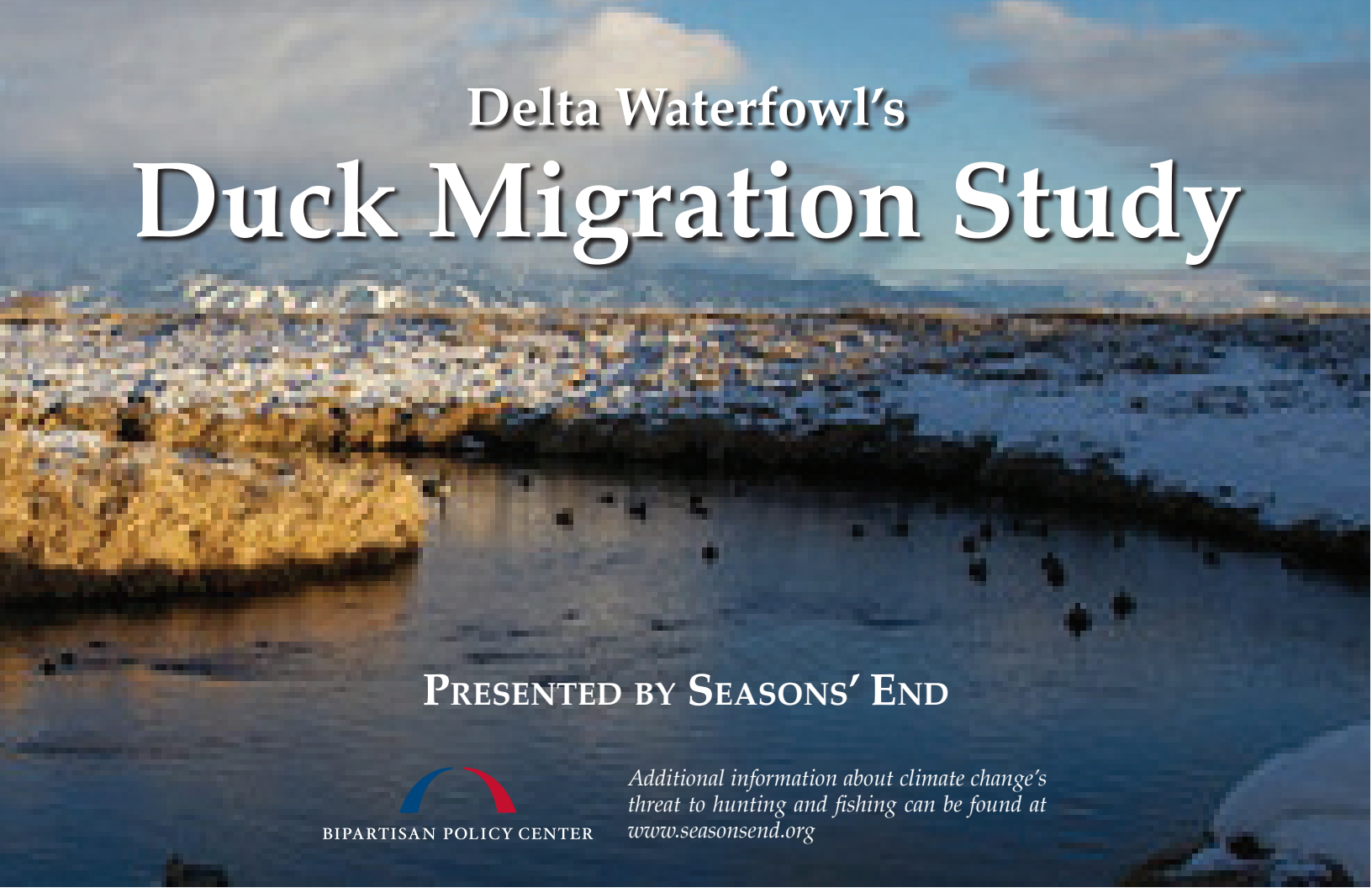

Delta Waterfowl's
Duck Migration Study
Presented by Seasons' End



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BIPARTISAN POLICY CENTER

Additional information about climate change's threat to hunting and fishing can be found at www.seasonsend.org

