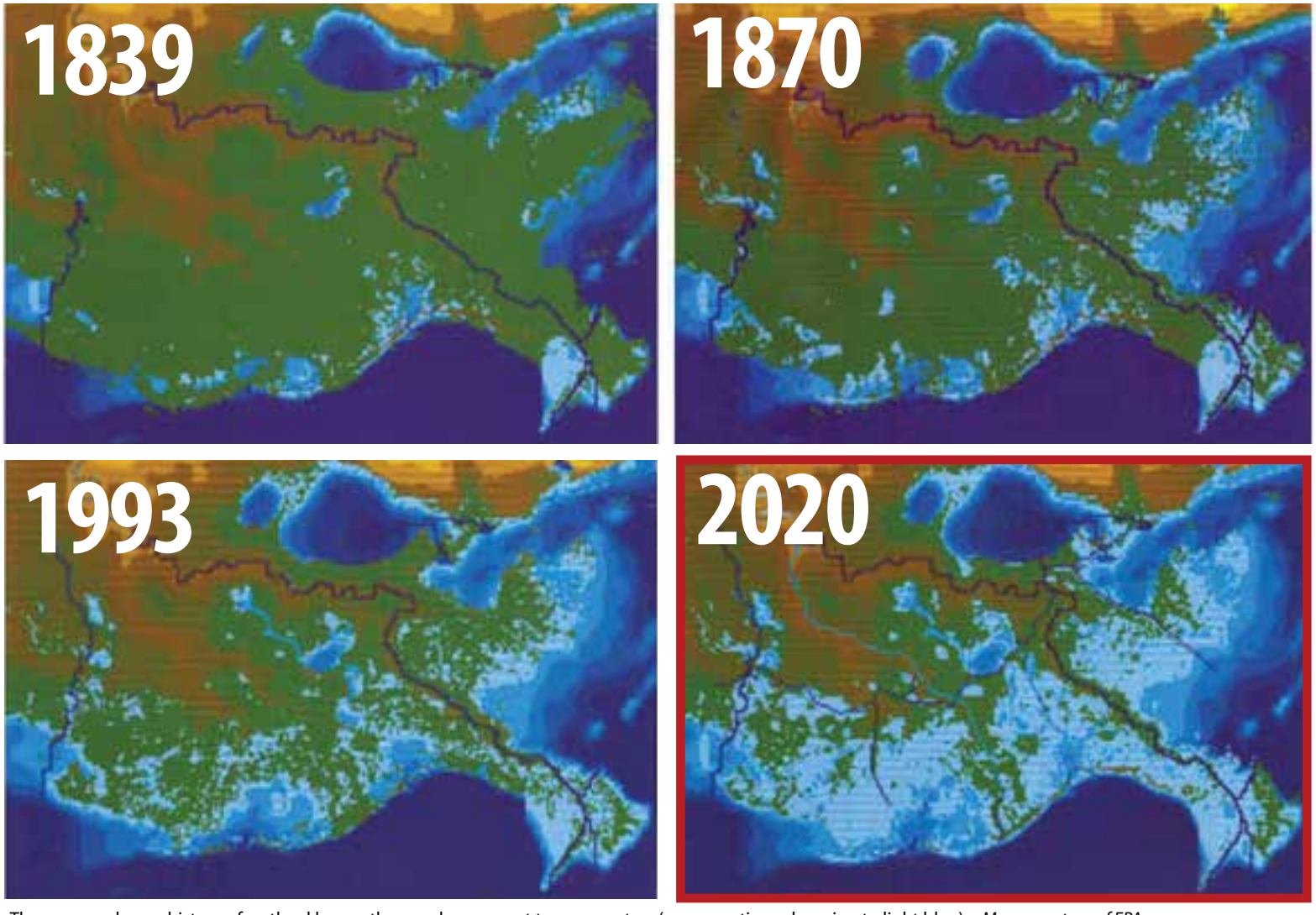
2020 SPECIAL EDITION - Changes in Waterfowl Migratory Patterns

# Louisiana WILDLIFE INSIDER




These maps show a history of wetland loss as the marshes convert to open waters (green sections changing to light blue). - *Maps courtesy of EPA*
*Duck photos by (left and center) Joy Viola, Northeastern University, forestryimages.org and (right) Shutterstock.com*

# LETTERS FROM THE EDITORS

*Louisiana, The Sportsman's Paradise, or is it?*

Every year we reach out to hunters in an effort to determine harvests of game and satisfaction of the most recent season, seeking input of those willing to answer these surveys. I want you to focus on the word "willing", as it allows you to voice your desires, concerns and levels of satisfaction with the management of the wildlife resources of Louisiana.

You've most likely heard the term, "the squeaky wheel gets the grease", well that has some truth in how matters may work out at times. However, the staff at LDWF (technicians, biologists, agents, assistants, etc…) work collaboratively to collect and review data on the biological and physical aspects of the wildlife resources and their habitats in order to make recommendations to the Louisiana Wildlife and Fisheries Commission. Data collected and analyzed by staff provide the basis for those recommendations for seasons, rules and regulations adjustments, with such recommendations made to ensure the sustainable use of our wildlife resources.

*Willing.*

The following was part of a comment we recently received during our Annual Hunter Harvest Survey: "*It has become increasingly challenging to introduce new people and especially young people to the sport of waterfowling as the quality/success of these hunts appears to decline more each year. I know ldwf hears a bunch of crying about this topic however it is extremely disheartening that ldwf does not seem to care, provide any possible solutions, acknowledge the thousands of hunters having the same poor experience, or even attempt to provide evidence otherwise*." That kind of cuts to the bone, but it also shows us where we are failing to provide the best possible customer service to the sportsmen of our great state.

I asked our staff to put together this Special Edition of the Wildlife Insider as a means to provide you insight into what is happening with our waterfowl and other migratory birds, here in Louisiana and across the globe. The changes we are experiencing have many causes, many are beyond our direct means of control. Can you do anything about it? Absolutely! The simplest thing you can do is take time to review the papers we have put together for you in this document, understand the real issues across the global landscape, then work with us, allowing us to use our time most prudently to address factors we can change for the good of the resource.

I appreciate your time, and look forward to continue discovering opportunities for us to improve your ability to enjoy the tremendous migratory bird resources we have in our state and nation.

***Kenny Ribbeck, Chief***
***Wildlife Division***

An adult female white-fronted goose, whose long, elegant wings beat rhythmically and strong through the air, creating the lift needed to keep her at the optimal altitude, rides a southerly tail wind at 60 mph to her natal breeding grounds in the Arctic, a 3,500-mile migration. She had no emotion when the low- flying, offshore bound, Bell Ranger helicopter forced her off the rice field in south Louisiana early on her last day of rest before her departure for the breeding grounds. She has no emotion over the industrial development, where she once stopped over in a grain field to refuel, or the drained wetland where she roosted overnight on a previous journey. She just keeps flying. The reasons why the changes in the landscape she passes over appear as they do, do not matter to her; stimulation for her flight comes instinctively. Her survival instinct drives her to nest and recruit more young into the adult population. Her decision to winter in Louisiana will have an impact on her fitness level to achieve that end goal. Will she have enough energy reserves to get to her breeding grounds early enough to beat the competition for the best place to nest? Will she have a normal, viable clutch of eggs and the ability to incubate them and avoid predation? Will she or her young survive to return to Louisiana? Or, If she does survive the spring and summer ahead, then in the next fall on her southerly migration, will she find a different wintering area further north, requiring less effort and energy to reach, with greater food resources and less disturbance, thereby increasing her odds for future reproductive success? These are a few of the questions on waterfowl managers' minds these days, and not just about white-fronted geese, but about most duck species as well.

Migratory ducks and geese are among the most studied avian species in the world, yet mysteries remain. Is that what drives the passion of committed waterfowl hunters? The sheer wonder and awe of birds that may fly non-stop from high latitudes in the north to the Gulf Coast marshes, with nothing but the energy and lean muscle mass of their streamlined bodies and an innate ability to navigate by the stars or dark landscape features thousands of feet below? Or, is it some unknown mechanism that only God will ever know about?

Historically, Louisiana has been one of the top waterfowl harvest states in the nation. Cameron parish alone could boast of harvests larger than even some other states' entire harvest. For many of us, killing lots of ducks seemed to be our birthright, and a large part of our culture. We took for granted that this would always be so, because after all, this is Louisiana, the Sportsman's Paradise! Today this might not always be the case. There are many reasons why, a few we can control, but many we cannot, such as climate change, global economic forces, political forces, human population, development and infrastructure, industry, agriculture and so on.

Southeast Louisiana has seen the greater majority of the 1.3 million acres of marsh loss noted along Louisiana's coast during modern times. Much of the rest of the fresher marsh types across the coastal zone often become choked with invasive plant or animal species, greatly reducing their quality for waterfowl. The one redeeming quality of a hurricane is its ability to open up these fresh marsh habitats again, setting back plant succession for a few years.

LDWF's operating budget has seen large reductions in recent years. However, our research programs are still involved in several waterfowl telemetry projects in collaboration with private individuals, other states, Joint Ventures, universities and Flyways. We anticipate these projects will shed light on trends in waterfowl ecology, migration and habitat use. Within this Special Edition Wildlife Insider, we hope to provide some pertinent information for waterfowl hunters that may be interested in an answer to the question, "What has happened to our ducks?" We present, for your review, the landscape and environmental changes that are occurring in North America and globally, affecting waterfowl migration and ultimately hunter success here at home.

We also focus on the need to collect valid data to estimate the number of hunters and migratory bird harvests in Louisiana. LDWF is involved in a pilot project to improve the Harvest Information Program (HIP) that will improve the ability of the U.S. Fish and Wildlife Service to make those estimates from the hunter surveys and parts collections in which many of you participate.

We hope you will enjoy this Special Edition Wildlife Insider. LDWF is grateful for your support and the wonderful wildlife resources we still have here to enjoy in The Sportsman's Paradise!

***Scott Durham, Biologist Director***
***Wildlife Division/Species and Research Programs***

***Jeff Duguay, Ph.D., Research and Survey Program Manager***

## IN THIS ISSUE



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# From Decoys to Duck Leases, Waterfowl Hunting is Big Business in Louisiana


BY TREY ILES, LDWF Public Information
SCOTT DURHAM, LDWF Director - Research & Species Management


Waterfowl hunting in Louisiana is an enjoyable pastime that tens of thousands of state citizens and non-residents take part in each year. But, it is also an important business on which many people rely.

Waterfowl hunting is linked to more than 1,000 jobs in Louisiana, and waterfowl hunters spend money that, according to estimates, results in $4.3 million in annual state tax revenue. When local taxes are included, other estimates triple that amount.

That figure doesn't include federal taxes that circulate back into Louisiana from the Pittman-Robertson Act. Also known as the Federal Aid in Wildlife Restoration Act of 1937, Pittman-Robertson generates revenue from excise taxes on firearms, ammunition, and archery equipment which are apportioned to state wildlife agencies for their wildlife conservation efforts and hunter education programs.

Nationally, waterfowl hunters spend about $958 each per season, according to the U.S. Fish and Wildlife Service (USFWS). Of that, about $546 is for trip-related expenses such as food and lodging. They spend about $320 on average for hunting equipment such as firearms and ammunition and $68 for auxiliary equipment such as camping gear.

Louisiana has about 54,000 waterfowl hunters, which equates to about 35 percent of the hunters in the state. The USFWS estimates about 46,900 are considered active hunters. Louisiana Department of Wildlife and Fisheries (LDWF) license sales and annual surveys of harvest activity suggest there are likely more than that.

The state's reputation for waterfowl hunting is recognized nationally. Louisiana is one of the nation's top duck hunting spots. For the 2017-18 hunting season, waterfowl hunters in Louisiana harvested 23.1 birds on average for the season. That is second only to California, which has a longer season and a larger bag limit. Recent year's harvests have declined due to a number of factors, such as changes in agricultural practices, weather patterns, loss of coastal marsh and overall habitat loss. During the 2018-19 season there was a decline in harvest for most states in the Mississippi Flyway. In Louisiana the average bag fell to 13.9 ducks per hunter, but still second only to Arkansas. Louisiana waterfowl hunting is still the envy of most states in the nation.

About 3,200 non-resident waterfowl hunters come to the state each year and another 1,000 former Louisiana residents make their way back home to bag ducks and geese. The 3,200 number is about 80 percent of the non-resident hunting licenses the LDWF sells each year.

Consider, too, the amount of land leased to waterfowl hunters. According to statistics from the LSU AgCenter, a total of 1,505 waterfowl leases encompassing more than 1.9 million acres were available during the 2016-17 hunting season. The value of those leases was $55.2 million. That is an average of $29 per acre.

Though the primary aim of state waterfowl hunters is to harvest ducks and geese, it certainly isn't the only ambition they share. Many are very concerned about conservation of this wild resource and take up membership in organizations like Delta Waterfowl and Ducks Unlimited (DU), which are non-profit groups that work to conserve wetlands and upland habitats for waterfowl and other wildlife.

One thing that is required of all waterfowl hunters 16 and older is a federal duck stamp, which costs $25. The duck stamp program was created in 1934 and has raised more than $1 billion to conserve and protect more than 6 million acres of waterfowl habitat throughout the nation. The stamp must be purchased by waterfowl hunters, but, waterfowl hunters aren't the only ones buying the stamp. According to the USFWS, more than 20 percent of the purchasers aren't hunters. Many bird enthusiasts and conservation minded non-hunters purchase federal duck stamps too!

In addition, LDWF has provided funding to support conservation of breeding grounds habitat for migratory waterfowl through a state statute that allocates 10 percent of fees collected from basic hunting license sales. The funding began in 1965 and in the last eight years an average of about $320,000 annually has been used to support breeding habitat for migratory waterfowl, primarily in the Prairie Pothole Region of Canada, where a large portion of the ducks harvested by Louisiana hunters are raised.

Another revenue producer aiding waterfowl habitat in Louisiana comes from the Louisiana Waterfowl Conservation Stamp, a program authorized by the Louisiana Legislature in 1988. It was created to bring in money for conservation and enhancement of waterfowl populations and habitats on the wintering grounds in Louisiana. Since 1989, more than $14 million has been generated with approximately $6 million spent on land acquisition alone. The revenues have supported wetland development projects on state Wildlife Management Areas and the Louisiana Waterfowl Project, a cooperative endeavor between LDWF, DU, the Natural Resources Conservation Service and USFWS to provide habitat for waterfowl and other wetland birds on private lands. The state stamp can also be purchased by non-hunters as well to support wildlife and wetland habitats in Louisiana.

Throughout modern history, people with vested interests in waterfowl hunting have largely funded critical habitat programs on both the breeding and wintering grounds. These habitat programs benefit many species of hunted and non-hunted birds and other wildlife. As hunter numbers decline due to access, age, lack of recruitment, or other reasons, the traditional model of waterfowl conservation is in jeopardy. Although the contributions of non-hunting bird and wetland enthusiasts has been important, it will not likely carry the weight needed for future sustainability and continued habitat conservation efforts. In states such as Arkansas and Missouri, legislation was passed that devoted small portions of those state's sales taxes to help fund wildlife conservation. Is it possible that such a funding mechanism could become a reality here in Louisiana one day? The Sportsman's Paradise may be hinged on that happening.

Photo by Shutterstock.com

# Duck Dilemma

Photo by Shutterstock.com

## *Louisiana Remains One of the Nation's Top Waterfowl Hunting Spots, but the Sport Faces Significant Challenges*

BY TREY ILES, LDWF Public Information
LARRY REYNOLDS, LDWF
Waterfowl Program Manger

Duck hunting in Louisiana is a treasured tradition, handed down from one generation to the next. From the anticipation of the first teal hunt in September, to bagging big ducks in November, to a frosty January morning in a duck blind and the fellowship before, during and after a hunt, nothing surpasses the delight Louisiana hunters feel when harvesting waterfowl.

Even as times have changed, technology has advanced, communication has become nearly continuous, and the digital age has altered all aspects of life, duck hunting in Louisiana remains a favored past time for some and a revered way of life for many. However, several factors have conspired to change duck hunting in the Bayou State, and it hasn't been for the better.

Ask any seasoned Louisiana duck hunter and he or she will tell you it's not like it used to be. There seem to be fewer ducks on Louisiana's landscape, and it causes great angst for the state's zealous hunters. Many grew up thinking that partaking in plentiful duck hunts was a birthright, and that it would never change. Even in disappointing seasons, Louisiana was still the envy of the nation when it came to bagging ducks. But despite 60-day seasons with six-duck daily bag limits, estimated harvests in the last two seasons have fallen to levels not seen since the restrictive 30-day seasons with three-duck daily bag limits of 1988-1994.

In the latest statistics compiled by the U.S. Fish and Wildlife Service, those hunting ducks in Louisiana bagged an average of 11.5 birds for the 2019-20 season (*Figure 1*). That ranked 14th among the 49 states with open duck seasons and was a marked decline from two years prior when active hunters averaged 23.1 ducks during the 2017-2018 season. In that year California, with a longer season and a more liberal bag limit, was better at 23.2 ducks. Furthermore, 2017-2018 harvest success was not particularly good when we consider Louisiana duck hunters averaged 28.5 in the five years 2010-2014. Overall duck harvest of 572,000 last season was fourth in the nation behind California, Texas, and Arkansas; it's not like it used to be.

Indeed, aerial waterfowl surveys conducted by Louisiana Department of Wildlife and Fisheries biologists indicate fewer ducks are wintering in Louisiana since the mid-1990s, especially in the coastal habitats. Since 1996, estimates from the coastal transect aerial survey show a decline from more than 4 million to less than 3 million, a period when breeding populations of ducks have been relatively high including new records in 1997, 1999, 2011, 2012, 2014 and 2015 (*Figures 2 and 3*).

But not all duck species are showing the same trends in coastal Louisiana. Mallards and pintails, favorites among duck hunters everywhere, have declined markedly on the coastal transect survey (*Figures 4 and 5*). However, northern shovelers and ring-necked ducks are increasing in the same surveyed habitats (*Figures 6 and 7*). Gadwalls, often the most abundant species in the bags of Louisiana's hunters, vary widely but seem to be on a slight increasing trend (*Figure 8*).

When looking at the mid-winter survey for the entire state, instead of just the coastal zone, the data are more variable but an important recent trend seems clear. The five-year averages in total ducks since 1996 show Louisiana is wintering a smaller proportion of the ducks in the Mississippi Flyway (*Table 1*).

Fewer ducks wintering in the state is certainly not good for hunting success, but the relationship between winter populations and hunting success is not linear. While the wintering population averaged 3.5 million, the average ducks bagged per hunter averaged 29.5 during the 2010-2013 seasons. However, ducks bagged per hunter fell to 12.5 (-58 percent) during the 2019-2020 seasons while average winter population dropped only 23 percent to 2.7 million. That decline in duck hunting success is disconcerting, but it is similar to that in the early-2000s (*Figure 1*). Particularly bothersome, however, is that the recent decline in hunting success came while duck breeding populations are far higher than in the early-2000s (*Figure 3*), so there must

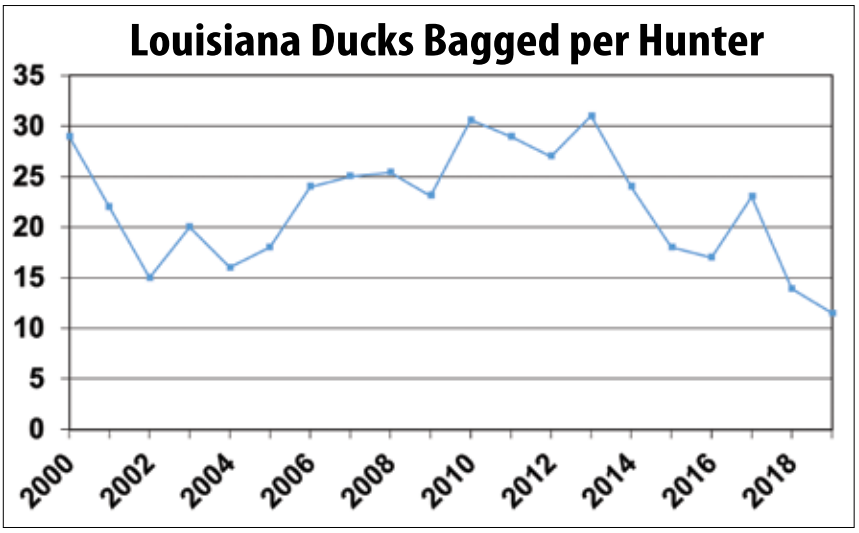


***FIGURE 1***. Average ducks bagged per hunter during the Louisiana duck season. Source: USFWS annual report on Migratory Bird Hunting Activity and Harvest (*www.fws.gov/birds/surveys-and-data/reports-and-publications/hunting-activity-and-harvest.php*).

