastern Canada may contribute to waterfowl harvest in the Atlantic Flyway, however current methodologies provide little information on abundances that may originate from these areas. Additionally, population estimates and variances in abundance for gadwalls and wigeon are not reported for eastern North America in the annual U.S. Fish and Wildlife Service Waterfowl Status Report. Banding data also are limited for these species in eastern Canada because it is logistically infeasible to capture and mark individuals across such a vast inaccessible region.

We aim to use stable isotope analysis informed by winter banding data to estimate relative origins of green-winged teal, gadwalls, and wigeon across their breeding range, including the PPR. Previously, Fleming et al. (2022) used this methodology to estimate percentages and origins of lesser and greater scaup that winter along the Atlantic coast.

Our analysis will provide novel information not otherwise available through traditional survey and banding methods and reflect the relative contributions of the PPR vs. eastern Canada to harvest of these species by Atlantic Flyway state hunters.

### 📍 Monitoring of Wood Duck Box Program

**Establishing Wood Duck Recruitment in Delaware and Maryland**

Blake Struthers, M.S. student and Dr. Chris Williams, University of Delaware

Struthers will work on comparing nesting chronology, nest-box selection, and recruitment for nesting wood ducks in Maryland and Delaware. He will focus on micro-habitat factors that female wood ducks use to evaluate and select nest boxes and how this relates to recruitment.

Other components of the project include investigating the size and symmetry of female wood ducks' white eye patches to determine if the wood duck densities associated with habitat types are potentially affecting stress and nest success. Lastly, Struthers will attach GPS transmitters on female wood ducks and radio-marked ducklings to monitor movement trends, habitat selection, and survival rates.

### 📍 Blue-winged Teal Survival During the Non-breeding Period

**Studying the effects of habitat selection and factors influencing migration**

Jeffrey Edwards, M.S. student and Dr. Lisa Webb, University of Missouri; and Dr. Drew Fowler, Louisiana State University

Most blue-winged teal research has been focused on the breeding grounds, leaving substantial information gaps related to the non-breeding period of the annual cycle, including distribution, habitat use, and linking survival to environmental factors and individual decision making.

Using movement data from approximately 350 blue-winged teal, Edwards will use an integrated step selection to link wetland inundation and habitat selection to blue-winged teal survival throughout the non-breeding season. He will also examine what factors may be influencing blue-winged teal migration using discrete choice modeling to test the hypothesis that blue-winged teal migrations are driven primarily by the daylight cycle.



# SCHOLARSHIPS

## DAVE ANKNEY AND SANDI JOHNSON WATERFOWL AND WETLANDS GRADUATE RESEARCH SCHOLARSHIP

**2023**

Caroline Blommel, M.S. student and Dr. Dave Koons, Colorado State University

Blommel is analyzing long-term mark-recapture and harvest data (1990-2021) to estimate the joint impact of harvest and seasonal climate change on the demographic rates of black brant that breed on the Yukon Kuskokwim Delta.

Blommel will develop custom multi-event models in a Bayesian framework to estimate annual cause-specific mortality and breeding propensity of brant, as well as the effect seasonal climate change-driven processes have had on these vital rates. Multi-event models allow for some uncertainty in the assignment of breeding status to estimate annual breeding propensity more accurately, while also allowing for the discernment of harvest and non-harvest mortality.

Blommel's research will provide valuable insight into how the brant population will be jointly impacted by climate change and harvest and could

help inform anticipatory management decisions to compensate for the demographic impact of climate change.

Jeffrey Edwards, M.S. student and Dr. Lisa Webb, University of Missouri; and Dr. Drew Fowler, Louisiana State University— See Delta research projects on Page 8.

**2021**

Mike Johnson, PH.D student and Dr. Dave Koons, Colorado State University — See Delta research projects on Page 4.

Jordan Thompson, M.S. student and Dr. Ben Sedinger, University of Wisconsin-Stevens Point

Thompson has spent the past few summers studying emperor geese in southwest Alaska on the waterfowl rich Yukon Kuskokwim Delta.