This report is a publication of the Bipartisan Policy Center, which commissioned Delta Waterfowl to produce a study of duck migration in the era of climate change. Completed in 2011, the study was authored by Frank Rohwer and John Devney and is available in its entirety at www.seasonsend.org

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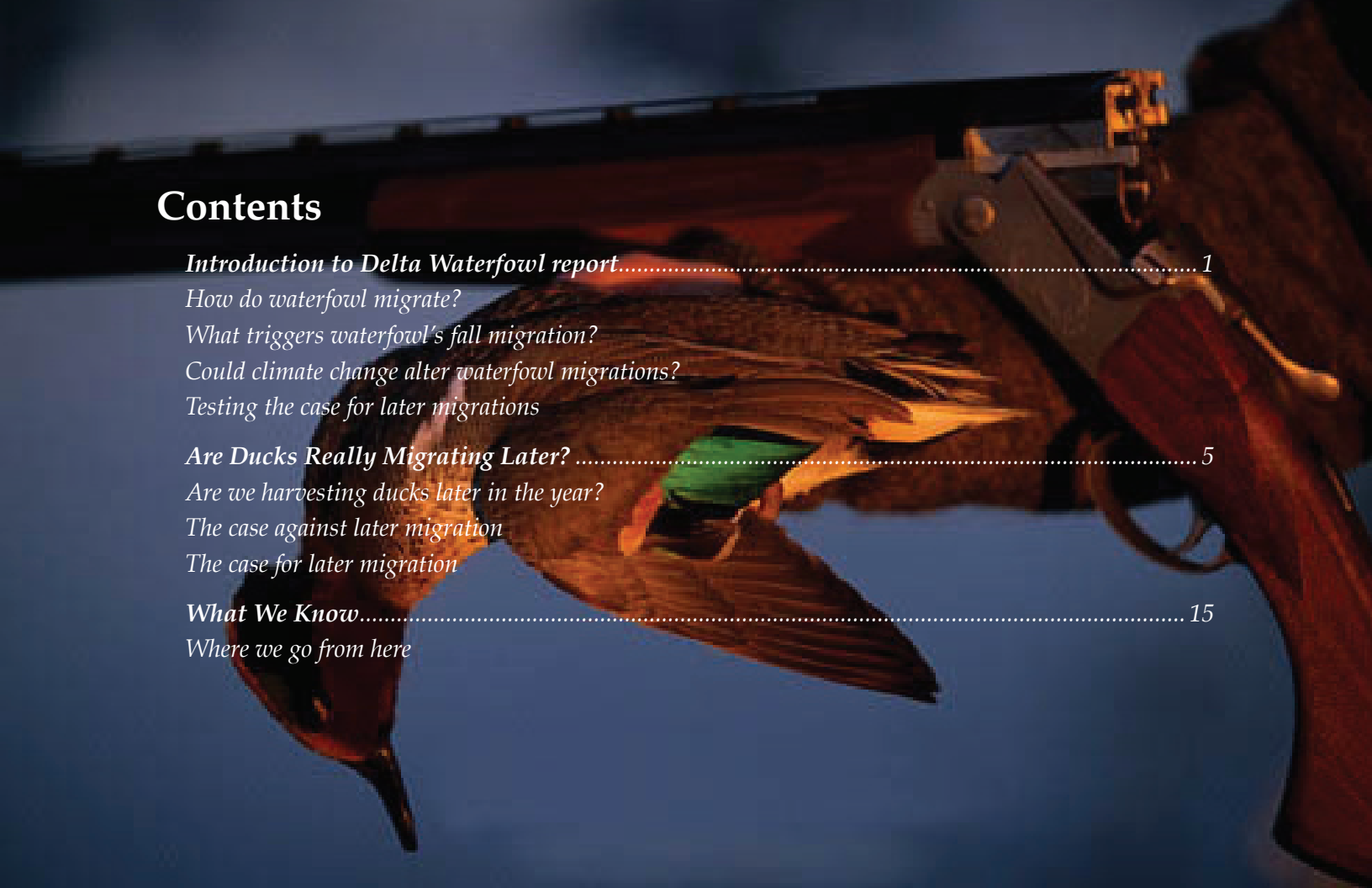
Dusan Smetana's Photography Featured in *Delta Waterfowl's Duck Migration Study*