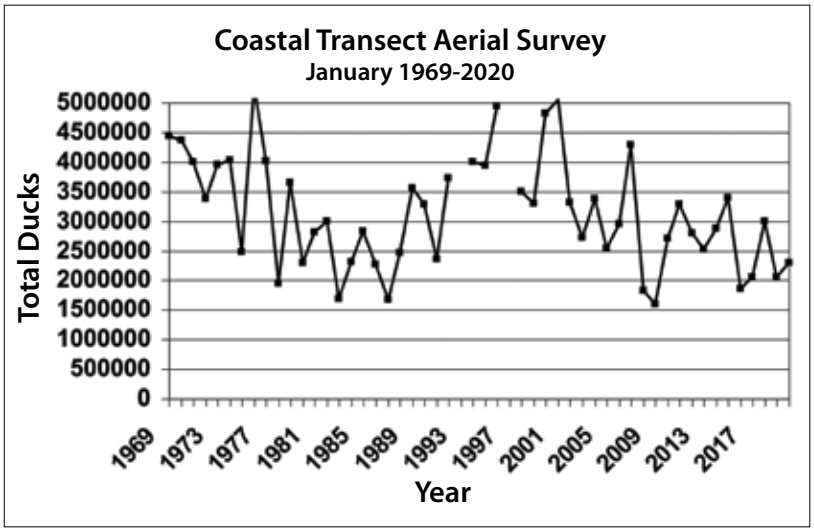


***FIGURE 2.*** LDWF Mid-Winter Coastal Transect Aerial Survey of waterfowl, 1969-2020.

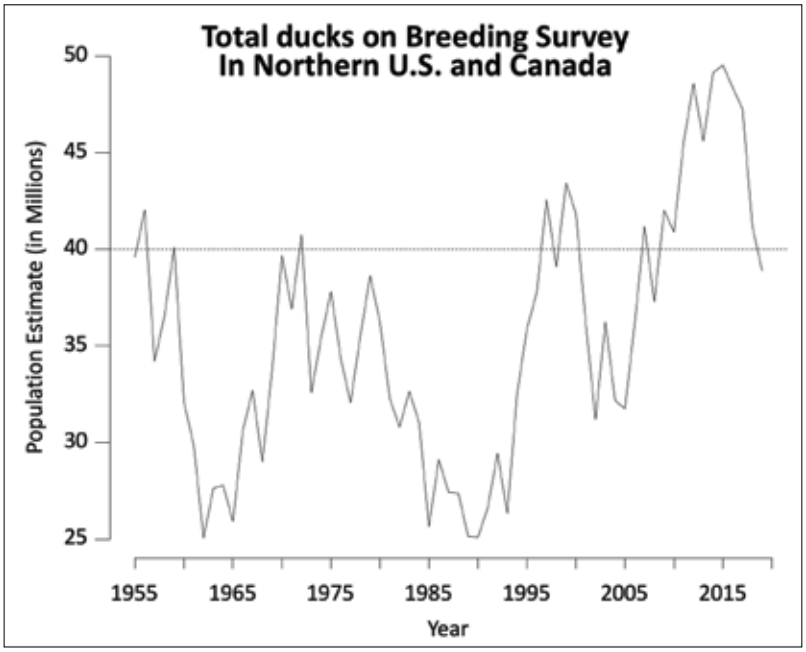


***FIGURE 3.*** Waterfowl population estimates from breeding surveys in northern U.S. and Canada, 1955-2020 (*USFWS*).

be other factors influencing harvest success beyond the size of the breeding and wintering populations.

Ducks wintering in Louisiana are a highly mobile and adaptable array of species responding to a variety of interacting factors such as coastal wetland loss, wetland habitat degradation, less waterfowl-friendly agricultural production in Louisiana and more in states to the north, increasing temperatures, invasive plant species, and probably others that influence the habitats they use over mostly a period of years. Combined with factors like reproductive success on the breeding grounds, weather, and local habitat conditions, which tend to vary annually, the migration and wintering distributions of waterfowl in the Mississippi Flyway and across Louisiana, change continuously in the short- and long-term, as would be expected. Confounding efforts to understand shifting wintering distributions, variation in short-term factors, like annual weather, reproductive success, and habitat quality can mask or amplify long-term trends caused by coastal wetland loss or shifts in agriculture. The challenge is to use our best available science to describe the factors, or interaction of factors, most influencing winter distributions and related hunting success, and then generate strategies to alter those that can be mitigated and adapt to those that cannot.

## DISAPPEARING COAST & CLIMATE CHANGE

Although almost every region of Louisiana can provide outstanding waterfowl hunting, no region exemplifies the risk to that institution more than the state's fragile coastline. According to the most recent analysis from the U.S. Geological Survey, 2,006 square miles in coastal parishes have been converted to open water since 1932 (*https://pubs.er.usgs.gov/publication/sim3381*). In addition to conversion to open water, much of the remaining marsh has been degraded by saltwater intrusion or hydrologic alterations that reduce food production necessary to support a robust winter population of ducks. Using the energy necessary to support a duck during the wintering period, scientists with the Gulf Coast Joint Venture have estimated Louisiana's coastal wetlands can now support nearly 3 million fewer ducks than in the past.

Coastal wetlands provide critical habitat starting in September for migrating blue-winged teal and year-round for mottled ducks. Because they provide a reliable source of food and water relative to other wetland types in October and early-November, coastal wetlands are the first habitats used by early migrating ducks. Lastly, as evidenced by the large majority of mid-winter duck estimates in Louisiana coming from the coastal survey, coastal wetlands provide high-value wintering habitat at both the state and flyway scale. It is certainly no coincidence that with declining coastal wetland resources we are witnessing fewer ducks during winter.

Climate is a fundamental evolutionary factor influencing bird migration. Ducks migrate south to escape the cold, snow, and ice that make it difficult to find food necessary to survive. However, flight is energetically expensive, and the fall/winter migration takes ducks to new habitats where they may be more vulnerable to predation (or hunting mortality) for a short period, in addition to taking them further away from spring breed-

ing grounds to which they must return. So there are clear benefits to not flying any further south than necessary to find food, open water, and secure roosting habitat.

Hunters have long known the effect of weather on duck distributions. Classic studies of banded mallards show the distribution of recoveries shifts to the south in colder winters and to the north in warmer winters. Interestingly, those same studies showed the influence of rainfall as well, with band-recovery distributions shifting further north in warm, wet winters and further south in cold, dry winters. So, long-term increases in temperature are expected to produce a more northern distribution of wintering ducks.

Minimum average temperatures in states north of Louisiana have increased significantly over the last 50 years. In North Dakota, for instance, the minimum average temperature has increased about 6 degrees Fahrenheit in the last 50 years. Additionally, the number of winter days below zero have been well below the average since 1980.

Researchers in Mississippi and Missouri developed a Weather Severity Index (WSI) that incorporated temperature, snow depth and duration of below-freezing temperatures, and measurable snow. They showed a relationship between WSI and migration of mallards in Missouri that explained about 40 percent of the variation in their change in abundance. Colleagues expanded use of WSI to 25 locations in the Atlantic and Mississippi flyways and other dabbling duck species, and all showed similar relationships. Most importantly, because of increasing temperature and decreasing snowfall, WSI showed a significant decline from 1979 to 2013, enough to allow millions of dabbling ducks to winter further north. Unfortunately for southern duck hunters, current climate models predict that will continue. Extended use of WSI to predict duck migration can be seen at: *https://schummerlab.weebly.com/duck-migration-forecast.html*.

## CHANGES IN AGRICULTURE PRODUCTION

From the coastal prairie of southwest Louisiana up through the delta region of northeast Louisiana, flooded rice fields are important habitat for wintering ducks. In close proximity to coastal wetlands, lakes, and bottomland hardwood swamps, rice fields provide a critical part of the wetland complex necessary to meet conservation goals for Mississippi Flyway waterfowl. However, over the last 40 years, acreage used to produce rice in Louisiana has fallen by nearly 40 percent from a peak in the 1970s.

Technology has also improved rice production in ways that reduce the amount of food left for waterfowl. Rice farmers cultivate new varieties that tolerate herbicide treatments to virtually eliminate annual weeds, like grasses, sedges or red rice, that in the past provided foods for ducks in addition to the waste grain. With vastly improved harvest efficiency, far less waste grain is left in the field, and early maturity of the first rice-crop means waste grain is deteriorated or sprouted before migrating ducks arrived. Overall, it means less food is available for migrating and wintering.

Estimates of waste rice from the 1980s showed more than 400 pounds per acre were left in the field as well as additional seeds from other annual plants. Now, about 75

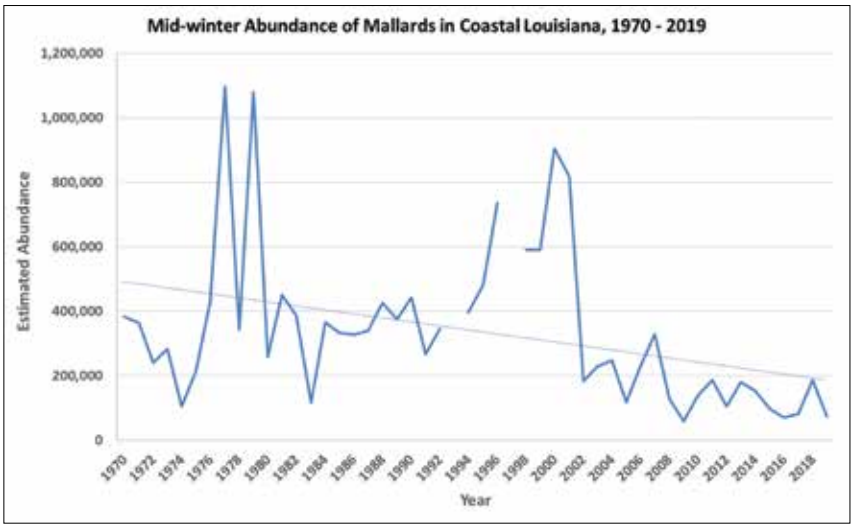


***FIGURE 4.*** Trend in mallards from the coastal transect survey in Louisiana (*LDWF*).

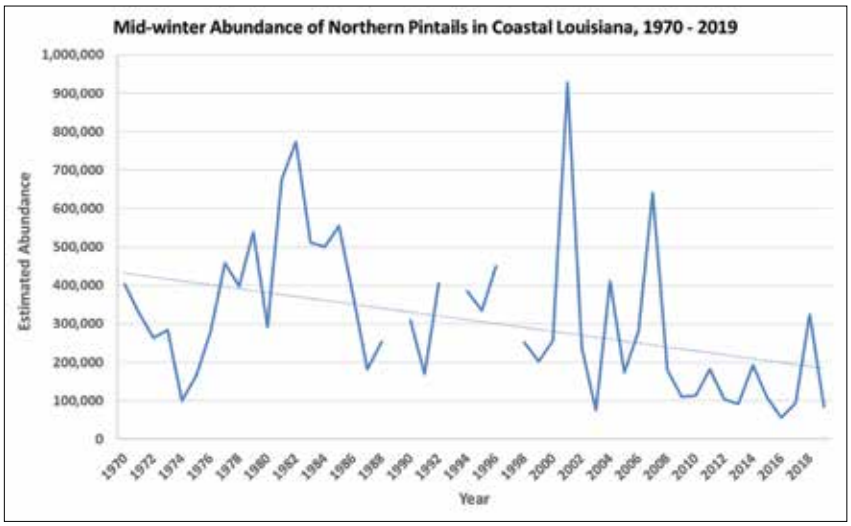


***FIGURE 5.*** Trend in northern pintails estimated from coastal transect survey in Louisiana (*LDWF*).

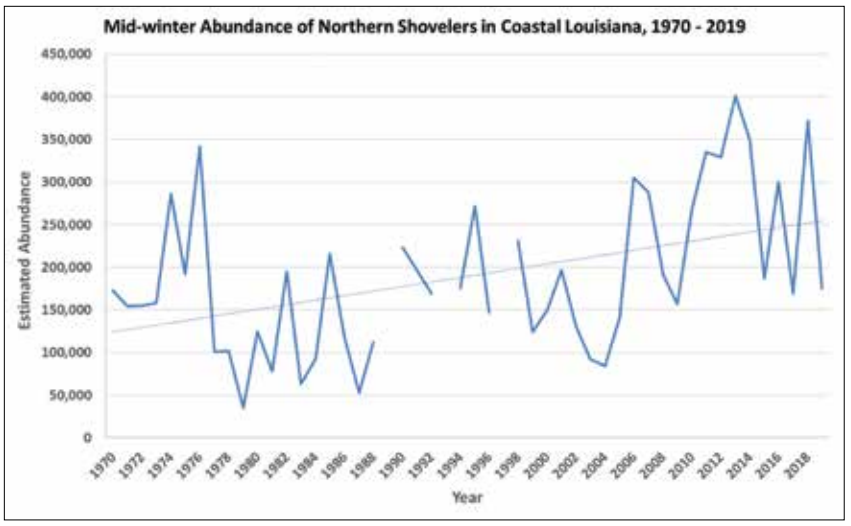


***FIGURE 6.*** Trend in northern shovelers estimated from coastal transect survey in Louisiana (*LDWF*).

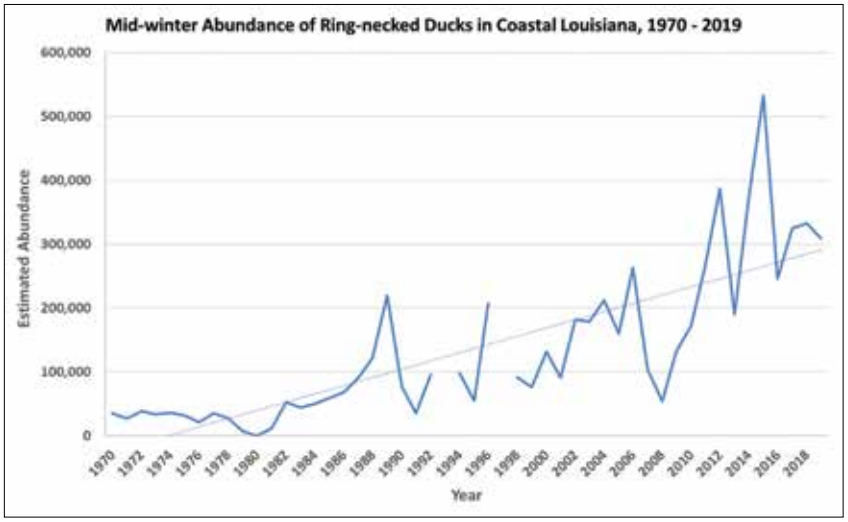


***FIGURE 7.*** Trend in ring-necked ducks estimates from coastal transect survey in Louisiana (*LDWF*).

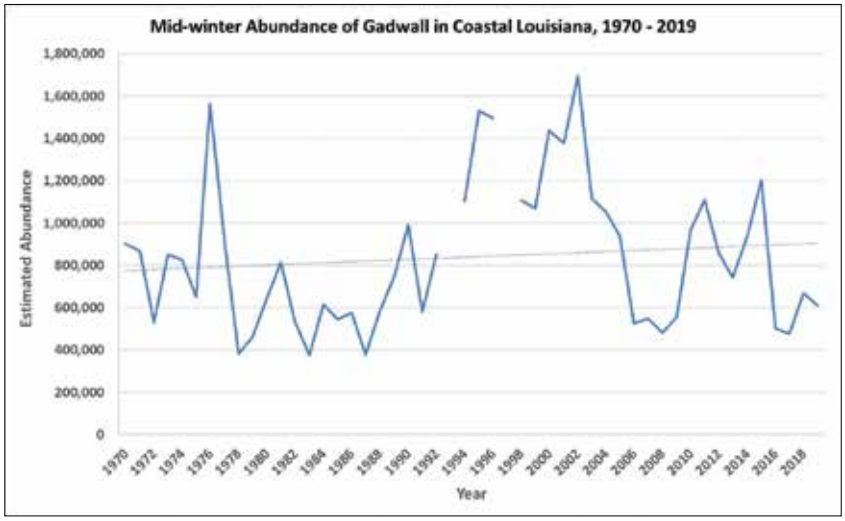


***FIGURE 8.*** Trend in gadwalls estimated from coastal transect survey in Louisiana (*LDWF*).

***TABLE 1***. Five-year averages of the percentage of ducks in the Mississippi Flyway that are wintering in Louisiana, 1996-2020.

| MID-WINTER SURVEY FOR ALL DUCKS: Louisiana and Mississippi Flyway | | | |
|---|---|---|---|
| **5-year Average** | **Louisiana** | **Miss. Flyway** | **%** |
| 1996-2000 | 3,820,000 | 6,392,000 | 60% |
| 2001-2005 | 3,910,000 | 6,381,000 | 61% |
| 2006-2010 | 3,109,000 | 6,531,000 | 48% |
| 2011-2015 | 3,686,000 | 7,742,000 | 48% |
| 2016-2020* | 2,818,200 | 7,036,000 | 40% |
| **January 2020** | **2,814,000** | **6,131,000** | **46%** |

**WI and MN did not conduct surveys in 2019, 2020*

Emily Hartdegen (right) and Leslie Twiner wait patiently in a duck blind.

pounds per acre of waste rice, with virtually nothing else, is available after harvest. Waterfowl managers have calculated a "give-up" density of 50 pounds per acre. That is the point where ducks abandon a field because it costs more energetically to continue foraging than to find another field with a higher density of food. When that is considered, the amount of available food for wintering waterfowl in a harvested rice field has declined about 90 percent since the 1980s. Furthermore, crawfish farming has expanded greatly in Louisiana, and a large portion of those farms utilize harvested rice fields. Typically, deeper flooding, more disturbance, and active hazing of birds on crawfish farms make those fields less available to waterfowl. Together, fewer acres of rice providing less food for ducks per acre, with alternative post-harvest uses have reduced the capacity of Louisiana's agricultural waterfowl habitats to support wintering ducks.

Agricultural changes in other Mississippi Flyway states are likely affecting winter distributions of waterfowl. While Louisiana has lost rice-growing acreage, it has increased to the north in the Mississippi Flyway. For example, rice acreage is increasing in Missouri to the point that there is now 30 times the amount of flooded rice habitat for duck hunting in Missouri as there was 20 years ago. There have been huge increases in the corn production in northern Mississippi Flyway states. Since 1990, combined corn acreage in North Dakota, Minnesota, South Dakota, Nebraska, Iowa and Kansas has increased by almost 12.6 million acres. Corn is an important food for migratory and wintering waterfowl, especially geese and mallards. Other species will use flooded corn habitat to a lesser extent.

It's important to recognize that the species wintering in Louisiana in lower numbers, like mallards and pintails, tend to be well adapted to agriculture habitats. Expansion of those habitats further north complement the effect of climate change in enhancing habitat available to migrating and wintering birds in those areas.

## INVASIVE AQUATICS

Vegetative growth in Louisiana's wetland systems is the foundation of food resources for migrating and wintering waterfowl. Submerged aquatic vegetation like wigeongrass, southern naiad, or sago pondweed, and seed-producing annuals like millet, smartweed, and flatsedges provide resources for foraging waterfowl either directly via seeds or plant parts, or as habitat for aquatic invertebrates. Even invasive species like hydrilla or Eurasion milfoil provide food for some duck species, but others, primarily water hyacinth and giant salvinia, degrade or eliminate habitat value for waterfowl over large expanses of otherwise productive wetland habitat.