Sport and subsistence harvests of emperor geese in Alaska were closed in the mid 1980s following greater than 50 percent population declines between the mid-1960s and mid-1980s. However, after a gradual population increase spanning 30 years, subsistence harvest

and a limited sport harvest season were reopened in 2017. Maintaining the recently opened harvest season requires that the emperor goose population remains above the harvestable threshold set forth by managers.

Thompson will assess nest survival models and analyze them in a Bayesian framework to test for drivers of annual and individual variation, compare characteristics of used nest sites and associated randomly determined sites, and she will construct a multistate capture-mark-recapture model to predict the probability of an emperor goose returning to within 200 meters of its nest site in the previous year.

## JOHN DALE SCHOLARSHIP

**2022**

Hunter Veltkamp, M.S. student, University of Minnesota – See completed thesis on Page 10.

Blake Struthers, M.S. student and Dr. Chris Williams, University of Delaware – See Delta research project Page 8.

**2023**

Jeffrey Edwards, M.S. student, University of Missouri – See Delta research project on Page 8, under Ankney/Johnson Scholarship.

Kelsie Huss, PH.D student, University of Saskatchewan – See Delta research projects on Page 5.

**2024**

Laura Wallace, M.S. student and Dr. Thomas Riecke, University of Montana – See Delta research projects on Page 2.





## THESES AND DISSERTATIONS

- Byrne, M. 2023. Demographic response to mercury levels in wood ducks. Thesis, University of Nevada Reno.
- Coffield, H. 2021. Effect of contract attribute levels on willingness to participate in a Working Wetland Program. Thesis, North Dakota State University.
- Davis, M. 2022. Comparison and Evaluation of Simple Chain and Cable-chain Upland Nest Searching Techniques on Predator Trapped and Non-trapped Sites. Thesis, Brandon University.
- Harvey, K. 2022. Geographic origins and genetics of pre-hunting season banded mallards in the northern Atlantic and Mississippi flyways. Thesis, University of New York.
- Kucia, S. 2021. Investigation of eastern mallard breeding metrics. Thesis, State University of New York.
- Neufeld, L. 2021. Comparing migration ecology among geographically distinct populations of Canada Geese (*Branta canadensis*) and Cackling Geese (*Branta hutchinsii*). Thesis, University of Manitoba.
- Phelps, S. D. 2023. Moon Illumination Influences Fine-scale Movements of Dabbling Ducks Wintering in the Mississippi Alluvial Valley. Thesis, University of Arkansas Monticello.
- Rohrer, T. 2021. Effects of predator management and parasitism on over-water nesting diving duck production in southwestern Manitoba. Thesis, South Dakota State University.
- Stander, R. 2023. The use of drones and thermal camera imaging technology for avian nest searching. Thesis, University of Manitoba.
- Stedman, R. 2024. Habitat selection of American Black Ducks and Mallards during winter on eastern Long Island, NY and spring migration in the northeastern US and eastern Canada. Thesis, State University of New York.
- Terry, C. 2021. Duck brood density in relation to invertebrate abundance in agriculture wetlands in the mid-continent prairies. Thesis, Louisiana State University.
- VeltKamp, H. 2024. Estimating Observer Detection Probability and Flushing Probability of Upland Nesting Ducks. Thesis, University of Minnesota.