All the photographs in *Delta Waterfowl's Duck Migration Study* are the work of outdoor photographer Dusan Smetana. Raised in a small village in the Czech Republic's Carpathian Mountains, Dusan spent his boyhood following in the footsteps of his father in quest of trout, red deer and wild boar. He studied forestry and photography in Czechoslovakia, became mesmerized by stories of cowboys and Indians in the American West and eventually escaped the communist regime of his homeland.

His work is widely used by editorial and corporate clients.

Today he makes his home in Montana with his wife, two children and a loft full of homing pigeons. To see more of his images, please visit www.dusansmetana.com.



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Introduction to Delta Waterfowl report

The sight and sound of migrating waterfowl are sure signs of changing seasons in North America. To reach suitable seasonal habitat, ducks and geese journey along four major flyways – the Atlantic, Mississippi, Central and Pacific. The longest flyway that waterfowl use, the Mississippi, spans 3,000 miles across the Northern Hemisphere, from the shores of the Arctic Ocean to the Gulf of Mexico.

In spring, migratory waterfowl head north to habitats that support breeding and the raising of chicks. The long daylight hours of northerly latitudes extend the time these diurnal birds can feed their young, increasing the chances of raising large, strong clutches.

With the coming of autumn, availability of food and open water declines and the birds reverse their migrations to overwinter in the milder climates of the southern United States and Mexico. There they feed, fatten and prepare for the next year's cycle of migration and breeding.

How do waterfowl migrate?

Most birds migrate in flocks. Numbers reduce their vulnerability to predators and increase the efficiency of flying. For instance, geese flying in a V-formation rather than alone conserve as much as 20 percent of their energy. Also, flying in a flock can accelerate speed. Radar studies show some birds fly more than three miles an hour faster as part of a flock than as individuals.

Migrating waterfowl combine cognitive capacity and inherent physiological capabilities to find their routes between summer and winter habitats. Studies have demonstrated that they employ innate abilities to navigate, such as using polarized light, stars and the sun to determine direction; responding to visual landmarks and olfactory cues; and detecting the Earth's magnetic fields through specialized cells.

Many, though not all, species of ducks return to precise locations year after year. Scientists believe that experience enhances these birds' ability to recognize habitats and form mental maps. Recent studies suggest that birds also learn to associate their destinations with magnetic signals, which wax and wane according to latitude.

What triggers waterfowl's fall migration?

Observers have long understood that waterfowl migrate to find food, water and suitable habitat so as to maximize their chances of survival and breeding. However, the triggers that set ducks and geese on their long flights are less fully understood. As daylight wanes prior the advent of cold weather, birds become restless and begin to accumulate fat to fuel their migration south. Shortened daylight hours and changes in the weather seem to prompt waterfowl to begin their long flights toward the food, water and shelter of winter grounds.

For thousands of years, changes in the length of daylight hours, or photoperiods, have been coupled with climatic patterns. Shorter days brought cooler temperatures, freezing precipitation and icing of water bodies. Weather varied from place to place and year to year, but the general patterns of temperature

and precipitation in North America changed little over millennia. Waterfowl adapted to these reliable patterns, timing their migrations with the disappearance of food and the unfolding of unfavorable habitat conditions.

Could climate change alter waterfowl migrations?

Shorter photoperiods and seasonal changes in habitat set the stage for waterfowl migration, but immediate and local conditions – food availability, wind direction, and approaching precipitation or cold fronts – determine the actual dates of departure. While a changing climate cannot affect photoperiods, it may alter the local conditions that trigger the start of migration, lengthening the season of favorable fall habitat by maintaining the availability of food and open water.