Water hyacinth and giant salvinia form impenetrable mats on the water surface, blocking all light transmissions so aquatic duck food plants can't grow, open water disappears, and habitat quality for waterfowl drops to zero. They have choked many waterways throughout the state and covered thousands of acres of marshes, ponds and lakes that were previously outstanding habitat for wintering ducks. During aerial waterfowl surveys conducted in the last three years, LDWF observers have noted areas of traditional duck abundance south of

White Lake, west of Hwy 27, and north of Grand Chenier that were completely covered by water hyacinth or giant salvinia and no ducks were counted.

Another example is in the Maurepas Swamp, where a very popular duck hunting video, "The Duckmen of Louisiana" featuring Phil Robertson and Warren Coco was filmed in the late-1980s. Mallards, gadwall, wigeon and wood ducks frequented that area in good numbers. Today, the swamp is dominated by a thick mat of salvinia with a community of sedges growing on it providing virtually no habitat for ducks except for a few wood ducks. It seems every year, expanses of marsh in coastal Louisiana and reservoirs in north Louisiana have seen similar infestations, reducing the capacity of those habitats to support wintering waterfowl. Consequently, private leaseholders and public lake hunters alike have lost hunting opportunity and struggle to take back their duck holes.

LDWF allocates substantial resources combating those invasive species using both herbicides and biological controls, like weevils that prey upon giant salvinia, but the battle is difficult and expensive. Delta Waterfowl has partnered with LDWF to develop ponds to propagate weevils which are provided to private landowners to combat giant salvinia infestations, and the Coastal Wetlands Planning Protection and Restoration Act has provided funding to further expand the availability of salvinia weevils, monitor their success, and scientifically assess the short- and long-term impacts on the landscape. So, progress is being made, but the negative effects on waterfowl habitat remain widespread.

## LOOKING AHEAD

Although it may not be the same as it used to be, the grand tradition of waterfowl hunting in Louisiana remains, and LDWF, conservation partners, and private landowners are working to maintain, and in some areas improve, that tradition. Several telemetry projects by LDWF and an impressive network of partners are helping biologists better understand waterfowl migration patterns, and the factors that influence them, to inform management decisions. The department is also constantly working to improve habitat throughout the state, on wildlife management areas, private lands and certainly in coastal Louisiana.

Louisiana is the midst of an ambitious coastal land restoration project. Of the approximately $5 billion in Natural Resource Damage Assessment (NRDA) funds from the 2010 *Deepwater Horizon* oil spill, $4 billion is designated for coastal and nearshore habitat. That's not only prime waterfowl country itself, but those projects add protection and longevity to wetland habitat further inland. Cleaning out distributary channels and crevasses at the mouth of the Mississippi River speeds deposition of new marsh in the areas of Delta-Breton National Wildlife Refuge and Pass-a-Loutre WMA. Using dredge-spoil to create new marsh, build bird nesting islands, and restore landbridges and barrier islands counters continuing wetland losses and provides habitat for waterfowl and waterfowl hunters.

The LDWF Hunter Education program is working to recruit new hunters, waterfowl or other game, through several initiatives as well as educating hunters. Delta Waterfowl has focused efforts in Louisiana toward recruiting new waterfowl hunters through their First Hunt program and has provided wing-shooting training opportunities for students in LSU's College Hunt program making their first hunts. Even with smaller average winter populations and recent lower hunter success, Louisiana's waterfowl hunting experience can still be spectacular and it remains an integral part of Louisiana's outdoor culture. The passion of the state's waterfowl hunters will help keep the sport strong as it rebounds to past levels of harvest success, like it did after the early-2000s, or adapts to a new normal in a changing landscape.

On the way to the blind.

Photo by Dr. Kevin Ringelman, LSU

Madelyn McFarland (left) and Colleen Walsh and scan the sky.

Photo by Shutterstock.com

# Are Waterfowl Migrations Changing?

## *Ducks Unlimited (DU) chief scientist discusses the many factors that influence where and when waterfowl migrate*

BY TOM MOORMAN, Ph.D.,
Ducks Unlimited

***Editor's Note:*** *Dr. Tom Moorman has long, strong ties to Louisiana waterfowl management, research, and hunting. Tom accomplished his PhD degree working on mottled duck energetics through the annual cycle, while his wife, Anne, completed her M.S. degree work on the effect of salinity on mottled duck duckling growth and development at Rockefeller Refuge in 1987-91. For over 25 years between then and being appointed Chief Scientist for Ducks Unlimited in 2017, he was based in Jackson, Mississippi and actively involved in Gulf Coast and Lower Mississippi Valley Joint Venture conservation planning and implementation. Tom's been intimately involved in waterfowl-related research and management across the southeastern United States into Texas, and is a member of the Mississippi Flyway Non-breeding Waterfowl Distribution Working Group, raising awareness of shifting winter distributions of ducks and associated changes in hunting success, as well as initiating research and monitoring to better understand the factors influencing those changes. He hunts ducks extensively in Mississippi and Louisiana, and has a personal connection to changes seen in our state. We are grateful for his approving this article to be reprinted here.*

As waterfowl seasons unfold each year across North America, the question "Where are the ducks?" inevitably arises somewhere, and sometimes everywhere. While that seems like a straightforward, easy question, the answer is actually very complex. There are many factors that influence distribution of waterfowl in fall and winter, some that occur annually and others that cause longer-term changes. Let's have a look at some of the most significant factors.

### WEATHER

Most waterfowl hunters understand the effect weather has on waterfowl migration. After all, who among us is not guilty of checking our favorite weather app daily to see if Old Man Winter has awakened and hastened waterfowl migrations? Except for the few species that are hard wired for more dependable long-distance migrations, such as blue-winged teal, waterfowl are adapted to migrate only as far as is necessary for them to find food, open water, and places to rest. For some species, it may take several consecutive days of freezing temperatures and snow cover to push them southward.

Without freezing temperatures and snow to cover food sources, waterfowl linger. It is advantageous for them to reduce risk of mortality from migration and remain closer to spring breeding areas. Especially among mallards and northern pintails, birds that arrive earliest on breeding areas have access to the best territories, which results in a higher probability of nesting successfully and rearing a brood.

Snow and ice cover and their influence on waterfowl migration and distribution are intuitive to most duck hunters. However, what may be less understood is the trend toward warmer winters. The science is very clear - if current climate trends continue in North America, midlatitude and northern regions will have less frequent ice and snow cover in future winters. Considering that waterfowl are adapted to stay as close as they can to breeding areas, such a trend does not bode well for waterfowlers farther south. In fact, recent research publications that model both climate and bird distribution indicate that by 2050 the core of the mallard wintering range may extend from Nebraska eastward to the Great Lakes region.

Other species of ducks are likely to be similarly influenced, meaning significantly delayed fall migrations and shorter periods spent on southern wintering areas. Similar northward shifts are being documented in Europe. Given these trends, hunters should expect increased variability in migration activity and waterfowl distribution in the years ahead.

## LANDSCAPE CHANGE & VARIATION

In the past 200 years the landscapes that are most important to waterfowl have suffered tremendous habitat loss, with some states losing more than 90 percent of wetlands, and nearly all losing over 50 percent. Such rapid change must have had significant effects on waterfowl distribution, but most of the changes occurred before modern waterfowl management and population surveys.

Perhaps the most discouraging loss of wetlands important to wintering waterfowl has been in coastal Louisiana, where more than 40 percent of the state's approximately 3 million acres of marsh has disappeared over the past several decades. Large portions of remaining coastal wetlands have been invaded by nonnative plants, including water hyacinth and giant salvinia, which do not provide food resources for waterfowl and out-compete the native plants that do. Such habitat loss and degradation has undoubtedly reduced the number of waterfowl in coastal Louisiana and changed the distribution of birds that still winter there. The decline in resident mottled ducks along the coasts of Louisiana and Texas likely reflects the loss of these crucial marshes.

Across the continent, millions of acres of wildlife habitat have been converted to agriculture. Some waterfowl - such as geese, mallards, pintails, American green-winged teal, American wigeon, and wood ducks - have learned to exploit harvested rice, corn, wheat, barley, peas, and lentils. These landscape changes happened relatively rapidly, and while no one is certain when waterfowl adapted to feed in harvested grainfields, it likely began in the early 20th century, before modern waterfowl science could document the effects of this dramatic landscape change.

There is annual and long-term variation in agricultural crops and acreage, both of which influence waterfowl distribution. Along the Louisiana and Texas coasts the amount of rice agriculture, an important resource for wintering waterfowl, has declined from about 1.2 million acres to approximately 500,000 acres since 1970. The decline has been most significant along the Texas Mid-Coast, an area that once supported millions of snow geese and a thriving hunting industry. In recent years, only a couple of hundred thousand snow geese have wintered in coastal Texas. Millions of snows have shifted north to the Mississippi Alluvial Valley, where they find nearly 1 million acres of rice fields and an abundance of other cropland with green winter grasses. The steep decline of rice in Texas and Louisiana has likely also affected the number of puddle ducks wintering in the region, especially seed eaters such as pintails, teal, and mallards.

Farther north, there have been significant increases in the amount of corn agriculture, particularly in North and South Dakota, Iowa, Nebraska and Minnesota. Not historically a common crop in North Dakota, today corn is grown as far north as Manitoba thanks to the development of varieties that can mature faster in shorter, cooler growing seasons. In recent years, there have been up to 55 million acres of corn planted in the Mississippi River Basin. With millions of acres of harvested wheat, barley, and peas on the landscape, an abundance of waste grain is available to migrating waterfowl, especially if it is not covered by snow.

## WEATHER & LANDSCAPE INTERACTIONS

Changes in the amounts and types of crops along with warmer winters are likely enabling waterfowl to winter farther north or are at least delaying fall migration. Annual rainfall also influences waterfowl distribution. For example, the winter of 2018-19 was the third warmest on record across most of the United States, and in the eastern part of the continent it was the wettest in over 120 years since records have been kept by the NOAA National Centers for Environmental Information. With that much water on the landscape, waterfowl had no shortage of places where people were not shooting at them - a recipe for a tough duck season. Unsurprisingly, across most of the eastern United States, many waterfowl hunters saw reduced harvest as a result.

## WETLAND RESTORATION

In the past 50 years, significant wetland restoration has occurred, though the number of restored acres pales in comparison to what has been lost. We lack good information on how such restoration has affected waterfowl populations, migrations, or non-breeding distribution. However, we do know that birds abandon even food-rich habitats when they are covered in ice and snow. Alternatively, in the absence of ice and snow, birds linger at more northerly latitudes due to the adaptations discussed earlier. On most of the important winter and migration landscapes in North America, conservation planning models indicate that the amount of habitat and food energy available during fall and winter is below the levels needed to support established waterfowl population objectives. While conser-

Photo by Jiri Vaclavek, Shutterstock.com

vation efforts continue in these areas, the highly mobile nature of waterfowl enables them to locate and exploit resources where they may exist across larger geographies in a given year.

## HUNTING PRESSURE

While hunting pressure is probably the least understood variable in the waterfowl distribution equation, we know that ducks and geese do not like disturbance and will abandon heavily disturbed areas for places where they can find food and rest. Furthermore, hunting has changed in the past few decades. Advances in equipment and technology have made it easier to access nearly all places waterfowl are found. Many hunters have purchased or lease land that is intensively managed to attract waterfowl for hunting, leading to more and often higher-quality habitat on many landscapes. Hunters commonly use motion decoys and machines that keep wetlands from freezing in cold weather. Regulations enabling multiple, split seasons in any given state mean that waterfowl are subjected to more hunting pressure in midlatitude and southern states.

The effects and interactions of these variables are poorly understood. However, the surest way to lower the quality of hunting in your favorite duck hole is to disturb birds too often - by hunting or even riding through it too frequently. Ducks simply will not tolerate intense disturbance and will readily relocate to other areas, sometimes far away.

## ANNUAL WATERFOWL PRODUCTION

Each year hunters await the release of the Waterfowl Breeding Population and Habitat Survey issued by the US Fish and Wildlife Service. If populations are above average and wetland conditions favorable, breeding waterfowl are generally more successful and production of young increases. Years with more juvenile birds in the fall flight lead to better hunting success and larger harvests across the continent. However, hunters should know that increases in waterfowl breeding populations don't always mean increased production, because the surveys are conducted in May, while breeding success depends on habitat conditions well into July.

To achieve greater satisfaction from your hunting season, my best advice is to temper your expectations based on waterfowl breeding populations, and then temper your expectations further based on fall and winter weather to the north of your blind. I hunt in Mississippi, but the weather stations I watch to get a sense of the migration are in Saskatchewan, South Dakota, Nebraska, and Missouri. Only when I see extended freezing temperatures for a week or more in those areas do I know large numbers of birds will be winging their way to the southern end of the flyway.

Then consider habitat conditions across the region you hunt. Birds evaluate habitat conditions on larger scales than your local honey hole. If conditions are good at a landscape scale, birds will stay in the area, and the chances of seeing them over your decoys increase. If the region is excessively flooded, the birds will have many options on where they can feed and rest, and you may experience tough hunting. If the region is dry, but there is water in the area you hunt, you may do pretty well.

We as hunters often look for a silver bullet if birds don't show up in anticipated numbers over our decoys. It's human nature to seek simple explanations and solutions, but waterfowl distribution is driven by multiple interacting variables over which humans have little control and some of which are poorly understood. Waterfowl are very well adapted to exploit highly variable environments, and that is part of what makes them such worthy quarry. For those of us who love to pursue ducks and geese, the best way forward is to provide quality habitat, minimize disturbance as much as possible, hope for some help from Old Man Winter, and then hunt as much as our schedules allow!

**This article is reprinted from a previous issue of Ducks Unlimited magazine.*

Photo by Shutterstock.com

# Declining Waves of Geese

BY LARRY REYNOLDS, LDWF Waterfowl Program Manager
PHOTOS BY RUTH ELSEY, Biologist Manager - Alligator & Furbearer Program

According to the 2020 Louisiana Waterfowl Hunter Survey, 18 percent of waterfowl hunters made at least one hunt specifically for geese during the 2019-20 season, and 5 percent made at least five. Although a small proportion of total waterfowl hunters, this group of passionate, dedicated goose hunters have growing concerns about declining numbers of geese wintering in Louisiana. Indeed, the January 2020 mid-winter count of 35,200 white-fronted geese was the lowest since 1969, and the count of 313,200 white geese (snow/Ross') was the third lowest since 1982. Despite healthy mid-continental populations of those species, fewer birds and/or a declining proportion of those populations are wintering in Louisiana.

Shifting distributions of wintering geese is well known, and in Louisiana that started with Canada geese in the mid-20th century. Nearly 100,000 Canadas spent at least part of the winter in the state in the 1930s. However, as agricultural production expanded in the Midwest and goose management zones were established in Missouri, Illinois and Wisconsin, which included refuge and farming programs to entice birds, mid-winter counts in Louisiana dropped from 88,250 in the late-1930s to only 5,200 by mid-1950s. In 1962, the hunting season on Canada geese was closed, and by the early 1970s, winter counts fell below 2,000.

An attempt to establish a breeding population of Canada geese in coastal Louisiana began in 1960 at Rockefeller Refuge using geese from Wisconsin, Saskatchewan, Missouri and Minnesota, released into fenced goose pastures totaling nearly 300 acres. Although initially successful through protection on Rockefeller, the population failed to maintain itself without intensive protection outside the refuge. Consequently, the program was discontinued in the 1990s, but the area still has a small population of Canada geese descended from that population.

The Canada goose hunting season in Louisiana was reopened in 1990 but not due to an expanding population of large Canada geese from the restoration effort. Instead it was because of growing numbers of migratory small Canada geese (Cacklers) wintering in southwest Louisiana. As many as 20,000 were counted on ground surveys in the 1990s (*Figure 1*). Counts declined markedly in the mid-2000s due to conversion of rice to sugarcane and crawfish farming, despite stable or growing populations of mid-continent Cackler population during that time (*Figure 2*). The survey was discontinued in 2016, and only a few scattered flocks are seen each winter.

A similar pattern, but less severe, has been seen for white geese wintering in Louisiana. Ross' and snow geese cannot be distinguished during the January aerial survey, so the counts include both species. Ross' geese make up about 5 percent of the white goose population, based on harvest data. Mid-winter counts show high annual variation, but using five-year averages from 1996 to 2020, *Table 1* shows declining numbers of white geese counted in Louisiana, while total numbers in the Mississippi Flyway have increased. On average, Louisiana is now wintering half the white geese of 25 years ago, and the proportion of Mississippi Flyway white geese counted in Louisiana in early January has fallen from over half to less than 20 percent. Given the strongly increasing trend in the mid-continent population of white geese (*Figure 3*), this confirms that the winter distribution of these species is simply shifting north in the Mississippi Flyway. A similar, if not stronger trend of fewer white geese wintering on the coastal prairies of Texas has caused even greater consternation among hunters there.

A somewhat different trend in wintering numbers of white-fronted geese has emerged from mid-winter survey data. The five-year averages of total birds do not show the same continuous decline, and the most recent period shows about the same aver-

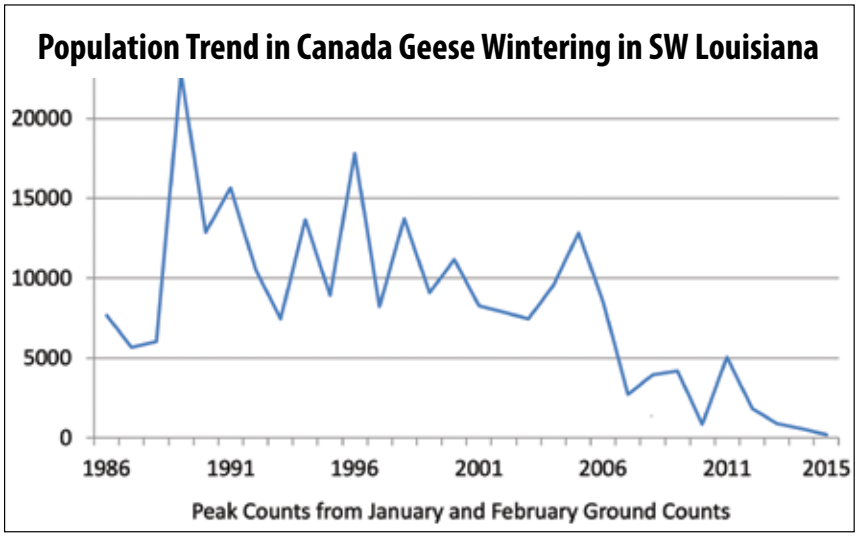


***FIGURE 1***. Overwintering estimates of Canada geese in southwest Louisiana, 1986-2015 (*LDWF*).

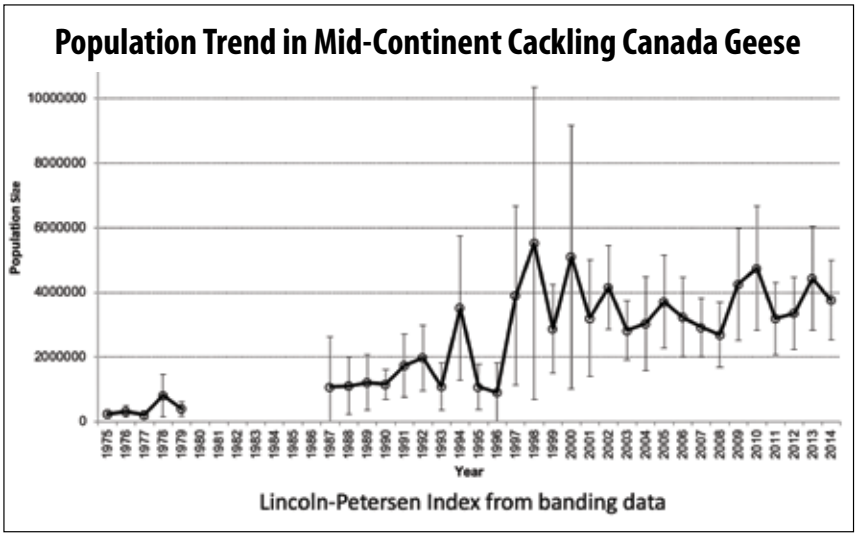


***FIGURE 2***. Population trend in mid-continent cackling Canada geese, estimated from banding data, 1975-2014 (*USFWS*).

age number of white-fronts as both the 1996-2000 and 2006-2010 periods (*Table 2*). However, the mid-continent white-fronted goose population, as indexed by the fall aerial survey in Canada, has increased markedly since 2000 (*Figure 4*), and mid-winter counts in the Mississippi Flyway have increased four-fold. These numbers indicate Louisiana is now wintering less than 20 percent of the Mississippi Flyway's white-fronts, compared to 80 percent 25 years ago. Like white geese, the winter distribution of this species has clearly shifted further north in the Mississippi Flyway, but unlike white geese the increasing population seems to have maintained the total number of white-fronts, on average, wintering in Louisiana. Still, the last six years have included very low mid-winter counts of 59,000 and 35,200 in 2015 and 2020, respectively, as well as very high counts of 143,000 and 151,000 in 2016 and 2018, respectively. Such extreme variation, especially the lows, increases concern about the future of hunting white-fronted geese, or specklebellies as they are known locally, in the state.