# PUBLICATIONS

- Bushaw, J.**, C. Terry, K. M. Ringelman, M. K. Johnson, K. Kemink, and **F. C. Rohwer**. 2021. Application of Unmanned Aerial Vehicles and Thermal Imaging Cameras to Conduct Duck Brood Surveys. *Wildlife Society Bulletin* 45:274-281.
- Cook, N., K. Shoemaker, and **C. A. Nicolai**. 2021. Inferring movements and staging locations for canvasback (*Aythya valisineria*) using light-level geolocators. *Journal of Fish and Wildlife Management*. 12:308-321.
- Koons, D. N., T. V. Riecke, G. S. Boomer, B. S. Sedinger, J. S. Sedinger, P. J. Williams., and T. W. Arnold. 2022. A niche for null models in adaptive resource management. *Ecology and Evolution* 12:e8541.
- Kucia, S. R., M. L. Schummer, J. W. Kusack, K. A. Hobson, and **C. A. Nicolai**. 2023. Natal Origins of Mallards Harvested in the Atlantic Flyway of North America: Implications for Conservation and Management. *Avian Conservation and Ecology* 18: article 10.
- Masto, N. M., R. M. Kaminski, P. D. Gerard, B. E. Ross, M. R. Kneece, K. Barrett, and G. Wilkerson. 2021. Aerial strip-transect surveys: indexing autumn-winter waterbird abundance and distribution in South Carolina. *Journal of Southeastern Fish and Wildlife Agencies* (In press).
- Mezebish, T. D., R. B. Chandler, G. H. Olsen, M. Goodman, **F. C. Rohwer**, N. J. Meng, M. D. McConnell. 2021. Wetland Selection by Female Ring-necked Ducks (*Aythya collaris*) in the Southern Atlantic Flyway. *Wetlands*. 41:84
- Mezebish, T. D., G. H. Olsen, M. Goodman, **F. C. Rohwer**, and M. D. McConnell. 2022. Spring Migration and Breeding Distribution of Female Ring-necked Ducks Wintering in the Southern Atlantic Flyway. *Avian Conservation & Ecology* 17:2:5
- Milling, Charlotte R., and Stanley D. Gehrt. "Behavior-specific habitat selection by raccoons in the Prairie Pothole Region of Manitoba." *The Journal of Wildlife Management* 87.7 (2023): e22448.
- Mitchell, B.J., C.V. Terry, K.M. Ringelman, K.M. Kemink, M.J. Anteau, and A.K. Janke. 2022. Wetland occupancy by duck broods in agricultural landscapes of the United States prairie pothole region. *Journal of Wildlife Management* (in press).
- Overton, C. T., A. A. Lorenz, E. P. James, R. Ahmadov, J. M. Eadie, F. Mcduie, M. J. Petrie, **C. A. Nicolai**, M. L. Weaver, D. A. Skalos, S. M. Skalos, A. L. Mott, D. A. Mackell, A. Kennedy, E. L. Matchett, and M. L. Casazza. 2021. Megafires and thick smoke portend big problems for migratory birds. *Ecology* 103:1-5.
- Palumbo, M.D., **S.A. Petrie**, M. Schummer, B.D. Rubin and J.F. Benson. 2022. Influence of Resource Selection on Nonbreeding Season Mortality of Mallards. *Journal of Wildlife Management*. <https://doi.org/10.1002/jwmg.22292>
- Sedinger, J. S., D. N. Koons, M. S. Lindberg, T. V. Riecke, A. G. Leach, B. W. Meixell, and **C. A. Nicolai**. 2022. Do hunters target auxiliary markers? An example using black brant. *Journal of Wildlife Management* 86:1-15.
- Thompson, J. M., T. V. Riecke, B. L. Daniels, K. A. Spragens, M. Gabrielson, B. S. Sedinger, and **C.A. Nicolai**. 2022. Survival and cause-specific mortality of American green-winged teal banded on the Yukon-Kuskokwim Delta, Alaska. *Journal of Wildlife Management* 86:5 e22223.

\* **Delta Staff noted in bold.**



## RESEARCH LEADERS

Throughout the organization's storied history, Delta Waterfowl has amassed an impressive body of research that includes supporting more than 300 graduate students and publishing 600 peer-reviewed scientific papers.

Delta's research has profoundly influenced how waterfowl, wetlands,

and annual harvest are managed. It has also provided biologists, technicians, and young scientists with the opportunity to gain hands-on experience and guidance to become leaders in waterfowl and wetland conservation. We are proud that many of Delta's former students are working

for government and non-government agencies, as well as universities.

Delta Waterfowl's important waterfowl and wetland research is made possible by you—our generous donors, members, and volunteers. We deeply appreciate your support. Thank you!



DELTA  WATERFOWL

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