Higher temperatures, the most prominent feature of climate change, will instigate a cascade of other consequences that are less easily modeled but could have pronounced effects on waterfowl. For instance, precipitation patterns across the North American continent are predicted to change, resulting in a smaller snowpack to feed summer waterways and in more frequent extreme events that alter wetland dynamics. How these phenomena will affect waterfowl populations is hard to forecast. Will the result be a precipitous decline in national waterfowl numbers? Will waterfowl be able to respond quickly and relocate to newly developing, favorable environments? Will the timing of migrations fall out of synchronicity with the unfolding of food sources and habitat conditions?

Testing the case for later migrations

It is possible that consequences of climate change – longer warm seasons and delays of freeze dates – are already setting back the timing of fall waterfowl migrations. According to anecdotal reports from the field, many migrations are occurring later in the year than they did no more than a few decades ago, but such observations have yet to undergo rigorous scientific scrutiny. In the following report, Delta Waterfowl undertakes examination of available harvest data in an attempt to determine if, indeed, waterfowl in North America are migrating later in the season in response to climate change.


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Are Ducks Really Migrating Later?

Recently, hunters in mid-latitude and southern states have frequently talked about the late arrival of the mallards. Many hunters believe ducks are staying north longer and arriving at migratory stopover and wintering sites later than they used to "back in the day."

Yet there is no scientific study either confirming or disproving these anecdotal observations. The ideal data set to evaluate shifts in the timing of migrations would be a history of waterfowl counts conducted throughout the flyways – just as waterfowl breeding surveys have been carried out for decades. Unfortunately, such systematic fall migration surveys do not exist. The best alternate is harvest data collected over the past five decades by the U.S. Fish and Wildlife Service (USFWS). In 1961 the agency began contacting waterfowl hunters in every state and asking them to send one wing from each duck they harvested to a collection site. Each wing includes the date and the location at which the duck was harvested. This Parts Collection Survey now comprises more than four million wings collected over a half century. But what do these millions of wings tell us? Are waterfowlers harvesting ducks later in the year? If so, does this mean that ducks are migrating later, as waterfowlers claim, or are there other explanations?

Are we harvesting ducks later in the year?

To answer these questions, researchers had to identify patterns in the harvest dates. For example, the Parts Collection Survey shows that in 1961 the average harvest date of mallards in Kansas was November 7th. In the 2008-2009 season, however, the average harvest date was December 5th – 28 days later. The chart below shows that, with few exceptions, harvest dates for mallards throughout the mid-latitude and southern states have become consistently later. However, the waterfowl production states of North Dakota and South Dakota contradict the pattern, since harvest dates there have advanced slightly.

Shifts in average harvest dates for mallards

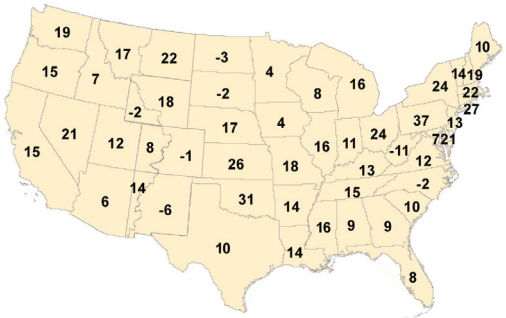

Figure 1. The map shows changes in average harvest dates from 1961 to 2008. Positive numbers show the number of days the average date moved later in the season. Negative numbers show the number of days the harvest date was earlier. For example, for mallards surveyed in Louisiana, the average harvest date was 14 days later in the 2008-2009 season than it was in the 1961 season. In contrast, the average harvest date in North Dakota advanced by three days. Altogether, during the five decades surveyed, states' mallard harvest dates shifted between six days earlier and 37 days later. Some states, such as Montana, have two numbers because the state is split between two flyways.

What about other species?

The following six maps show that later harvest dates are not unique to mallards, but occur among most migrant duck species. The degree to which harvest dates have changed over time differs somewhat by species. However, the pattern of change is quite consistent, with average harvest dates between 1961 and 2008 becoming later for most species. In recent decades and over much of their range, only blue-winged teal, cinnamon teal and mottled ducks have run contrary to the shift toward later harvest dates.