Moving further north is not the only story for distribution shifts of white-fronted geese. White-fronts have been banded every year in similar locations in the Arctic, and graduate student Callie Moore and Dr. Doug Osborne at the University of Arkansas, Monticello, have summarized the recovery data from those banded geese. They created an animation showing the core of the band-recovery distribution from Nov. 1 until the end of February every hunting season from 1974 to 2016, clearly illustrating the winter distribution moving from southeast Texas, east to southwest Louisiana, and then northeast into eastern Arkansas during that period (*www.youtube.com/watch?v=njUranK0czk*). So, despite being banded in the same general location in the Arctic, the core of the white-fronted goose wintering distribution has shifted substantially north and east, along with the associated harvest opportunity. Indeed, Louisiana's harvest of white and white-fronted geese has declined markedly since the mid-2000s (*Figure 5*), at least partially related to the shifts in distribution demonstrated by mid-winter surveys and banding data.

The reasons for the shifting winter distributions are not well understood, but almost certainly are related to changes in agriculture, specifically the loss of rice acreage in coastal Texas and Louisiana. In Texas, rice has declined from over 600,000 acres in 1980 to less than 200,000 acres in recent years. Similarly, in coastal Louisiana, rice acreage has declined from 550,000 in the mid-70s to less than 300,000 acres. Although snow geese and white-fronted geese likely evolved to eat vegetative parts of prairie and marsh plants on wintering grounds, they have adapted remarkably well to exploit expanding agricultural habitats, and their mobility allows them to do so wherever those habitats occur on the landscape. In North and South Dakota, acres of corn planted has doubled since 1990, and the combined corn acreage in North Dakota, South Dakota, Iowa, Nebraska, Kansas and Minnesota has increased by 12.58 million acres since 1990. As rice agriculture declines in Texas and Louisiana, while expanding in states further north, and as corn and other agricultural crops expand up the Mississippi Flyway, we have experienced and should expect continued northward shifts in wintering distributions of geese.

And that isn't limited to just white and white-fronted geese in Texas and Louisiana. Canada geese overwintering in states Louisiana hunters might accuse of "short-stopping" birds that once wintered here, are now wintering even further north. Both western Kentucky and southern Illinois have seen strong declines in wintering Canadas from the late-1990s to mid-2000s. In Ballard County, Kentucky, winter counts declined from over 100,000 annually to only a few hundred during that time. Large hunting communities with rich goose-hunting traditions have disappeared from those states, as the Canada geese they once pursued now winter in Wisconsin, Michigan and Ohio.

***TABLE 1***. Percentage of snow geese in the Mississippi Flyway overwintering in Louisiana, 1996-2020, in five-year averages (*USFWS/LDWF*).

| TRENDS IN 5-YEAR AVERAGES OF MID-WINTER SNOW GEESE | | | |
|---|---|---|---|
| **Date** | **Louisiana** | **Flyway** | **%** |
| 1996-2000 | 834,000 | 1,615,000 | 52% |
| 2001-2005 | 635,000 | 1,634,000 | 39% |
| 2006-2010 | 569,000 | 1,819,000 | 31% |
| 2011-2015 | 568,000 | 2,820,000 | 20% |
| 2016-2020 | 434,000 | 2,564,000 | 18% |
| **January 2020** | **314,000** | **2,863,000** | **11%** |

*Counts in Illinois, Missouri, and Tennessee have increased.*

***TABLE 2***. Percentage of white-fronted geese in the Mississippi Flyway overwintering in Louisiana, 1996-2020, in five-year averages (*USFWS/LDWF*).

| TRENDS IN 5-YEAR AVERAGES OF MID-WINTER WHITE-FRONTED GEESE | | | |
|---|---|---|---|
| **Date** | **Louisiana** | **Flyway** | **%** |
| 1996-2000 | 105,000 | 132,000 | 80% |
| 2001-2005 | 70,000 | 127,000 | 55% |
| 2006-2010 | 103,000 | 225,000 | 46% |
| 2011-2015 | 98,000 | 309,000 | 32% |
| 2016-2020 | 101,000 | 560,000 | 18% |
| **January 2020** | **35,000** | **578,000** | **18%** |

*Counts in Illinois, Missouri, Arkansas, Tennessee and Kentucky have increased.*

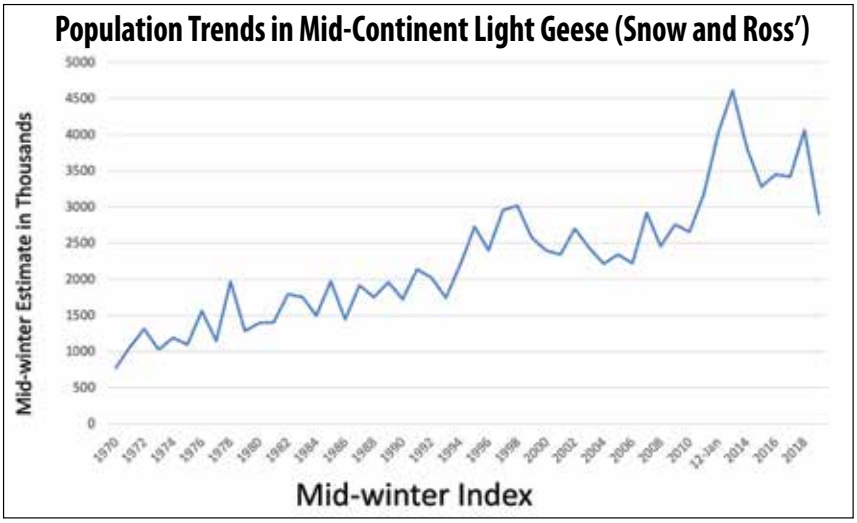


***FIGURE 3***. Mid-winter survey estimates of mid-continent light geese, 1970-2018.

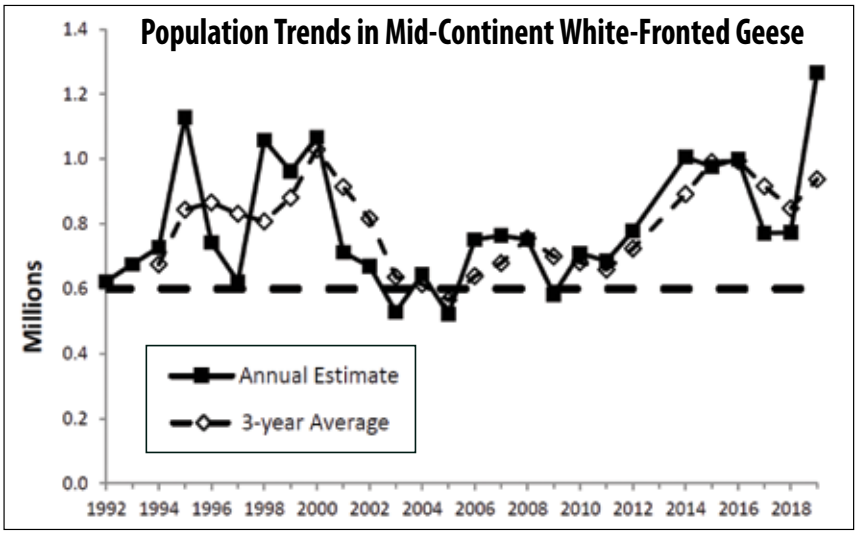


***FIGURE 4***. Fall aerial survey estimates of mid-continent white-fronted geese, 1992-2019.

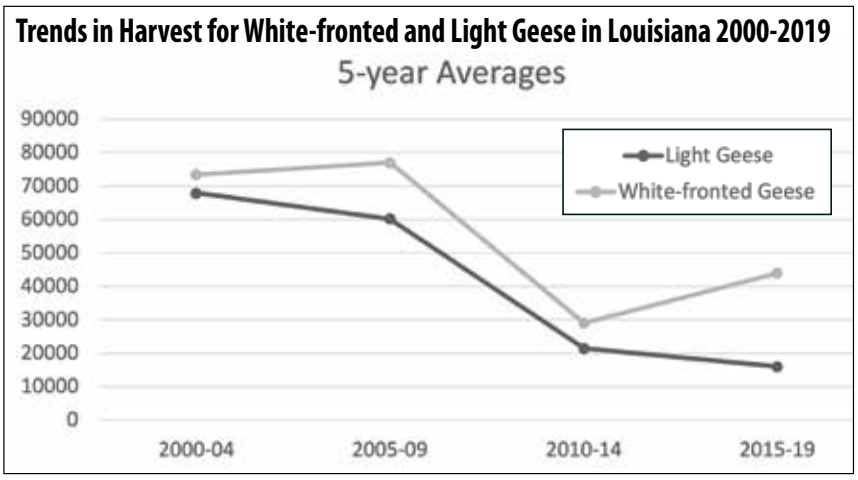


***FIGURE 5***. Five-year trends in harvest of light and white-fronted geese in Louisiana, 2000-2019.

Those hunters mostly blame no-till agriculture in more northern states, providing additional food resources and thus the shifting winter distribution of Canada geese, but the exact cause is not well understood.

There is growing discussion among hunters and waterfowl managers alike about the potential effect of "hunting pressure." Discussions about long seasons, liberal bag limits, increased accessibility to birds through advances in GPS, all-terrain vehicles, and surface-drive motors, as well as better hunter networking through cell-phone and on-line communication, suggest these activities have forced birds to move somewhere else. On the small scale, we can see the effect of sanctuary, and how limiting the number of hunters or days hunted can maintain local populations, but that has not been demonstrated on a large scale. Indeed, closing hunting seasons in 1962 did not lead to a return or even maintenance of the migratory populations of large Canada geese in Louisiana. In most cases, the effect of changes in hunting opportunity is confounded with other factors. Canada goose hunting re-opened in Louisiana in 1992, then expanded from nine to 16 days in 2006, and again to 44 days in 2009 during a period of both large-scale conversion of rice to sugarcane and expanding crawfish farming as well as declining ground counts for migratory Cacklers. Discussions about the effect of expanded season lengths and bag limits for snow geese culminating in the Conservation Order in 1999, which allowed liberalized hunting methods and hunting into spring, can't be separated from landscape-level changes in agricultural habitat availability. But, there is growing interest among dedicated Louisiana goose hunters in limiting hunting opportunity in an attempt to maintain or expand the current wintering population of white-fronted geese. From the 2020 Waterfowl Hunter Survey, 22 percent of respondents who expressed an opinion preferred reducing the white-fronted goose season to 60 days with a two-bird bag over either 88 days with a two-bird bag (88/2) or 74 days with a three-bird bag (74/3). Although far from a majority, that is up markedly from 2015 when only 4.5 percent preferred leaving the season unchanged at 74 days with a two-bird bag rather than liberalizing to 88/2 or 74/3.

It's a recurring theme in waterfowl population monitoring; fewer birds of some species wintering at the southern end of flyways while overall populations remain stable or increasing. Because it is happening across the northern hemisphere, rather than just in North America, large-scale ecological factors like changes in climate and agriculture are the likely ultimate factors. LDWF's Paul Link initiated a study using GPS/GSM transmitters on white-fronted geese captured in Louisiana in 2015. These instruments allow determination of precise local habitat use as well as large-scale movements across multiple years (*page 30 of this issue*). It's hopeful the data can inform both habitat and harvest management decisions in the future to benefit Louisiana's goose hunters. Similar studies on other species integrated with assessment of landscape-level habitat changes and targeted studies of disturbance are necessary to better understand the factors driving these apparent shifts in winter distributions, and most importantly, what we can do to address or adapt to them.

# The Black-Bellied Whistling Duck: *Irruption?*

BY PAUL LINK, NAWMP Coordinator

The black-bellied whistling duck (*Dendrocygna autumnalis*; BBWD) is an increasingly common waterfowl species in Louisiana. They have long been established in south Texas, Mexico and South America; however, it wasn't until 2001 that they were first documented on the Breeding Bird Survey (BBS) in Louisiana (Figure 1). The BBS is perhaps the best survey for BBWD as traditional waterfowl surveys are inadequate due to low detection probabilities of this species. They are often observed in or under trees, and at certain times of the year, in urban, suburban, and even industrial habitats where low-flying aircraft could not make reliable estimates. My field observations corroborate the BBS data with a spike in 2011 followed by a gradual decline.

Some have purported that the BBWD population in Louisiana was established by a captive release program (Wiedenfeld and Swan 2000). The last reported captive release of 12 BBWD in Louisiana occurred in 1974. It seems unlikely that BBWD could have remained undetected by the BBS for nearly 30 years. Further, the rapid spike in numbers is more likely to have occurred from a large immigration or displacement event rather than within state growth. While we can't be sure what exactly caused them to expand or shift their range into Louisiana in the early 2000s, they have very successfully occupied an available niche. The Texas population appears to be trending upwards. Biologists in Mexico don't have any formal surveys or vital rate estimates, but suspect their BBWD population trending downward with wetland loss and declining acreage of preferred agricultural crops. There is little to no information as to the status of BBWD in South America, but I suspect a similar declining trajectory given mining, agricultural, and development intensification. In the near term, wetland destruction by industrial development in South America will far outweigh the negative impacts of global climate change (Junk 2013).

I started working for LDWF in November of 2008. Shortly thereafter I joined LDWF biologists Christian Winslow and Mike Perot banding BBWD in the greater New Orleans area. That exposure really sparked my interest in this species. At the time, fewer than 5,200 BBWD had been banded since the inception of the North American Banding Program more than a century ago. By comparison, more than 7 million mallards have been banded! I was amazed that at our current knowledge of waterfowl, some of the most studied species in the world, that such a common and abundant species as the BBWD could be so poorly understood and studied. Over the last 11 years I have spent the majority of my personal time during the spring and early summer months trying to learn more about them.

The first thing I learned from Christian and Mike's banding during 2004-2008 was that there were very few subsequent encounters or recaptures. During that five-year period they averaged approximately 210 bandings per year with just 4 percent subsequently re-encountered. I began looking for additional BBWD concentrations wondering if perhaps those urban birds were year-round residents and thus unlikely to be encountered by hunters (roughly 52 percent of my band recoveries are shot and reported by hunters). I also began aging and sexing all captured individuals. This hadn't previously been done and I questioned if the large urban concentration of birds could have been a particular cohort having low survival or be less likely to make seasonal movements. I was able to band more than 1,000 BBWD on private lands across southeast and southwest Louisiana (avoiding the New Orleans area) over the next several years and found a consistently low 5-6 percent encounter rate. For comparison, recovery rates for preseason banded wood ducks may exceed 20 percent. During each of the past four years my goal has been to band more than 3,000 BBWD, trying to split them equally between southwestern and southeastern Louisiana. Rockefeller Refuge and Pass-a-Loutre staff regularly band 300 and 200 per year, respectively, as well. Elsewhere in North America, on average fewer than 300 BBWD are banded annually. To date I have personally banded over 27,000 BBWD, have recaptured nearly 4,000, and have over 1,300 reported encounters. My bandings debunk the theory that they are migrating out of Louisiana in fall and winter. Nearly 80 percent of my bandings are recovered within Louisiana, with just 10 percent in Mississippi (most of these within a few miles of the Pearl River), 8 percent in Texas, less than 1 percent each in Arkansas, Florida, Tennessee, Alabama and North Carolina. I've had resightings of color marked birds as far away as New York. My lone recovery of a banded BBWD in Mexico was found dead in a cargo ship transporting grain that had departed the Port of New Orleans days earlier. I get many reports of blue-winged teal that I've banded in Louisiana and SK that have been recovered by hunters in Central and South America, so I

don't foresee reporting issues from Spanish-speaking regions.

In April and early May 2015 Dr. Jim LaCour (LDWF veterinarian) and I radio-marked 20 adult male BBWD with implant satellite transmitters; 10 in southwest and 10 southeast Louisiana. We had very high survival and excellent transmitter performance. Those birds primarily moved from coastal into the Mississippi Alluvial Valley of central and northeast Louisiana for the breeding season (July-September). However, one made a three-week exploratory flight down the Gulf Coast of Florida and returned to southeast Louisiana, and another nested in central Texas. By early November, 17 of 20 marked birds had settled into the metro New Orleans area where they remained throughout much of the winter. This movement was initiated prior to the opening of coastal duck season; they seem to anticipate trouble brewing. They gradually disperse from that region in late February and March, with some locations maintaining more than 200 BBWD throughout the summer. At one of my privately owned banding sites in southwest Louisiana, BBWD have predictably shown up on the afternoon of the last day of the coastal duck season. These data in addition to band recoveries support my theory that BBWD are primarily transient residents within Louisiana, and are rather limited in their inter-state migrations.

Another behavioral advantage BBWD have at avoiding hunting exposure is their very nocturnal nature. Most of their foraging is done at night, particularly during winter, which is afforded by a higher concentration of rods (receptors for night vision) in their eyes than most waterfowl. I've listened to, and on moonlit nights, observed large flocks of BBWD departing Lacassine Pool well after sunset. Conversely, they often return well before dawn. This behavior is common for those wintering in the metro New Orleans area as well. Flock after flock can be seen coming from the west and southwest marshes into the city at dawn. I've often heard BBWD prior to shooting time while paddling into the public marshes I hunt, and heard their mass exodus as shooting time neared. I bet most people don't even know their duck hunting spots host BBWD all night as they approach on their ATV or boat.

Photo by Denton Rumsey, Shutterstock.com

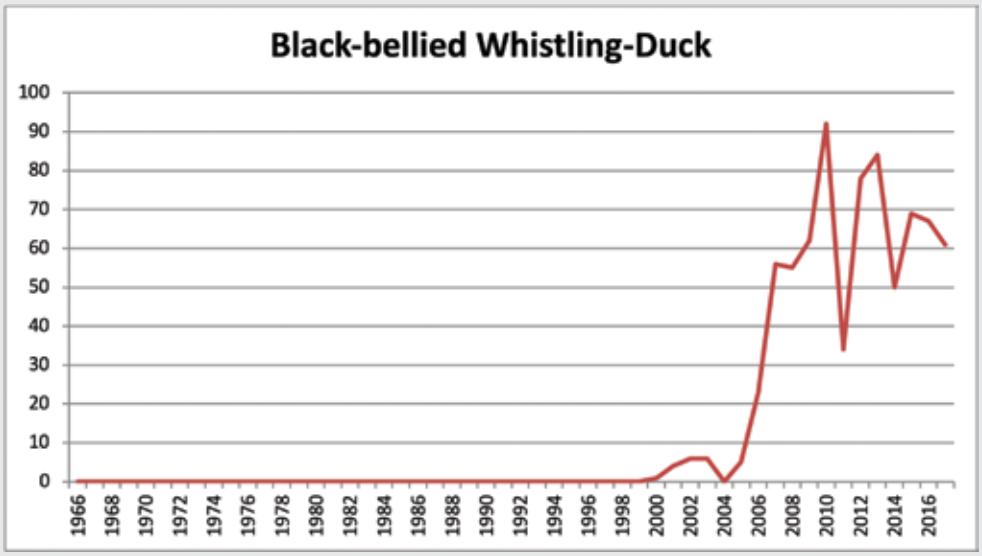


***FIGURE 1.*** Breeding Bird Survey data for black-bellied whistling ducks (BBWD) in Louisiana. No BBWD were detected on the survey prior to 2001. Pardieck, K.L., D.J. Ziolkowski Jr., M. Lutmerding, V. Aponte and M-A.R. Hudson. 2019. North American Breeding Bird Survey Dataset 1966 - 2018, version 2018.0. U.S. Geological Survey, Patuxent Wildlife Research Center. *https://doi.org/10.5066/P9HE8XYJ.*

A common question from hunters is why they aren't able to harvest BBWD during the September teal season. States like Florida, Tennessee and Kentucky have five-day "early duck" seasons followed by a four-day teal-only season. During the early duck season no more than two wood ducks can be harvested. Most Louisiana hunters will agree losing a full week of teal hunting opportunity would not be worth possible opportunity at BBWD. For many years the U.S. Fish & Wildlife Service would not consider additional requests to add additional species to early duck/teal season, and at a minimum it would have to come thru the Flyway process and include population and vital rate estimates, identify potential impacts to mottled ducks, and mandate hunter performance evaluations. Fulvous whistling ducks (FUWD) are also present across much of southwest Louisiana during teal season. Hunters struggle to correctly differentiate between FUWD and BBWD on the wing, and we have even less information on FUWD population dynamics than BBWD to justify additional harvest.