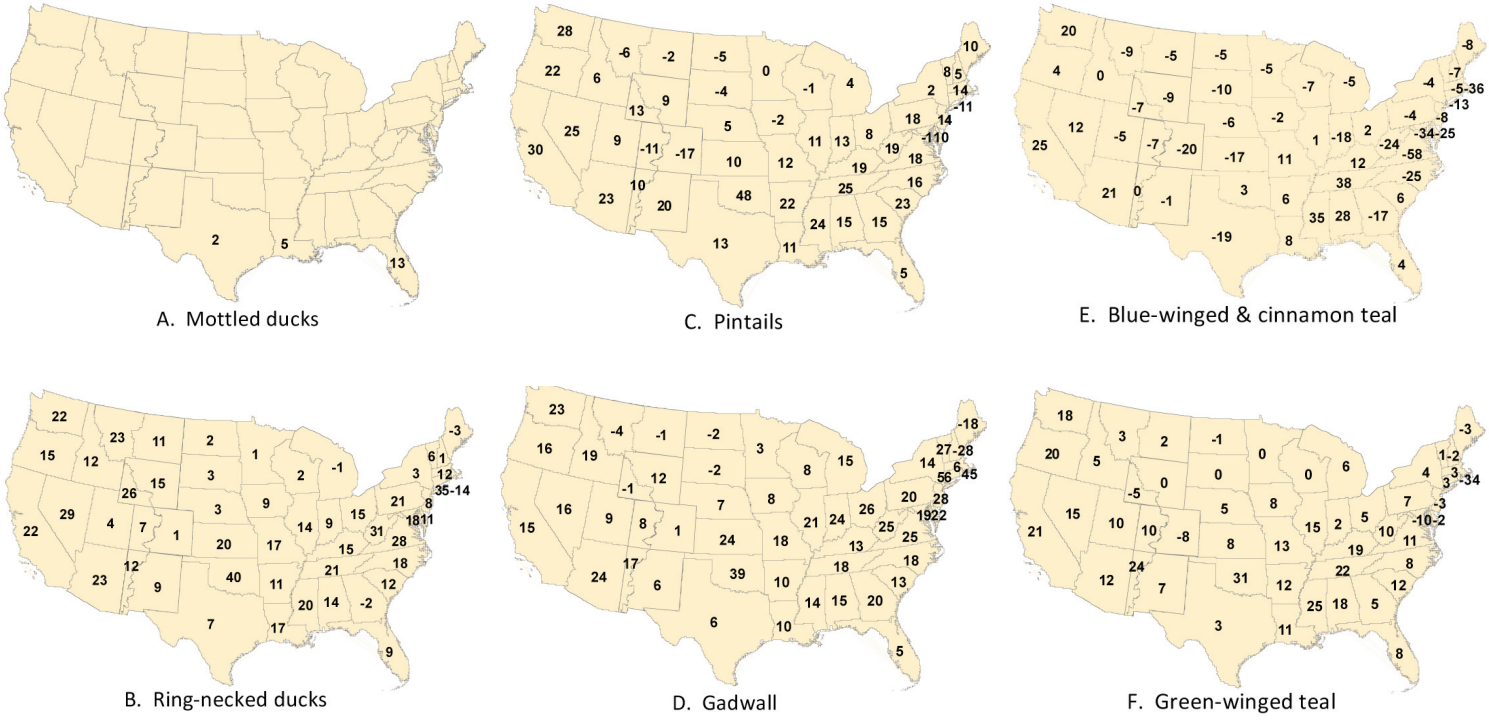

Figure 2. Positive numbers show by how many days average harvest dates have shifted later in the fall over the 49-year span of harvest surveys. Negative numbers show by how many days average harvest dates have become earlier.

Do later harvests mean ducks are migrating later?

If waterfowlers are harvesting ducks later in the year, it might appear that ducks are migrating later – especially since later migrations are consistent with anecdotal information from hunters. Unfortunately, data don't fully support the explanation that migrations are occurring later in the season. But neither do data support the theory that there has been no change in migration dates. An analysis of the Parts Collection Survey doesn't provide conclusive answers, although it does clarify the debate by bringing solid data to bear on arguments that thus far have been based on conjecture.

The case against later migration

Some scientists think that there is no connection between harvest dates and the timing of migration. They suggest that harvests are later now because hunting seasons are later.