So where is the BBWD population heading from here? By definition, an irruption is population growth often categorized as an explosion, often followed by an abrupt or severe crash. You'll notice a recent declining trend in the BBS data for BBWD (*Figure 1*). Since the spike in 2011 I've documented multiple large die-offs of up to 3,000 BBWD due to unintentional poisoning at water treatment and grain handling facilities. An unknown number are killed via shooting or avicide under agricultural depredation and aircraft bird strike prevention orders. Due to their highly gregarious behavior, BBWD are particularly susceptible to communicable diseases. Thus, their population is already predisposed to high annual fluctuation.

If you haven't had the pleasure of observing BBWD I encourage you to get to know them. They are excellent parents, have complex social structures and diverse communications, are highly intelligent, and very adaptive. They are primarily transient residents within Louisiana, but are still migratory birds. They could move on just as quickly as they arrived should their habitats here change. However, I think BBWD are here to stay.

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Photo by Shutterstock.com

# Louisiana Mottled Duck Update

BY SCOTT DURHAM, LDWF Biologist Director - Research & Species Management

Louisiana mottled ducks are part of a larger West Gulf Coast (WGC) population shared with Alabama, Mississippi, Texas and Mexico (see Reynolds, Louisiana Wildlife Insider Fall/Winter 2017; *www.wlf.louisiana.gov/resources/category/wildlife-insider#2*). They are usually found in pairs or small groups, although occasionally can be seen in large numbers in the fall (Bielefeld et al. 2010). They are year-round residents inhabiting emergent estuarine marshes, palustrine wetlands, rice fields, and other agricultural wetlands (Stutzenbaker 1988). Mottled ducks are sexually dimorphic, that is, males and females have similar plumage characteristics.

Although seemingly an adaptable and robust species of waterfowl, capable of exploiting a variety of habitats, the WGC mottled duck population has been in decline in recent decades. One analysis of banding data from 1994 to 2005 estimated a finite population change rate of .82 for mottled ducks in Texas and Louisiana (Johnson 2009). A later population model indicated a lower growth rate of only .54 in Texas (Rigby and Haukos 2014). A growth rate of 1.0 indicates a stable population, so anything less than 1.0 indicates population decline. Surveys of breeding mottled ducks from 1985-2009 on Texas coastal National Wildlife Refuges indicated a 12 percent annual decline (Haukos 2009). Current breeding and mid-winter period aerial surveys in Louisiana and Texas still document long-term population declines (Reynolds 2017).

The WGC adult mottled duck female annual survival estimate is similar to mallards, the most successful and numerous duck species in North America. So why are mottled ducks failing in the WGC? There are many possible reasons for the mottled duck decline.

Some of the same issues that have affected migratory wintering waterfowl populations in Louisiana have negatively affected mottled ducks as well, such as loss of 1.3 million acres of coastal marshes due to subsidence and coastal erosion, loss of rice acreage to other forms of agriculture such as crawfish and sugar cane farming, changes in remaining rice acreage agricultural practices, invasive species, human development, and other landscape changes. In fact, the habitat changes are even more detrimental to year-round residents that must meet their ecological needs not only during the fall and winter, but also during the breeding and molting periods of spring and summer. Despite lead shot being banned for waterfowl hunting nearly 30 years ago, residual lead shot likely persists around historic hunting blinds and in areas without regular soil disturbance. As residents, mottled ducks are potentially more at risk to lead shot ingestion and other local environmental issues, and the potential negative effects of that exposure.

The loss of fresh and intermediate marsh type habitats across the coastal zone may also be a factor in reduced mottled duck recruitment. Marsh types are normally described based on plant species composition, but evolve as such partially due to water salinity effects. Thus, marsh types are indicators of mean water salinity levels. Moorman et al. (1991) found mottled duck ducklings exhibited detrimental effects from water salinities above 9 parts per thousand (ppt), indicating ducklings require 0-8 ppt for optimal growth and survival. Remarkably, even with the decline in fresh and intermediate marsh habitats, coastal alligator populations, as estimated from alligator nest counts, have increased. Has the loss of fresher marshes forced mottled ducks to live with higher concentrations of alligators that prey on ducklings? Historical studies reported low amounts of mottled duck contents as prey items in alligators, but more current information suggests that mottled ducks as prey could be substantially higher in alligator diets (Elsey et al. 2004).

In Louisiana and Texas, where habitat quantity and quality have been declining for mottled ducks and other waterbirds, low recruitment (the number of young that enter the huntable or adult population) is thought to be the most limiting factor negatively impacting the sustainability of WGC mottled ducks. Recruitment begins with nesting propensity, then nest success, brood survival, and finally, individual duckling survival to fledgling (flight) stage.

Declines in mottled duck numbers are clear indications that recruitment is not adequate to sustain WGC populations in the face of habitat loss and degradation. Although hunting mortality, as determined from band returns, is not thought to be an additive form of mortality and a defining contributor to the decline, it is unlikely that biologically sustainable hunting of mottled ducks will be allowed much longer in the face of the long-term downward population trends. If this occurs, it will be a significant loss to hunters and to waterfowl managers, as banding data is an important and efficient long-term population monitoring tool to estimate survival of mottled ducks.

Female survival is also a major driver in wildlife populations. In a 2006-2009 telemetry study of 503 female mottled ducks radio-marked across coastal Texas and Louisiana, estimated annual female survival was 48 percent and 40 percent for adult and juvenile females, respectively (again, similar to mallards). The study divided the annual cycle and survival of mottled ducks into four biologically important periods (Wehland 2012).

## BREEDING PERIOD

Weekly survival and mortality based on exposure days were estimated. This analysis revealed that the nearly five-month long breeding period had the highest seasonal mortality rate (40 percent), and that this period of a female mottled duck's life cycle was one of the most significant sources of mortality (Wehland et al. in press). During the breeding period a female mottled duck will spend around 34 to 38 days laying eggs and incubating her clutch. This is a long time to be at the mercy of any predator that walks, swims, flies, or slithers by. Even if the hen escapes, the eggs or ducklings are still very vulnerable to loss and thus may not be added to the population.

In early spring, mottled duck females begin egg laying in well concealed nests lined with adequate litter (dead grasses mostly) and dense overhead cover in marsh and agricultural habitats. In Louisiana, nesting studies have documented nest success rates from 5 to 31 percent (Baker 1983, Walters 2000, Durham 2001, Stutzenbaker 1988, Holbrook 1997) with the highest success rate occurring on Atchafalaya Delta spoil islands (Holbrook 1997). A nest success rate of ≥15 percent is needed to sustain dabbling duck populations breeding in the northern latitudes. Peak mottled duck nesting is generally in March and April but extends through May with even a few nests initiated in June. Mottled ducks will re-nest several times if a nest is lost and habitat conditions remain adequate (Stutzenbaker 1988). Nest losses are primarily from predation but others are lost from abandonment or flooding, and a few from cattle trampling or machinery in agricultural habitats.

During drought years mottled duck females that forego nesting attempts may have higher breeding season survival, likely due to less exposure to predators. By foregoing nesting, mortality risk is reduced and reproductive efforts by individuals are conserved for the next breeding season (Dufour and Clark 2002) when wetland abundance and conditions might be more favorable for success. Mottled duck nesting efforts are much higher and earlier in the season in wet years than in dry years. In a Texas study, during two years of below average rainfall, Finger et al. (2003) observed 31 percent and 33 percent of radio-marked females initiate nests. During the year of the study when habitat conditions were wet, 77 percent of females initiated nests. Nest success (proportion of nests hatching at least one duckling) was 9 percent and 38 percent during dry years and 62 percent in the wet year (Finger et al. 2003). Brood success (proportion of broods where at least one duckling survived 30 days) during the two dry years was unknown one year and 0 percent the other year. During the wet year of the study, brood success was 69 percent (Finger et al. 2003).

Broods begin to hatch in mid-spring and into early summer and remain very vulnerable to predation and loss. Proximity of the nest bowl to good brood habitat is critical; the less distance from the nest to water and brood habitat, the better the chances for survival. Specific knowledge of optimal brood habitat characteristics is lacking due to the difficulty in observing brood success and survival to the fledgling stage. However, Rigby and Haukos (2015), using Baker's (1983) data, estimated a range of average ducking survival to 30 days at 35-57 percent. Finger et al. (2003) observed 41 percent duckling survival in the wet year of his study.


Photo by Ruth Elsey


Photo by Alfred Viola, Northeastern University (*forestryimages.org*)


Photo by Scott Durham


Photo by Scott Durham



Adequate brood habitat and water on the landscape is necessary through the summer months for brood survival.

## POST-BREEDING (MOLTING) PERIOD

Late summer molting period survival was thought to be a potential concern for mottled ducks (Wilson 2007). Molting mottled ducks, unable to fly, may be at increased risk of avian and other forms of predation. However, Wehland (2012) estimated post breeding period weekly survival to be the highest period of the annual cycle. The model averaged seasonal mortality rate during the post breeding period was 18 percent.

Additionally, molting habitat availability may not be as limited as breeding habitats for mottled ducks. Molting mottled ducks can survive in higher marsh salinities than ducklings. Molting habitats with high levels of invertebrates, seeds, and submergent vegetation, such as wigeon grass, can provide the additional nutritional requirements (Ringelman 1990, Chamberlain 1959) for growing new feathers. Wigeon grass is primarily a brackish marsh plant species, thus allowing mottled ducks to exploit a larger landscape of coastal habitats.

Molting female mottled ducks selected more permanent estuarine emergent wetland habitats with 35 percent open water and 45 percent vegetative cover and consistent water depths during the molting period (Wehland 2012).

## HUNTING SEASON

Beginning in the fall and extending through winter, mottled ducks, which normally exist in pairs or small groups, begin competing with thousands of migratory waterfowl for food and space when they arrive on the wintering grounds. This begins with early migrants such as blue-winged teal in late August and September, soon followed by northern pintails and northern shovelers in October. By December and January, millions of migratory waterfowl arrive in the formally exclusive mottled duck wetland home ranges. Although unable to determine cause-specific mortality due to scavenging, Wehland (2012) reported 12.2 percent of radio-marked female mortalities were known harvest, similar to Florida studies, suggesting that other forms of hunting season mortality may be important. Factors such as crippling loss, unreported harvest, or unknown data from radio failure or loss could not be accounted for in the study. Mottled ducks in poor body condition may also be more vulnerable to harvest or other stress related causes of death.

Hunting season had the lowest weekly survival rate for adult females. Adult female mortality during the 60-day hunting season averaged 32 percent. Although most of the total mortalities (52 percent) during the study occurred during the hunting season, and weekly survival was slightly lower than breeding period weekly survival, fewer exposure days during the hunting season resulted in a lower seasonal mortality rate than during the breeding season (Wehland et al. in press)

Direct harvest mortality is not thought to be the primary cause of decline in WGC mottled ducks. Survival of radio-marked females during hunting season was not different between Texas and Louisiana, even though the daily bag limit was three in Louisiana and one in Texas. Additionally, there was no difference in survival of radio-marked female mottled ducks in Louisiana when the limit was reduced from three to one (Wehland et al. in press).

## LATE WINTER PERIOD

Late winter, a relatively short period of time after the hunting season and before the breeding season, saw mortality rates for adult females at only 10 percent (Wehland 2012).

In late winter mottled ducks are pairing up and females will soon begin taking in calories and the necessary nutritional requirements for follicle development and subsequent egg laying in early spring. In the agricultural zone this means they need adequate amounts of water across the landscape. Historically this was provided by traditional rice agricultural practices where the seeds were flown onto flooded fields, dewatered for a short time for germination, and then re-flooded for weed control. Today many rice fields are dryland planted with herbicides, reducing the water and food resources on the landscape during the breeding period. There is also less rice being planted overall, with more conversions to crawfish farming, sugar cane or other uses.

## WHAT CAN WE DO?

Our main priority is to facilitate management actions and landscape scale initiatives to increase recruitment of mottled ducks. Can we use intensive management

techniques to increase recruitment to sustainable levels? Is this something wildlife managers should consider now?

Coastal prairies in Texas and Louisiana once spanned 6.4 million acres and contained numerous small, shallow wetlands that were used by mottled ducks (Allain et al. 1999). Today most of it is gone, especially in Louisiana where only remnant isolated patches of native prairie remain. But these existing prairie remnants give clues as to what mottled duck breeding habitat, especially the nesting component, should be to increase recruitment. Some of the characteristics of prairie nesting habitat could be simulated or restored in fallow rice fields, old fields, and cattle pastures.

What potential does the current agricultural region in southwest Louisiana have to sustain mottled ducks as further coastal loss or degradation continues? Although nest density in the agricultural region is generally low and on average only one nest per 640 acres (Stutzenbaker 1988), mottled ducks will nest in very high densities within the rice prairie agricultural landscapes under optimum conditions. Nest densities of 1 nest per 10 acres have been recorded in a 250 acre remnant prairie during a dry year when mottled ducks concentrated around available flooded rice fields (Durham and Afton 2003). However, this does not ensure nest success or increased recruitment; nests must successfully hatch and then broods must survive to fledge. To enhance brood survival, nesting habitat must be in close proximity to adequate and quality brood habitat.

Mottled duck ducklings, like other waterfowl species, need a protein rich diet to develop and grow. They also need adequate escape cover from predators. Shallow water habitats devoid of large fish, turtles, alligators, or other aquatic predators, with emergent vegetation for cover and submergent vegetation to harbor invertebrates, would seem optimal. Rigby (2008) observed broods using shallow water habitats (approximately 3-12 inches) where emergent vegetation to surface water ratios were in the range of about 50:50. Broods have also been observed in southwest Louisiana habitats with higher proportions of emergent vegetation (Paul Link, pers. obs.). Submerged aquatic vegetation harboring aquatic insects would provide needed protein sources for broods. In marsh habitats, water salinities at or below 8ppt are optimal for duckling growth and survival. However, longtime marsh managers in southwest Louisiana have consistently observed mottled duck broods in more brackish habitats where salinities may not be optimal, but are perhaps selecting these habitats due to fewer alligators and other predators (Darren Richard, pers. obs.).

Average brood home range sizes range from 100-173 acres (Rigby 2008, Rigby and Haukos 2015) in marsh habitats. These conditions can also be managed for and simulated in agricultural habitats. Flooded rice fields can serve as secondary brood habitats or water escape ways to other primary brood habitats such as natural wetlands maintained in pastures or other grasslands. Idle lands or fallow rice fields can develop into simulated fresh marsh habitats which could provide optimal brood habitats on a temporary basis.

One of the greatest potential sources of brood habitat may now be in permanent or semi-permanent crawfish ponds in southwest Louisiana. However, this is a new concept, and crawfish pond management may have to be tweaked for those potential habitats to benefit mottled ducks and increase recruitment.

The West Gulf Coast Mottled Duck Management Plan (Wilson 2007) will soon be updated and include further recommendations for the current sustainability of WGC mottled ducks. LDWF is committed to ensuring the sustainability of this important waterfowl species in Louisiana and the entire WGC. Many partners such as NRCS, DU, USFWS, private companies, farmers, hunters, and private landowners are equally committed to working together to bring incentives to agricultural producers and landowners to manage for mottled ducks. Easement purchases to permanently protect mottled duck breeding habitats are another landscape tool that could be used towards this conservation effort. LDWF is also committed to providing a demonstration area where management techniques can be showcased so interested individuals can observe the results of focused management.

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Hudsonian Godwit

# Migration Alteration


Peregrine Falcon


Blue Grosbeak


Barn Swallow

## *Climate Change, Habitat Degradation Have an Effect on Non-Waterfowl Migrating Birds in Louisiana Too*

BY TREY ILES, LDWF Public Information
PHOTOS BY MICHAEL SEYMOUR, LDWF Ornithologist

It's a term that will send you to the dictionary but once you understand the meaning, it sheds light on how climate change can alter the life cycle of species throughout the world. Phenology is the study of cyclic and seasonal natural phenomena primarily in relation to climate and animal and plant life.

The term phenological mismatch is often used by wildlife biologists to describe the interaction between the timing of resource availability and the life cycle of animals. That is, if the availability of food resources does not align with an animal's need for those resources, negative consequences on reproduction and survival could result.

Because many of the alterations occur at different levels of the food chain, some animal species will be negatively impacted more than others while some will likely benefit.

One easy way to consider this is how azaleas bloom in Louisiana. If the state experiences a rather mild winter, azaleas begin budding as early as the middle of February. These early blooming azaleas could be out-of-bloom by the time many families are taking their annual Easter photos, if Easter is, say, in April. The effect in this example, or course, pales in comparison to impacts felt by the natural world.

For animals, the impacts can be far greater than a missed photo op. A warmer winter could mean the early flowering and fruiting of plants upon which many insects and other pollinators rely to survive.

If the warmer weather affects the plants at a different magnitude, or rate, than the insects that pollinate them there could be detrimental impacts to both the plants and the insects. This would likely lead to declines in both the plants and their associated pollinators.

If, however, insects emerge, equivalent to budding out in plants, early from winter inactivity animals that feed on those insects will likely experience a disruption in their life cycles. Alterations in timing of resource availability can be particularly detrimental to nesting and migrating animals.

Michael Seymour, an LDWF biologist supervisor and an ornithologist, shares similar concerns with other biologists.

"During nesting season, many of our birds, even ones we would think of as seed-eaters like northern cardinals, require insects to feed their developing chicks," Seymour said. "In fact, according to University of Delaware entomologist Doug Tallamy, Carolina chickadees feed more than 5,000 insects to each clutch of young. A shift in insect emergence could lead to the loss of some of our most common and beloved birds."

But insects are seemingly omnipresent in Louisiana, a truth well known to duck hunters fending off mosquitos during their winter hunts.

Could the birds simply eat other species of insect? Unfortunately, not all insects are created equal. For example, several species of insects produce toxins. And even if palatable, other species may not provide similar levels of nutrients, leading to increased energy usage for less return on the investment.

The prevalence of invasive exotic insects and other organisms typically makes matters worse as invasive species often can spread unchecked and can outnumber native species. Exotic invaders may replace native organisms but may be far less suitable as a food resource.

When considering the effects of climate change on the spread of many invasive exotic species and their impacts to ecosystems, the disparity can become compounded and even more troubling.

Like migratory waterfowl, migratory nongame birds have changed their migratory timing and patterns, too.

Neotropical migratory land birds migrate from breeding grounds in North American to wintering grounds in Central and South America. This varied suite includes diverse birds from cuckoos to warblers, which have shifted arrival and departure times due to temperature change with earlier arrival to nesting grounds in spring and later departures in fall.

Although this would indicate a longer breeding season for such birds it could also indicate that mismatched phenology of food resources is causing the birds to stay longer than needed, decreasing the birds' chances of finding suitable wintering territories.

Seymour said that because so many migratory bird species and individuals use Louisiana as a stopover and refueling point, our state is particularly well positioned to boost resilience of birds as they attempt to adapt to climate change. Conservation and restoration of coastal forests would be one such benefit to birds as well as people.

As you might expect, migration is a challenging process for birds. In fact, Seymour

said it can be the most dangerous time in the life cycle of a bird. One of the keys for successful migration is getting enough energy for the trip. High quality habitat and its distribution on the landscape play important roles in ensuring proper provisioning.

"If the distribution of habitat changes due to climate change, for example, there could be an increased distance between suitable breeding and nonbreeding areas which means an increase in energy need,'' Seymour said. "That energy need may be difficult to fulfill if there are significant changes in food availability due to climate change and the resulting mismatched phenology."

And those non-waterfowl birds are oftentimes guided by internal wiring that alerts them when it's time to head south and what routes to take.

"With longer lived birds like waterfowl and cranes, the adults teach the young their migratory routes,'' Seymour said. "When it comes to species such as songbirds like warblers, it's ingrained into their genetics where to go. They have an internal map that guides them. They're wired to do that.''

So if climate and habitat change have altered the landscape, how quickly can those birds adapt? It's something ornithologists are observing closely.

"Some of them likely will be able to adapt even if habitat shifts significantly,'' Seymour said. "Others may not be able to adapt as quickly.''

Mitigating adaptation is likely linked to the distance of travel between seasonal locations and to whether or not migratory routes are learned or genetic.

Something else impacting Neotropical migratory birds is the severity and frequency of storms over the Gulf of Mexico whether they be tropical or temperate in origin. Birds migrating over the Gulf can end up in the crosshairs of a hurricane or a strong spring cold front.

"It's fairly safe to say we're seeing more violent tropical storms and there is evidence that we could be seeing an increase in their frequency,'' Seymour said. "Storms occurring over the Gulf during peak migration can be catastrophic for birds.

"In spring, many Neotropical migratory birds leave the tip of the Yucatan Peninsula at sunset. They leave at 6 or 7 at night and fly, for example, to Grand Isle, where they show up at 1 or 2 p.m., about 19 hours of flight time. But if they're flying over the Gulf and a spring storm comes through, you're talking significant mortality, potentially hundreds of thousands of birds.''

In fall, tropical cyclones, particularly in the Caribbean, can result in substantial losses of birds, too. Many of North America's birds migrate south off the tip of Florida in fall and several species winter on Caribbean islands.

With their vast resources, states bordering the Gulf of Mexico, including Louisiana, remain a critical destination and stopover point for many migratory bird species. One study by Mehlman and colleagues broke migratory bird stopover sites into three categories that the casual observer could readily understand; convenience stores, full-service hotels and fire escapes.

A convenience store was compared to New York's Central Park, a small area of forested habitat surround by inhospitable habitat. The idea is that birds facing otherwise adverse conditions can stop in, get some food, rest briefly then be on their way.

A full-service hotel provides plenty of food and ample rest opportunities. The Atchafalaya Basin in Louisiana is one of the few places in the southeast United States that acts as a full-service hotel.

The final type, the fire escape, is just what it sounds like, a place used in emergency conditions. A fire escape isn't used continuously but its presence on the landscape is absolutely crucial to survival.

In fire escapes, birds can hunker down should conditions warrant it such as in strong spring storms over the Gulf. Louisiana's coastal forests, its cheniers and barrier island forests, supply these fire escapes.

But Louisiana's coastal habitats have shrunk significantly through the years. And as buffering coastal marsh is lost to sea level rise, subsidence and more violent storms, so too is the state's coastal forest. Present-day acreage of coastal forest is only 1-5 percent of what occurred pre-settlement in Louisiana according to the Louisiana Wildlife Action Plan.

"It's very simple,'' Seymour said. "If we lose our coastal woodlots we will lose our birds. It's a sobering thought. But in addition to active habitat management, bird scientists are directing their collective focus on understanding these critical needs while filling data gaps that would otherwise hinder conservation.''

Technology to track migratory birds has vastly improved since the 1960s when VHF transmitters were first placed on animals. The transmitters, or tags, have become more powerful, more versatile and much smaller, allowing biologists to study the migration of birds that would have been unable to carry a tag just a few years ago.

The data are providing them with previously unknown, sometimes surprising, information. But there is still much to learn.

With the state's Coastal Protection and Restoration Authority and LDWF leading the way, the state is working to improve habitat.

The state is using in excess of $4 billion in National Resource Damage Assessment, or NRDA, funds to restore coastal and nearshore habitat. About $148 million of these funds are earmarked for bird habitat. The money is all from the 2010 *Deepwater Horizon* oil spill settlement and will be distributed over 15 years.

"The bird funding will focus several species of birds that were heavily impacted by the BP oil spill," said Todd Baker, LDWF's Coastal Resource Scientist Manager. "An initial focus will be on colonial nesting waterbirds such as brown pelicans, egrets and herons."

Other projects will focus on building habitat for several species of secretive marsh birds and mottled ducks. These projects will benefit Louisiana's year-round resident birds such as rail, gallinule and seaside sparrows as well as a multitude of migrant birds of the same species plus many additional ones.

Habitats that are a primary focus for restoration include many habitats that are identified in Louisiana's Coastal Master Plan and provide tremendous benefits for wildlife including barrier islands, coastal-forested ridges, colonial nesting islands and marsh.

One recently completed project, utilizing early restoration funding from the BP oil spill, is the restoration of Whiskey Island, the Caillou Lake Barrier Headland Restoration Project. This island is part of the Isle Dernieres Refuge located in Terrebonne Parish.

It's designed to provide defense from tropical storms but an added benefit is the habitat it provides birds year round.

"The beach built there has already benefitted a lot of black skimmers and least terns which nest there,'' Baker said. "Additionally many migratory birds, such as sand pipers, plovers and a host of other shore birds and wading birds were utilizing the new restoration project this past winter.''

Two additional projects are also in the works. The restoration of Queen Bess Island near Grand Isle in Jefferson Parish is set to begin construction. Rabbit Island, located in Calcasieu Parish, is in the design phase and may be under construction in 2020. The star of the show in these projects is the brown pelican, a species that has recovered since its disappearance from Louisiana in the 1960s because of the pesticide DDT.

While brown pelicans will benefit from these two projects, the designs include features that will benefit more than one single species. These islands will provide critical nesting habitat for a number of bird species that are in decline across the Louisiana coast.

"Loss of our coastal wetlands equates to habitat loss for many species of wildlife and fisheries,'' Baker said. "Species that live in the coastal zone and migrate there have suffered. The state is making a serious push to restore, preserve and improve those habitats so that our children and grandchildren can enjoy the wildlife, fisheries and wetlands that we have today.''

# Species' Range and Range Shifts

BY JASON OLSZAK, Wetland Bird Specialist

Since a species' geographic range contains all the biotic and abiotic components it requires, and the presence of those components are fluid, the geographic ranges of species' populations are continually fluctuating also. Genetically controlled behaviors can restrict range, whereas behavioral plasticity, also genetic, enables the species to expand beyond it. Nevertheless, general geographic patterns for each species certainly occur and published range maps are the result of these determined patterns. Range maps show where species have been documented and are likely to occur across the continent. Within that range, the distribution of a species' population is rarely uniform, resulting in pockets of abundance and rarity. There are also areas, even large areas, where that species does not occur because of geographical habitat differences and deficiencies. Alternatively, transient/accidental individuals regularly occur well outside the published range. These individuals are not a true indicator of range expansion because of indeterminate survival or fecundity. When large numbers of individuals begin regularly appearing in new areas (or vacating traditional areas), species-level range shift occurs.

Species' ranges change in three ways:

1. Range changes may occur at one or more of the margins resulting in the expansion, contraction, or shift of the entire range.
2. The center of occurrence may shift if one margin advances or contracts at a different rate than another.
3. The center of abundance within a range can shift when densities within the range shift (LaSorte and Thompson 2007).

All of these shifts can occur with or without a corresponding change in the total overall population. Conversely, successive failures in a portion of the range result in contraction.

## PHENOLOGY

Intrinsic life cycle events of bird species often require different habitats. Courtship, mating, birthing, rearing of young, and wintering period habitats often differ due to specific biological requirements of the species. When required habitats are geographically distant, predictable, temporary, population-level range shifts take place. Phenology is the timing of when these changes occur. This is evident in migratory species, but is true of residents as well. Phenology often has an effect on social systems, which affect distributions. Many breeding birds achieve the best territories their physical condition, often a function of age, allow them to defend. Competition thus

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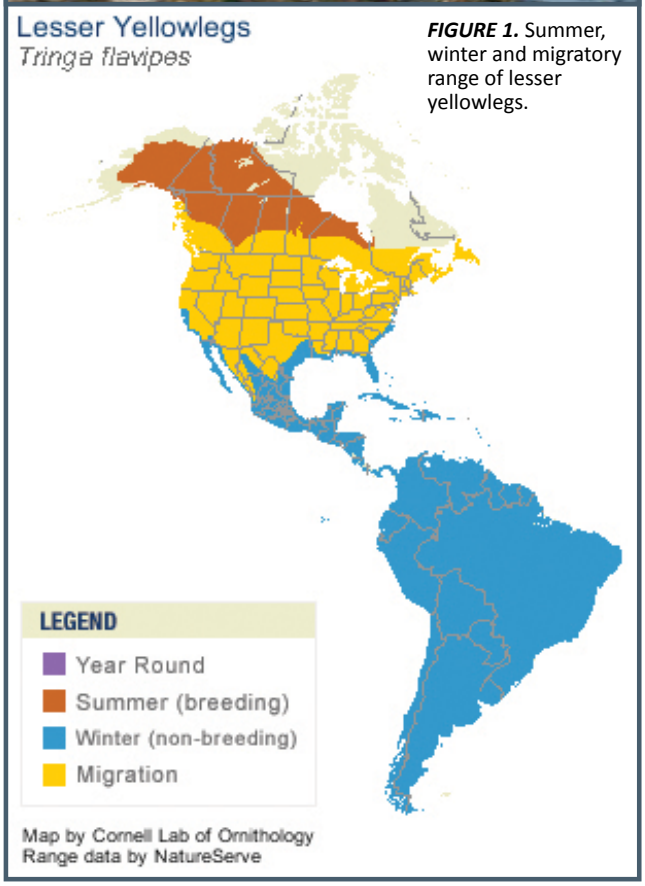


***FIGURE 1.*** Summer, winter and migratory range of lesser yellowlegs.

increases distribution during breeding season. This influences both the distance they migrate away from, and the time they arrive to, the breeding grounds (see Iles & Seymour Louisiana Conservationist Fall 2019 for changes in timing). Many of these spring territorial species are quite gregarious in winter (waterfowl, shorebirds, passerines). Conversely, some species nest in colonies. These include mainly water birds (egrets and other waders, pelicans, cormorants, penguins etc.), but other species as well (bank and cliff swallows).

## RANGE SHIFT CAUSES

***Hypotheses (Biotic-Abiotic; Behavioral)***

Fluid biotic and abiotic factors include changes in intra- and inter-specific competition, disease, predation, habitat and climate. These have immediate and lasting effects on populations, and are regular drivers of range adjustments. They also have the potential for carryover affects that influence ranges at different stages of a species' life cycle. Competition with conspecifics, harassment by predators, and habitat quality affect resource attainment on wintering and migratory grounds. This can influence breeding condition and therefore fecundity months later and hundreds of miles away on breeding grounds.

Behavioral aspects affect species' range as well. General hypotheses concerning the success of range shifts for birds have ties to invasive species study. Diet and habitat generalists, r-selected, widespread, and migratory species are all thought to be capable "invaders" of new territory (Jeschke and Strayer 2006; Vall-llosera and Sol 2009; Angert et al. 2011). Migration distance may also have an effect on range shift, as short distance migrants are more familiar with changing temperatures and conditions in their proximate breeding and wintering regions.

## SURVEYS THAT CAN EXAMINE RANGE CHANGE

Most analyses tracking North American avian population trends and species distribution changes on both breeding and wintering grounds have been done using data from two long-term, broad based surveys. Each spring since 1966, the United States Geological Survey's (USGS) Breeding Bird Survey (BBS) is conducted throughout the U.S. and southern Canada (*www.pwrc.usgs.gov/bbs/*). For wintering birds, the National Audubon Society's Christmas Bird Count (CBC) has taken place since 1900 from southern Canada and Alaska to northern South America (*www.audubon.org/conservation/science/christmas-bird-count*). Since there are few systematic avian surveys for non-waterfowl in the arctic, changes in breeding range can only be examined for temperate breeding North American species via the coverage of BBS survey lines. Though some northern temperate nesters may be less frequently encountered at the southern edge of their breeding range, we cannot be sure that they are shifting their range by expanding into the north temperate zone or further into the arctic because of the lack of survey coverage.

## RANGE SHIFTS

Climate change is thought to influence birds' ranges through the expansion of breeding and wintering habitat to higher latitudes and elevations and contraction from lower latitudes and elevations (Parmesean 2006; Virkkala, et al. 2008). Whether this is done out of necessity or opportunistically is unknown. Some evidence supports these predictions, but species-level effects are highly variable and factors other than, or in addition to, climate act on populations. Parmesean and Yohe (2003) analyzed 1,700 diverse wildlife species worldwide showing an average poleward range shift of 3.8 miles per decade.

## BREEDING RANGE

Over a 20-year period, breeding birds in the U.K. have shifted north 0.6 miles per year, and for declining populations of birds at the north end of the island the retraction took place at their southern range margin (Thomas and Lennon 1999). In North America, Hitch and Leberg (2006) showed similar results in 56 species of North American

## BREEDING BIRD SURVEY

Breeding Bird Survey (BBS) is conducted throughout the U.S. and southern Canada. Close to 3,000 routes, each 40 km long are driven in May or June depending on latitude as southern birds breed earlier than those farther north. On each route, 50 evenly distributed points serve as survey locations at which the single observer records all birds seen or heard for 3 minutes. Beginning before sunrise, including drive time, each survey takes around 5 hours

Photo by Jen Oswald, Shutterstock.com

Cardinal

Cedar Waxwing

Photo by Bonnie Taylor Barry, Shutterstock.com

## CHRISTMAS BIRD COUNT

Christmas Bird Count (CBC) is conducted in unevenly distributed ~12 km radius circles from southern Canada and Alaska to northern South America. Multiple observers count all birds seen or heard within the circle for an entire day between Dec. 14 and Jan. 5. This survey has been run, albeit with increasing participation throughout the years, since 1900

birds. The northward range expansion of southerly distributed birds was 1.5 miles per year. In western North America, comparing BBS data from 1977-1981 with 2007-2011 (a time period that generates the greatest slope of temperature increase over time), 40 songbird species' range margins shifted in both directions of latitude and elevation, but averaged northward 1.1 miles per year, and 11.8 feet per year uphill (Auer and King 2014). Interestingly, higher elevation species shifted less in latitude than low elevation species. The largest latitudinal shift in the time period occurred for Bell's Vireo (268 miles north) and the largest elevational shift was Bullock's Oriole (1,440 feet uphill). Auer and King's objective was not to correlate range shifts with temperature, but rather life history traits. Nevertheless, they found no evidence that species' range size, migratory status, historic northern boundary, or population trend influenced shift in breeding latitude. Contrary to hypotheses, species with smaller diet breadth (diet specialists) shifted farther north while smaller clutch size corresponded to increased latitude, but lower elevation shifts.

## WINTERING RANGE

Christmas Bird Counts have been used in different ways for a number of studies. Counts from 1930-2001 at and around Cape Cod, Massachusetts showed increases for species with traditional winter distribution centers south of Cape Cod. Species with a wintering tradition north of Cape Cod increased at the Cape Cod latitude until 1970, then decreased when local mean winter minimum temperatures increased (Valiela and Bowen 2003). From 1966 to 2005, 68 percent of 305 bird species across North America showed northward shifts in center of abundance (Niven et al. 2009). In California, the center of abundance for 234 wintering migratory and resident birds (many different taxonomic Families) shifted an average of 7 miles north and 1 mile coastward from 1966 to 2013, corresponding to warmer winter minimum temperatures. This same dataset showed 37 percent of species moving north, 32 percent moved south, and 31 percent showed no latitudinal movement. Analyzing all aspects of 254 species' wintering range, LaSorte and Thompson (2007) used data from 1975-2004 to show northern boundary shifts (+0.9 miles/yr.) in latitude. The center of occurrence and center of abundance also both shifted north 0.3 miles/yr. and 0.6 miles/yr. respectively. They concluded that poleward shift is an interaction between climate change and regional factors. Six western wintering raptor species also show poleward shifts from 1975-2011(Paprocki et al. 2014). Rough-legged hawk has had the fastest shift (5.2 miles/yr.), followed by Golden eagle (4.8 miles/yr.). The lowest was northern harrier, but it too shifted northward by 0.9 miles/yr. Another CBC analysis in which 68 percent of 551 species displayed a positive population trend, contained 305 species with centers of abundance increasing in latitude (Soykan et al. 2016). These results track with increasing BBS population trends. If birds shift their wintering ranges northward faster than their breeding ranges shift, shorter migration distances and earlier spring arrival, likely facilitate the attainment of higher quality territories that increase fitness.

Changes in climate may also affect species range use through precipitation in addition to temperature. Cranes require shallow water roost areas and grain fields in which to feed diurnally. During the mild Nebraska winters of 2011-2012 and 2012-2013, 4,000-5,000 of the mid-continent population of sandhill cranes wintered in the Platte River Valley though mid-January (Harner et al. 2015). Low temperatures and lack of snow cover in Nebraska coincided with historic drought in their traditional wintering sites in Texas and north Mexico. The same winter of 2011-2012 also recorded observations of endangered Whooping Cranes in north Texas, Kansas, and Nebraska (Wright et al. 2014) which traditionally winter around Aransas National Wildlife Refuge, on the Texas coast. Sandhill cranes have also been observed more often on Kansas CBC's during the last 20 years. Whether cranes are first going to Texas and later returning north is unknown. Apparent, yet equivocal, range expansion involving sandhill cranes was shown by Lopez-Saut et al. (2011). New wintering locations were discovered in Mexico during winters 2007-2009. Whether this was due to increased population, the addition of food resources in new areas, or the result of increased survey coverage was undetermined.

Changes in diet item distribution, abundance, and phenology causes bird species' ranges to change, though the interconnected effects of diet, climate, and range are difficult to isolate. Diet item availability, both plant and animal, will either change temporally or spatially near historic range edges as a result of warmer seasons. The diet generalist hypotheses, which suggests that species that consume a wide variety of food items will be more capable of range expansion when climactic changes occur, was supported by Angert et al. (2011) who showed a shift of 1.5 miles per year north for wintering generalist passerines. However, Auer and King (2014) found significant northward and uphill shifts in the breeding range of diet specialists, and attributed this to specialists' ability to better track shifts in prey or hosts compared to generalists. Yet, MacLean and Beissinger (2017), upon examining 21 studies across multiple taxa, showed no effect of diet breadth or fecundity on range shift.

## TIMING OF MIGRATION

Changes in the timing of spring migration have been widely reported for many species of birds including "songbirds" (order Passeriformes), American robin and purple finch (Oliver et al. 2020), "shorebirds" (order Charadriiformes) like black-tailed godwit and killdeer (Gill et al. 2014), and waterfowl (order Anseriformes), including mallard and blue-winged teal (Murphy-Klassen et al. 2005)

One study examining a 42-year database of spring arrival dates for migrating birds found that 71 of the 93 species in their dataset advanced their arrival date by 4.2 days over the 42-year period (DeLeon et al.

Photo by Terry Spivey, USDA Forest Service (*forestryimages.org*)

**Rough-legged Hawk**

2011). Another study examining a 63-year data set found that 27 bird species altered their arrival dates with Passeriformes arriving eight to 19 days earlier, Charadriiformes arriving seven to 20 days earlier, and many Anseriformes advancing their arrival dates from three to 11 days (Murphy-Klassen et al. 2005).