That seasons run later in the year than they did in 1961 is clear. In most states season closing dates have gotten later, substantially so in some instances. Opening dates are also later in most southern and in many mid-latitude states, although in many northern states they have become earlier. Since shifts in opening and closing dates varied significantly over the 49-year study period, it is helpful to use the midpoint between a season's open-

ing and closing dates (the average hunting season date) when evaluating the theory that later seasons are the cause of later harvests.

Seasons are later in the year

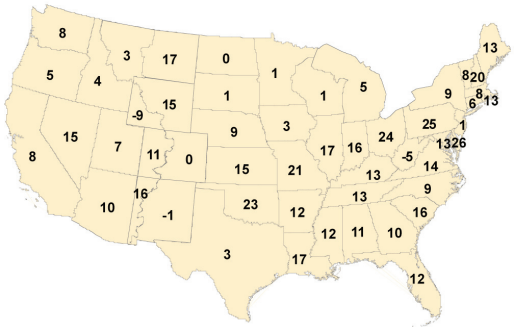

Figure 3. Positive numbers indicate how many days later the average date of the 2008 season occurred compared to 50 years ago. Negative numbers show how many days earlier the average date occurred.

Are later seasons causing later harvests?

If later seasons are driving later harvests, scientists expect to find a close correlation between changes in season dates and changes in harvest dates. Arkansas exemplifies such a correlation: The average season date in 2009 was 12 days later than

in 1961, and the average harvest date of mallards was 14 days later, a difference only of two days. Across the country – for example, in Colorado, Minnesota, Kentucky and Florida – there are states where shifts in harvest dates correspond within three days to shifts in season dates.

But such a close correlation is not consistent throughout the continent. In contrast to Arkansas, for example, Oklahoma's season dates shifted back 23 days, but mallard harvest dates were even later – 31 days later – a difference of eight days. In Michigan, the difference between changes in season dates and harvest dates was 11 days. Examining data presented in figures 1 and 3 reveals that these discrepancies between set-backs in seasons and harvests are common and widespread. If the timing of waterfowl migrations is unchanged, later seasons should consistently result in later harvests, but in numerous states from the east coast to the west, average harvest dates significantly lag behind shifts in season dates by five days, 10 days, even as much as 15 days.

Further, in Gulf coastal states the contrast between shifts in harvest dates for resident mottled ducks (figure 2a) versus migrat-

Why are seasons later?

The data clearly show that average hunting season dates have gotten later over the past fifty years. Could later migrations be causing the later seasons?

It is possible that the delayed arrival of ducks — later migration — has caused the shift to later hunting seasons across much of the U.S. Waterfowl hunters want hunting seasons open when the most ducks are present, and most state waterfowl biologists want hunting season dates that maximize harvest opportunities in their state. Thus it is reasonable to conclude that as hunters recognized later migrations in mid-latitude and southern states, biologists responded by moving back waterfowl seasons.

However, a contrasting hypothesis for the shift in season dates has little to do with altered migration but proposes that it is instead the result of changes in the policies of the USFWS. Charged with protecting the resource, the USFWS may have prohibited later seasons in the 1960s and 1970s

ing mallards (figure 1) contradicts the idea that season dates are the sole driver of harvest dates. Although the average hunting season date was later in Louisiana by 17 days and in Texas by three days, changes in mottled duck harvest dates were not statistically significant in either state – later seasons did not cause later harvests. In contrast, mallard harvests were later in Louisiana by 14 days and in Texas by 10 days. Why did harvest dates shift for mallards but not for mottled ducks? Mottled ducks do not migrate, suggesting that something other than later seasons, such as later migration, is responsible for the later harvest of mallards.

The evidence is far from conclusive, but these two observations contradict the idea that later seasons fully explain later harvests:

- The correspondence between changes in season dates and harvest dates is not consistent.
- There is no statistically significant change in non-migratory duck harvest dates despite changes in season dates.

Therefore scientists do not believe that season dates alone are driving changes in harvest dates.

to comply with the prevalent belief that duck harvests were the key driver of population size. Nonetheless, many states may have lobbied for later seasons. By the 1980s that belief began to change, and the USFWS adjusted its policies accordingly, resulting in later seasons.