Although the onset of migration may be determined endogenously (by an internal clock), the exact mechanisms causing changes in the timing of migration are not easily understood. Some studies have shown a correlation between arrival dates of migrants on the breeding grounds and temperature, earlier migration over time corresponds with increasing temperatures (e.g., DeLeon 2011). Temperature itself, however, may or may not be the primary factor driving changes in migration patterns. For example, as temperatures increase insects hatch earlier. If the food supply at a stopover site is no longer readily available migrating birds will stay for less time, moving to where there is an abundant food supply thereby adjusting the timing of migration (Zaifman et al. 2017).

## HUMAN INTERVENTION & OTHER CAUSES OF RANGE SHIFT

Anthropogenic activities such as conservation in the form of reforestation and wetland restoration, introductions and reintroductions, protections and regulations, and predator displacement improve fitness in species' range margins. Well publicized cases include the bald eagle, brown pelican, peregrine falcon, wild turkey, trumpeter swan, and Canada goose.

The reintroduction of migratory eastern sandhill cranes resulted in rapid population growth and large scale expansion of their wintering range. Birds unfamiliar with traditional wintering range, power plants that prevent shallow water bodies from freezing over, and the availability of corn fields without snow cover, all contribute to the expansion (Urbanek 2018). Artificial nest box programs have benefitted more than just the wood duck. In an example of interspecific competition-driven range shift, simultaneous range expansion of one species and contraction of another, occurred when western bluebirds recolonized former range in mountain valleys with the aid of nest boxes. Their increased aggression towards competing mountain bluebirds subsided once the mountain bluebirds withdrew from the valleys leaving only intraspecific competition (Duckworth and Badyaev 2007).

More than a few species benefit from urban/suburban development. Breeding white-winged doves expanded from the

**American Robin** Photo by LDWF Staff

**Blue-winged Teal** Photo by Shutterstock.com

**White-winged Dove** Photo by Shannon Tompkins

southwest United States, northeastward as urban land cover expanded (Butcher et al. 2014). Supplemental feeding and bird feeders provide a food source in winter months where it once did not exist and many range shift studies exclude species that frequent feeders as indicators of climate or habitat driven range shift and population change (Niven et al. 2009; Soykan et al. 2016). Rufous Hummingbirds were partly able to colonize new wintering areas along the gulf coast due to feeders, though a genetic glitch in migration orienteering may have been the reason they arrived in the first place (Hill et al. 1998). Kirtland's warblers wintering habitat shifts in the Bahamas, like range shifts for sandhill cranes in Mexico, are likely due to improved survey effort and technology rather than an actual shift in wintering range use (Cooper et al. 2019). Species declines in shorebirds at migratory stopover sites on the Atlantic coast may not be due to population level declines, but perhaps shifts in distribution to other stopover sites or reduced detection rates (Bart et al. 2007).

Though raptors have been protected by the Migratory Bird Treaty Act since 1918, recent population increases have the potential to affect other birds throughout their range. A shortened duration of stay for Western Sandpipers at stopover sites along their migration route on the west coast correspond to increased Peregrine Falcon presence (Ydenberg et al. 2004). Though long distance migrant shorebirds like Western Sandpipers succeed in migrating by increasing their body mass considerably at high quality stopover sites, the added mass increases their predation risk. For other species, mortality may decrease when predator species are displaced in suburban areas.

Avian species' range shifts are inevitable and unpredictable based on multiple genetic and environmental factors, though patterns of general poleward shifts in both breeding and wintering range have emerged. Although some North American species have demonstrated negative fitness in concert with range shifts and changes in climate, population trends for others have been positive. Nevertheless, successful conservation of wild bird populations, whether increasing or declining, whether expanding, contracting, or shifting requires two basic measures for success. First, systematic, range-wide monitoring at critical life-cycle stages is imperative to track trajectories of populations and distributions. Second, regional and national bird conservation planning should maintain the ability to adapt to changing species distributions, some of whose annual ranges are continental and hemispheric. Regional habitat conservation initiatives should account for species that are increasing or decreasing within the initiative area, and examine whether the change is a function of habitat deficiencies, or climatic changes that are beyond the control of wildlife managers. When the range of a species, especially one of conservation concern, expands into new territories, perhaps resources are better allocated in the existing and future range, rather than a vacated historical range. This will certainly be true if long-term climatic changes prove to be unidirectional.

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# Distribution Shift Across the Pond

BY LARRY REYNOLDS, LDWF
Waterfowl Program Manager

Barnacle geese were rarely observed in Sweden during the month of January until about 2001, but warmer winters have greatly increased their winter distribution in the country.

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As we consider the many factors likely affecting the winter distribution and associated hunting opportunity for ducks and geese in Louisiana, it is important to recognize what is happening elsewhere in the Northern Hemisphere. Are ducks and geese wintering further north on other continents as well?

The political landscape and flyways across the Atlantic Ocean in Europe are a little different than in North America. Dozens of independent countries share the waterfowl resource and flyways are predominantly in a northeast to southwest direction, with major breeding areas in Sweden, Finland and Russia feeding a migration to Spain, France, the United Kingdom and Ireland. Ducks and geese are popular with European hunters, and an estimated 5.5 million ducks were reported harvested in 24 countries in 2016.

However, unlike in North America, there is very little international coordination. Hunting regulations are set by each individual country, vary widely and are not cumulatively linked to the status of waterfowl populations. Consequently, there is a lot of concern about changes in winter distribution as they affect hunting mortality, survival and conservation.

Monitoring of waterfowl populations has traditionally been done through a variety of winter surveys. The coordinated International Waterbird Census was initiated in 1967 and now covers virtually all European countries, west to Russia and south through Africa. Along with dedicated winter waterfowl surveys in several other countries, providing data for the last 30 years, researchers have described changes in winter distributions of a number of duck and goose species.

Mallards are as important to hunters in Europe as they are here, and winter populations of mallards have declined in the United Kingdom since 1990 and in the Netherlands since 2000. At the same time, winter populations have increased further north and east in Sweden, Finland, Latvia and Estonia. Since 1995, counts in Sweden have increased more than 4 percent per year.

Data from banding, or ringing as they call it in Europe, also showed a northeast shift in winter mallard distribution. The recovery distribution of mallards banded in 2002-2008 shifted substantially to the northeast compared to that from mallards banded in 1964-1982. Bands also were recovered at a much lower rate (4.7 percent versus 13.3 percent) during the later period and survival rates were significantly higher.

Researchers speculated that change could arise from milder winter conditions in recent decades and/or a change in winter distribution from areas with high hunting activity to those with less.

Winter counts have shown shifts in winter distribution for other ducks as well. European wigeon have increased in the northeastern portion of their winter range, which includes Norway, Sweden, Denmark and Germany, but decreased in the southwest portion, Spain and Ireland. From 1980 to 2010, three species of diving ducks, tufted duck, goldeneye and goosander, increased in Finland and Sweden but declined in France, Ireland and the Netherlands while the overall population remained constant.

Some species of geese show similar shifts in distribution. European white-fronted geese, almost identical to the specklebellies so highly valued by Louisiana hunters, winter primarily in the United Kingdom, Netherlands and Belgium. But, from 1977 to 2013, winter counts in Sweden have increased tenfold while the overall population has remained stable.

Similarly, Barnacle geese were seldom seen in Sweden in January until around 2001, but counts had increased to nearly 8,000 by 2010. Wintering Greylag goose counts have increased from 120,000 to 610,000 across their winter range but the annual rates of increase from 1987-2009 were about 35 percent in Sweden and Denmark at the northern edge of their winter range compared to only 3 percent in Spain at the southern edge.

Climate change is considered the primary factor driving changes in winter distribution of European waterfowl. Temperatures in early winter at the northeast part of wintering areas have increased 2 to 4 degrees Celsius since 1980.

What that means is fewer freezing days, more open water, delays in fall migration and increases in birds wintering further north. A study from 2019 reported mallards wintering in Moscow increased from 7,500 in the early-2000s to about 30,000 in 2015, owing to milder winters resulting in a freezing season that declined from 132 days to only 104.5 days during the study period, representing four weeks of improved habitat conditions for wintering waterfowl.

However, researchers are quick to point out that not all species of waterfowl are responding the same and habitat changes have also occurred. Changes in land-use and agricultural practices combined with milder winters have increased food available for migrating geese in Europe allowing them to winter further north. That sounds a lot like what is occurring in North America.


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# Using Emerging Technology to Better Understand Waterfowl Movements

BY PAUL LINK, NAWMP Coordinator

Many goose populations have increased in recent decades due to increasing agriculture throughout migratory routes and wintering areas, essentially releasing many populations from food limitation constraints during the nonbreeding period. Greater white-fronted geese (GWFG) are common winter residents in agricultural habitats of Louisiana. They nest in the Arctic and are early migrants, primarily staging in Alberta and southern Saskatchewan in late August thru October, with many flying from there directly to Arkansas and Louisiana (Figure 1). GWFG are largely associated with small grain agricultural crops such as wheat and barley in Saskatchewan and rice in Louisiana. According to Louisiana Mid-winter Waterfowl Survey (MWS) estimates, GWFG increased from an average of 30,000 in the 1960s to an average of 103,000 during the 1990s. In the last 20 years, their numbers have fluctuated around 95,000, with a recent high of 151,000 (2018) followed just two years later with a low of 33,000 (2020). During that same 20 year period, GWFG numbers in the Mississippi Flyway more than doubled; however, Louisiana now winters less than 20 percent of the flyway GWFG compared to 80 percent just 20 years ago. Preferred waterfowl habitats in Louisiana have declined due to reduction in acreage planted to rice, changes in agricultural practices, long-lasting hurricane effects, industrialization, and urbanization. Increasing mid-winter counts are being reported in Illinois, Missouri, Tennessee, Arkansas and Mississippi. Not surprisingly, these states have increasing agricultural and water acreages and generally fewer hunters on the landscape. Managers and hunters of this popular species are concerned about this northward shift in winter distribution.

Minimal GWFG research has been initiated in Louisiana, primarily because they have proven difficult to capture in the winter. Marking them in the Arctic when they are molting, when traditional banding is conducted, would likely result in only one of five birds wintering in Louisiana. Catching GWFG that chose to come to Louisiana would be critical to better understand their use of habitats and drivers in wintering fidelity (i.e., the tendency to return to a previously selected location). With the help of some very passionate waterfowl hunters, I secured private donations to purchase 11 solar-powered GPS/GSM transmitters in summer 2015. This technology had just arrived. They were lightweight, powerful, and incredibly easy to deploy relative to the previous technology. The units are accurate to ±5m and also have a triaxial accelerometer that not only provides information during flight such as altitude, speed, and heading, but also elucidates behavioral activities (i.e., feeding, preening, walking, or sleeping). I then spent a couple months designing and building equipment to capture them. They are smart and generally prefer sparse habitats like mudflats where hiding traditional rocket nets used for ducks or turkeys wouldn't be possible. By the time the birds arrived in early October my volunteers and I were ready. Thankfully most private landowners were receptive to our efforts. I successfully captured GWFG in October and November 2015 in southwest Louisiana, and deployed all 11 transmitters. Since that pilot season, I've marked an additional 120 individuals and collected millions of data points to examine potential factors influencing site selection, habitat use, and movements. Because these transmitters are expected to last two to three years, we'll also be able to examine philopatry among seasons, years, and a wide range of habitat conditions (i.e., cold-dry winter, warm-wet winter, and other possible combinations).

So what have we learned? First, it's important to understand the MWS is the only count of GWFG in Louisiana. It's a good survey, but isn't perfect. While it is true that a decreasing proportion of the GWFG population is counted in Louisiana in January each winter, I often see more than our statewide MWS count during October in a single flock. There are several similarly sized concentrations annually in the Thornwell, Gueydan, Alto, and Mer Rouge, Louisiana areas. This is at a time period when habitats in the flyway are either very limited or non-existent in the aforementioned states with increasing MWS counts of GWFG. Agricultural crops in those regions are often immature and unharvested during this time. Thus, Louisiana continues to provide critical habitat for a large proportion of mid-continent GWFG when resources are most limited in the southern Mississippi Flyway, but they are leaving prior to January. There are many possible explanations for this. They could be depleting food resources and be forced to emigrate. Increasing availability of suitable habitats elsewhere throughout winter could simply be alleviating density-dependence. Localized disturbance could create an energetic deficit and drive birds out of Louisiana. Additional factors as well as near limitless interactions of those factors could be to blame. However, a better understanding of the selected habitats and their quality and quantity on the landscape is foremost in developing management actions to impact GWFG wintering numbers and distribution. Thus, for three winters, technicians and I ground-truthed all fields selected by GWFG in Louisiana. We recorded vegetative composition and height, flood status and depth, presence and estimated numbers of waterfowl, and other factors that may influence site selection. Results from this work are forthcoming. We are also proposing additional research to explore more complicated issues, such as cross-seasonal effects (i.e., what happens in one season has effects on what happens in the next) and quantify the relative importance of phases of the annual cycle to explain variation in productivity and survival. The technology in these telemetry devices is filling in critical information needs for effective management of this species.

## USING EMERGING TECHNOLOGY TO STUDY LARGE- AND FINE-SCALE MOVEMENTS OF DUCKS

We have a lot of similar questions with unknown or possibly shifting wintering distribution of many duck species. This same technology previously described for geese is rapidly miniaturizing allowing similar insights for dabbling ducks. However, ducks have much lower survival rates than geese so you have to mark more of them, and smaller transmitters are typically more expensive than larger ones. Additionally,

the smaller transmitters aren't nearly as powerful or efficient as the goose collars, as they have to be smaller (i.e., less than 3 percent body weight) and must be attached dorsally instead of on neck collars. The transmitter battery continues to comprise the bulk of a transmitter's weight, but a small battery and an efficient solar panel enable GPS/GSM transmitters to be as light as 9 grams. They'll continue to miniaturize as this technology is rapidly improving.

In spring 2019 I initiated a pilot telemetry project on female blue-winged teal (BWTE), again using donations from private individuals and conservation groups. Goals for this project are to identify migration routes, timing of migrations, and important breeding, staging, and wintering areas. Blue-winged teal are important birds to many waterfowl hunters. Early September hunting seasons have been around for decades, and recently expanded into northern production states (i.e., IA, MI and WI). They are among the earliest ducks to migrate south in the fall and the latest to arrive on the Prairies in the spring. Despite these additional harvest opportunities, many uncertainties remain given their long-distance migration and substantial harvest south of the United States border. Band recovery distributions of BWTE in Neotropical regions extend farther south and are more widespread than any other North American species of waterfowl. Additionally, there is a lack of information regarding their timing of migrations, distribution, and use of habitats, particularly in the winter.

We deployed 20 units during the pilot season; 10 in Louisiana during March and April and 10 in Saskatchewan during August. Hunters in Illinois and Texas harvested radiomarked BWTE last fall, and others wintered in Louisiana, Venezuela and Colombia. We learned a few lessons during that pilot year that benefitted developing this work into a graduate student project. Trapping plans were substantially altered this spring amidst the COVID-19 pandemic, but we were able to deploy all 42 of our transmitters in March and April in Louisiana. At the time of this writing in late June, most of our radiomarked BWTE are in the eastern Dakotas and a couple have successfully hatched nests. We'll be deploying 22 additional transmitters in South Dakota during August and will repeat deployments again during spring and fall 2021. Brett Leach (M.S. candidate) will be leading this project for the next two years with Dr. Lisa Webb at the USGS Missouri Cooperative Fish and Wildlife Research Unit - University of Missouri. This project is being funded by LDWF, Ducks Unlimited, Ducks Unlimited Canada, several Louisiana Delta Waterfowl Chapters, and many private businesses and individuals. Information and ways to support the GWFG and BWTE research projects can be found here: *www.lawff.org/waterfowl*.

I am also assisting Texas A&M University-Kingsville researchers Dr. Bart Ballard and PhD candidate Georgina Eccles with a study of movements and habitat use of female northern pintails (NOPI). The NOPI population remains depressed and below long-term average after more than 20 years of good to excellent habitat conditions on the Prairie breeding area; a period of time many duck species have reached record populations. Factors and conditions on breeding areas undoubtedly have major impacts on their population. However, NOPI spend a comparatively large proportion of their annual cycle in nonbreeding areas, thus, nonbreeding factors and habitats could potentially be a larger contributor in their population dynamics than for other duck species. This is a large study (n >400 females) encompassing a large geographic area. Birds will be marked in Texas, Louisiana, New Mexico, and California. Objectives for this study include comparing spring migration and wintering strategies (i.e., migration speed, arrival date on breeding areas, etc.) of hens and the relationship of those strategies to their reproductive success, as well as identifying critical stopover areas for pintails migrating from different wintering areas.

I captured and radiomarked 34 adult female NOPI in southwest Louisiana during February 2020. Nearly all of them settled into the eastern Dakotas this spring. This project will continue for two additional years. We're excited to see their travels over the coming years, and looking forward to even further improved technologies that will enable us to narrow the gap of knowledge on waterfowl migration activities.

Paul Link holding a greater white-fronted goose fitted with a solar-powered GPS/GSM transmitter.

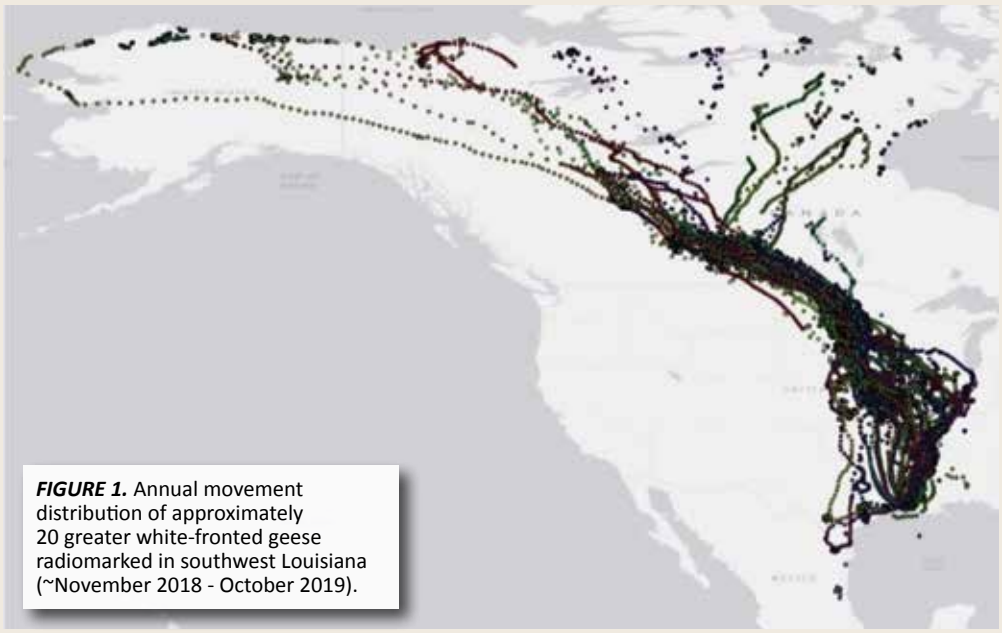

***FIGURE 1.*** Annual movement distribution of approximately 20 greater white-fronted geese radiomarked in southwest Louisiana (~November 2018 - October 2019).

Photo by Shutterstock.com

# Estimating Waterfowl Harvest in Louisiana

## *Recent Changes in the Harvest Information Program (HIP)*

BY LARRY REYNOLDS, LDWF Waterfowl Program Manager

Seldom has the process used to generate annual estimates of duck and goose harvest been more important or come under more scrutiny than today. Scientifically-defensible harvest numbers have long been required by federal law to maintain open hunting seasons for migratory birds and to inform population models within harvest-management strategies that guide regulatory decisions on season length and species-specific bag limits. But they are now regularly used in combination with band-recovery data to calculate Lincoln-Petersen estimators of population size and to construct trends for species that have no adequate population survey, like wood ducks or snow geese, or for those where surveys have been discontinued, like white-fronted geese. Harvest estimates are used to track hunter participation, activity, and success. The 2012 revision of the North American Waterfowl Management Plan added maintaining hunters as a fundamental objective of the waterfowl management community and it is considered as important as maintaining duck populations and the habitat necessary to support them. Hunter participation certainly responds to annual and long-term variation in harvest success. Lastly, and most important, conservation funding for migration and wintering habitats in North America is transitioning from being allocated based on Mid-winter waterfowl survey data, to being determined from distribution of the harvest. Consequently, it is increasingly important to get the most consistent, representative, reliable, and precise harvest estimates we can obtain.

Information used to estimate duck and goose harvest comes directly from active hunters. Prior to 1998, hunters who purchased their Federal Duck Stamp at a randomly-selected U.S. Post Office were given a postage-paid contact card and asked to provide their name and address to the U.S. Fish and Wildlife Service (USFWS). From those hunters who returned the cards, a sample was selected and sent a Waterfowl Hunting Record (*Figure 1*) on which to record their hunting activity and ducks and geese bagged. The completed form was returned to the USFWS after the season. From those hunters who participated in this survey the prior year, and reported killing at least one bird, another sample was selected, and those hunters were sent envelopes (*Figure 2*) and asked to submit one wing from each duck and tail feathers from each goose harvested. Together, the hunting records, wings, and goose tails allowed estimation of active hunters, days hunted, ducks and geese killed by species, and ratios of immatures to adults and males to females in the harvest. Those estimates are presented in annual reports at: *www.fws.gov/birds/surveys-and-data/reports-and-publications/hunting-activity-and-harvest.php.*

By the mid-1990s, participation from busier post offices was inconsistent, hunters could purchase federal duck stamps at many other locations, and the number of hunters to sample shrank substantially. Legal challenges based on inadequate harvest data threatened to close migratory bird hunting seasons, so an alternative method was needed. In 1998, the Harvest Information Program (HIP) was implemented with the primary goal of generating a list of names, addresses, species hunted, and relative hunting success for every migratory bird hunter in each state. This was accomplished by requiring every migratory bird hunter to obtain a HIP certification and answer a series of questions on which species and approximately how many he/she killed the year before as part of the annual licensing procedure. The waterfowl hunting records and wings/tails collected from selected hunters remained the source of data for the harvest estimates; that didn't change. But this new certification process assured that every migratory bird hunter was eligible to be selected to participate, and that sufficiently large, representative samples needed for scientifically defensible harvest estimates could be selected each year.

The new HIP was a big improvement over the post-office based sampling, especially for species other than ducks and geese. Before HIP, harvest estimates for doves, woodcock, and other migratory bird species were dependent on waterfowl hunters, who had to purchase federal duck stamps, that also hunted those spe-

cies. With the HIP certification questions, hunters who pursued those other species could be targeted for species-specific harvest surveys. In addition, the certification questions allowed classification of hunters into harvest groups for more efficient stratified sampling. For example, duck hunters are classified into groups reporting zero, 1-10, or more than 10 per year, and dove hunters into groups reporting zero, 1-30, or more than 30 per year. By sampling the higher-kill groups at a higher rate, precise harvest estimates can be generated more cost-effectively. For ducks, the USFWS currently samples the 0.4 percent of the zero group, 10 percent of the 1-10 group, and 13.3 percent of the more than 10 group. In 2018-19, that generated a sample of 2,098 participating hunters from Louisiana. From 1998 to 2001, post office and HIP sampling were done concurrently to determine the effect of the new method before the Post Office sampling was discontinued due to obvious advantages of HIP.

LDWF also conducts a state harvest survey independent of HIP that includes all game species. The Big and Small Game Harvest survey is sent to a random sample of 6 percent of all resident hunters and provides estimates of active hunters, total harvest, and seasonal harvest per hunter for migratory birds. Although using a different method that does not include non-resident hunters like HIP surveys, trends in those LDWF estimates are expected to generally correspond to those from HIP. Data from both surveys are included in *Figures 3-5*, but this discussion will focus on the HIP estimates.

During 2000 to 2019, HIP estimates of active waterfowl hunters have varied from a high of 103,700 in 2012 to a low of 36,300 in 2018. The general trend of declines the early-2000s followed by increases from the mid-2000s through the mid-2010s followed by strong declines since then is apparent in HIP estimates of active hunters, seasonal harvest per hunter, and total harvest. Notably, this variation in hunter numbers and harvest occurred despite duck season length and daily bag limit being a constant 60 days and six ducks respectively over this entire period. Recent harvest estimates of 507,000 and 13.9 per hunter in 2018, and 572,000 and 11.5 per hunter in 2019, are the lowest since 1993 when the season length was 30 days and the daily bag limit was three. The poor hunting success borne out in these harvest estimates have angered hunters, created widespread discontent over harvest and habitat management practices further north in the Flyway, and stimulated efforts by the waterfowl management community to better understand the multiple factors influencing apparent shifts in distribution of wintering waterfowl populations and harvest success.

Although estimates differ between the LDWF and HIP harvest surveys, and the HIP survey shows far more year-to-year variation, the general trends were similar until about 2013-2016, when HIP estimates of active hunters dropped precipitously, greatly affecting the total harvest estimates as well. Louisiana somehow lost 25,000 active waterfowl hunters in 2013 and another 30,000 in 2015 without any similar change in license sales or notable difference in hunter numbers on the landscape. Waterfowl hunter activity monitored through self-clearing permits on state wildlife management areas maintained a slight increase during that time. Other states noticed similar discrepancies between HIP hunter estimates and license sales and there was growing concern about potential problems with the HIP process and resulting estimates, especially for species other than waterfowl.

In August 2016, the Association of Fish and Wildlife Agencies (AFWA) established a HIP Working Group to evaluate the program and make recommendations to improve

WATERFOWL HUNTING RECORD
2017-18

Please print all characters in **BLACK** ink using CAPITAL LETTERS ONLY as shown below.
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0 1 2 3 4 5 6 7 8 9

Number of Birds Killed and Retrieved

| | Date of Hunt: Month | Day | County of Hunt | State of Hunt | Ducks | Sea Ducks | Geese | Brant |
|---|---|---|---|---|---|---|---|---|
| 1 | 09 | 16 | CAMERON | LA | 2 | | | |
| 2 | 09 | 17 | CAMERON | LA | 3 | | | |
| 3 | 11 | 11 | CAMERON | LA | 6 | | | |
| 4 | 11 | 12 | CAMERON | LA | 6 | | | |
| 5 | 11 | 18 | CAMERON | LA | 6 | | | |
| 6 | 11 | 19 | CAMERON | LA | 6 | | | |
| 7 | 12 | 16 | CAMERON | LA | 6 | | | |
| 8 | 12 | 17 | CAMERON | LA | 6 | | | |
| 9 | 12 | 22 | CAMERON | LA | 6 | | | |
| 10 | 12 | 23 | CAMERON | LA | 6 | | | |
| 11 | 12 | 28 | AVOYELLES | LA | 0 | | | |
| 12 | 12 | 29 | CAMERON | LA | 6 | | | |
| 13 | 01 | 01 | CAMERON | LA | 6 | | | |
| 14 | 01 | 11 | VERMILION | LA | 4 | | | |

7. IF YOU RUN OUT OF SPACE ON THIS FORM, you can request an additional survey form by logging on to https://migbirdapps.fws.gov/hipweb or calling 1-800-413-2365 from 7:30 am to 4:00 pm EST. We will ask you for the serial number located at the bottom of this form.

8. SEASON TOTALS

| | Days Hunted | Birds Killed and Retrieved | Birds Downed but Lost |
|---|---|---|---|
| Ducks | | | |
| Sea Ducks | | | |
| Geese | | | |
| Brant | | | |

Please report banded birds at www.reportband.gov

242171576 Louisiana Init 9/22/2017

***FIGURE 1. (Left)*** USFWS Waterfowl Hunting Record sent to selected hunters to record hunting activity for use in estimating harvest of ducks and geese.

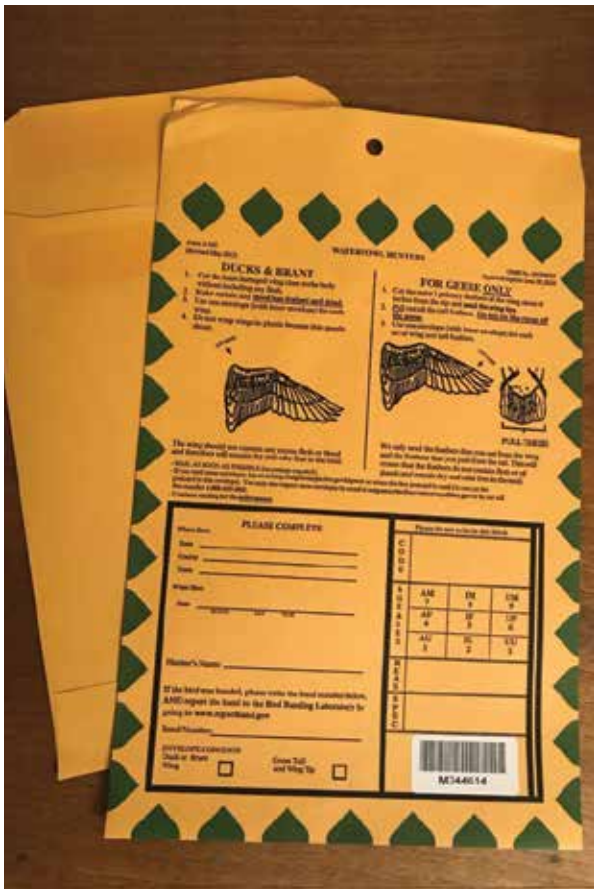


***FIGURE 2. (Right)*** Envelopes for selected hunters to submit wings from harvested ducks or tails from harvested geese for estimating species composition, age-ratio, and sex-ratio of the annual harvest.

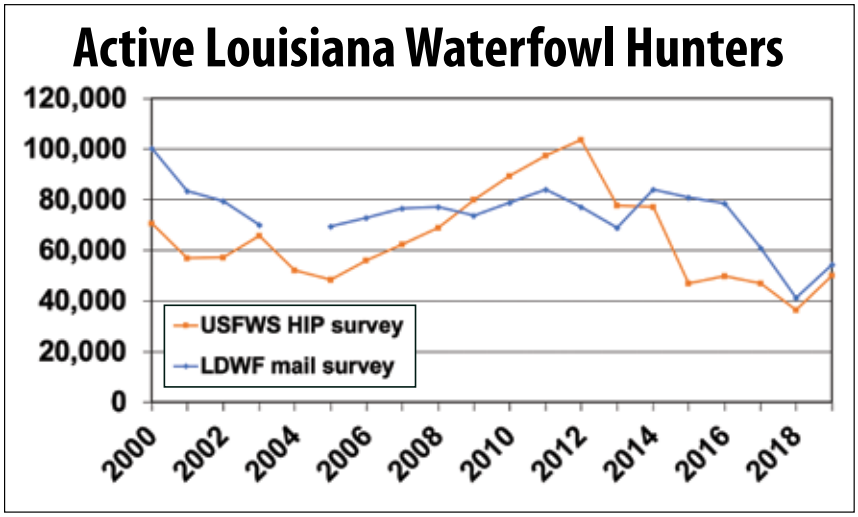


***FIGURE 3.*** Trends in Active Hunters in Louisiana as estimated by HIP and LDWF surveys 2000-2019.

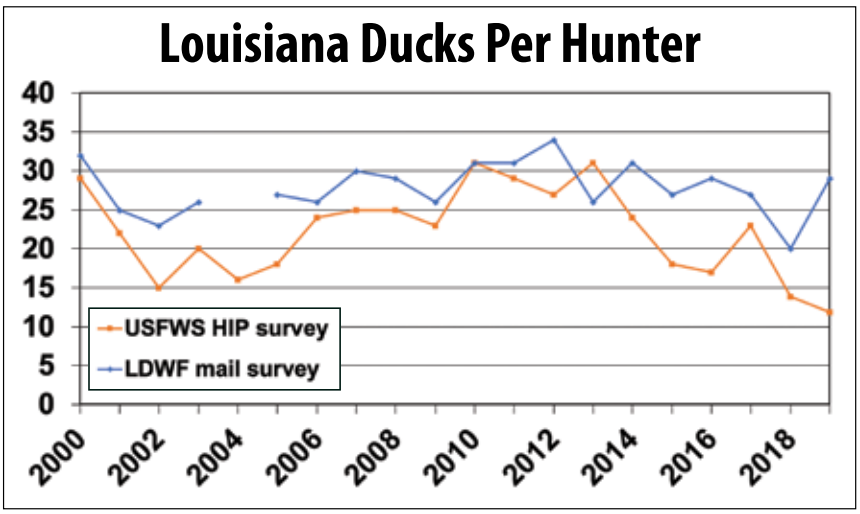


***FIGURE 4.*** Trends in Ducks Per Hunter in Louisiana as estimated by HIP and LDWF surveys 2000-2019.

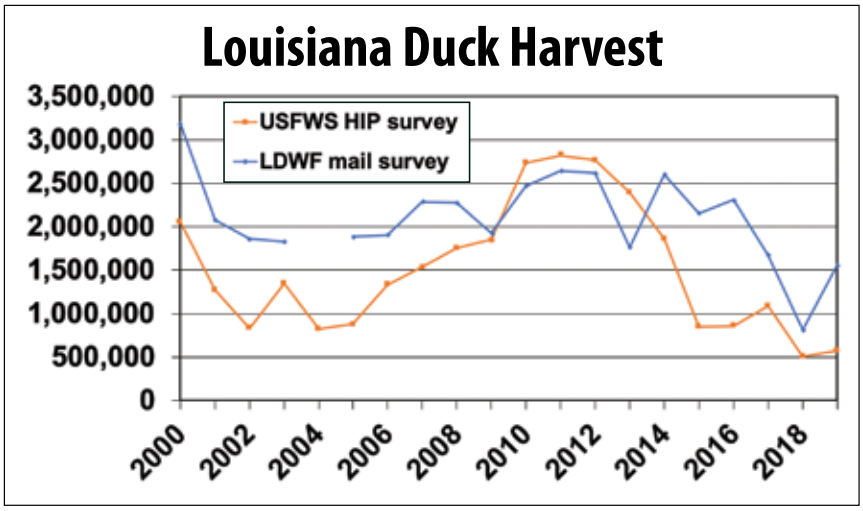


***FIGURE 5.*** Trends in total Louisiana Duck Harvest as estimated by HIP and LDWF surveys 2000-2019.

the process. Four major problems were identified: 1) people who do not hunt migratory birds were being HIP certified; 2) not all migratory bird hunters were being HIP certified; 3) vendors were not asking hunters about their hunting activity when they were HIP certified; and 4) late, inaccurate, or incomplete HIP certification data were provided by the state to the USFWS. In at least the last five years, the LDWF HIP certification database has showed evidence of all of these problems, but one is particularly egregious. In using the 2019 HIP certification data to identify waterfowl hunters to send the 2020 Waterfowl Hunter Survey, we found that 74.7 percent of all migratory bird hunters in Louisiana "DID NOT HUNT" migratory birds the prior year. According to HIP certification data LDWF sent to the USFWS, it was 82 percent in 2018 and 77 percent in 2019 that "DID NOT HUNT" migratory birds the prior year. That is nowhere near accurate and results from license vendors pre-filling the registration questions without asking the hunters. Most importantly, it voids any effort to target specific species or stratify sampling by harvest success thus increasing the costs and reducing the quality of resulting harvest estimates. Indeed, 29 percent of the responses to the 2020 Waterfowl Hunter Survey came from hunters that were not waterfowl hunters and thus provided no meaningful information.

Possible solutions to those four major problems have been suggested by various groups for years, including charging a fee for HIP certification so that those not needing it won't get it; linking HIP certification to a license required by every migratory bird hunter, which is a problem in states like Louisiana where Lifetime or other license holders may or may not need to register with HIP; require the hunter himself to enter the HIP certification questions rather than a third-party; and closer communication between state license-data managers and the USFWS. Acting on a recommendation from the HIP Working Group, and recognizing issues with data security and limited control over state license structure and fees, AFWA initiated and funded a pilot study to improve HIP certification by eliminating third-party entry of the registration questions. States from each flyway, including Louisiana, have volunteered to participate by restricting HIP certification to on-line or other methods that assure hunters are asked and answer the registration questions.

The study is off to a slow start with only Louisiana implementing changes to HIP certification process for the 2020-2021 license year (*Figure 6*). HIP certification is only available on-line and at the Baton Rouge headquarters, which creates an additional challenge for those hunters who normally get all necessary licenses from retail vendors. LDWF Licensing, Public Information and Outreach personnel have made numerous changes to the website (*Figure 7*), including providing a video demonstration, to assist first-time users to get HIP certified. A live "Conservation Conversation" on Facebook and podcasts with Ducks Unlimited featuring changes in HIP certification and the importance of getting the best possible harvest estimates were completed and shared. LDWF continues to work through anticipated and unexpected problems that arise when making changes like this and knows that our experience will help other states

intending to participate. Arkansas, although not initially part of the pilot study, has made similar changes to HIP certification starting in August. Arizona, Connecticut, Kansas and Montana are planning to modify their systems prior to the 2021 season, and Florida, North Carolina and Nevada are considering joining the pilot project in 2022.

It is important to not lose sight of the ultimate goal of the HIP program: to generate consistent, representative, reliable and precise estimates of hunting activity and harvest. Data collected through HIP harvest surveys are valuable for a variety of uses at multiple scales because each hunt and associated harvest and each wing submitted has a date, parish (or county) or nearest town, and are consistent across states and flyways. Every hunter is eligible to be selected for the surveys, so data are representative of all hunted locations and all times during the open season. Compared to aerial waterfowl surveys, which are conducted in limited areas of the state during just a few days during the migration and wintering period, harvest data may be more representative of distribution and abundance over the course of the season. Parish-level data allow summary of harvest by region of the state, which the LDWF Waterfowl Section has used to inform recent decisions on duck hunting zone boundaries. The ratio of immatures to adults in harvest, as estimated from wings submitted by selected hunters, are the best estimate of large-scale reproductive success on the breeding grounds and are an important input to population models guiding harvest management at the continental scale. In Louisiana, reproductive success on the breeding grounds appears related to hunter success, as evidenced by the lower age-ratios 2015-2018 compared to 2011-2014 (*Table 1*) corresponding to lower per-hunter harvest during those same years (*Figure 4*). In so many aspects of waterfowl management, scientifically sound harvest data are necessary.

The changes in HIP certification being implemented in Louisiana and other states are not likely to solve all problems affecting the harvest estimates. For example, response rates to USFWS requests to participate in harvest surveys are declining, and inconsistencies in reporting HIP certification data to the USFWS continue. Unfortunately, it's nearly impossible to evaluate the effect of those and other factors affecting harvest estimates until we get the sampling frame right.


***FIGURE 6.*** Cover of 2020-2021 LDWF Hunting Regulations Pamphlet focusing on HIP Certification changes.

***TABLE 1.*** Age-ratios in Louisiana harvest of 6 abundant species 2010-2018.

| LOUISIANA HARVEST AGE RATIOS (Imm/Ad) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Species** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018*** |
| Mallards | 1.87 | 2.26 | 1.93 | 1.25 | 1.76 | 0.83 | 0.96 | 0.56 | 0.63 |
| Pintails | 2.31 | 2.22 | 1.10 | 1.72 | 1.12 | 0.53 | 1.04 | 1.57 | 0.64 |
| Gadwalls | 2.19 | 2.03 | 1.27 | 1.26 | 1.44 | 0.89 | 1.06 | 0.64 | 1.02 |
| Greenwings | 1.88 | 2.19 | 1.75 | 1.80 | 1.51 | 1.42 | 1.55 | 1.36 | 0.95 |
| Bluewings | 2.22 | 2.14 | 1.57 | 1.50 | 1.15 | 0.98 | 0.88 | 1.57 | 1.46 |
| L. Scaup | 1.31 | 1.60 | 0.83 | 1.40 | 0.88 | 0.56 | 1.86 | 0.88 | 0.57 |

**2018 estimates based on 6,975 wings from Louisiana*


***FIGURE 7.*** LDWF website homepage with new banner and alert directing hunters needing to obtain HIP certification for hunting migratory birds.

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For more information about Wood Duck Banding, visit
***www.wlf.louisiana.gov/page/wood-duck-banding***

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