The case for later migration

Non-migrating mottled ducks in Texas and Louisiana are being harvested at about the same time as they were nearly 50 years ago. In contrast, hunters are harvesting mallards in those two states much later in the year. This suggests that mallards and possibly other ducks are not widely available to hunters until later in the season because they are migrating significantly later.

If later harvests are the result of later migration, why are ducks migrating later?

Is migration later because of changes in agricultural practices?

Some scientists suggest that agricultural changes provide field-feeding ducks with food longer into the year. Today the northern plains states and prairie provinces are producing corn, soy beans and other diverse crops which historically have not grown there.

But this new array of agricultural foods is unlikely to be changing migration patterns. If it were the driver of delayed migration, there should be a sharp contrast in harvest dates between

ducks that feed in fields and ducks that do not. However, data show similar migratory delays among four species: mallards and pintails, which feed in fields, and gadwall and ring-necked ducks, which do not feed in fields (see figures 3, and 4C and 4D). This indicates that the more diverse agricultural food in northern states is not the primary reason for later migration dates.

Is migration later because of climate change?

Some scientists think that ducks are migrating later in response to the consequences of climate change.

It is plausible that shifts in climate could explain any shift in migration chronology, but the survey data do not provide evidence of a direct causal relationship between climate change and later migrations. Indeed, there is no comprehensive study of any of the potential effects of climate change on waterfowl.

For instance, while it is clear that warmer air temperatures delay the advent of winter, to what extent weather fronts and freezing precipitation instigate migration is undocumented. How warmer fall weather affects duck energy budgets is unknown, as is the link between food availability and the timing of migrations, or the relation between factors such as delays in the accumulation of snowpack and pond freezing and the extended northern staging of ducks.

The strongest statement the present data support is that climate change-induced delays in migration are consistent with the later harvest dates shown among most migratory ducks, including field feeders, wetland feeding dabblers and divers, and both traditionally early and late migrants.

While there is reason to believe that ducks are migrating later, it is questionable to rely on harvest data alone for confirmation. Therefore, using harvest data to determine an association between climate change and delayed migration is speculative. The failure of other hypotheses to fully support the data does not lend additional credence to the climate change hypothesis. The data related to shifts in the timing of waterfowl harvests can neither prove nor disprove the connection between migration and climate change.


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What we know

While the Collection Survey fails to provide a definitive answer to the question "are ducks migrating later," analyzing it clarifies the debate by bringing solid data to bear on arguments that have thus far been based on conjecture. The data show that

1. Waterfowl hunters are harvesting ducks later in the season.
2. Although later season dates are a major driver of later harvests, they do not fully explain the phenomenon.
3. The later harvest is not fully explained by the recent cultivation of corn and soy beans on the northern plains increasing the quality and availability of food, consequently causing waterfowl to postpone migration,
4. Although later harvest dates are consistent with a climate change-induced delay in migration, the Collection Survey data do not provide any evidence of a direct causal relationship between climate change and later migration.

In short, the data examined confirm that ducks are being harvested later in the season, but the data do not allow the conclusion that there is later migration. According to the Delta study authors, Frank Rohwer and John Devney, it is reasonable to assume that the harvest dates are fair proxy for the timing of migration, but that is only an assumption.

Where we go from here

The importance of migration to waterfowl hunters, the consequent economic effects on the outdoor industry and tourism and the implications for waterfowl management make a compelling argument for allocating dollars to migration research. For example, the ideal data set to evaluate shifts in the timing of migration would be systematic waterfowl counts along entire flyways conducted over an extended period of time, just as waterfowl managers have conducted surveys for breeding waterfowl for decades. A joint effort among the states in each flyway and the U.S. Fish and Wildlife Service could produce definitive answers.

Similarly, investigating the connection between climate change and possible delays in migration could offer opportunities for research. For example, as average air temperatures have risen, as they have over the past decades (see Figures 4 and 5), lakes and ponds could remain habitable longer into the year as ice coverage shrinks (see Figure 6) and freeze seasons shorten. But while the connection between the availability of open water and the timing of migration may seem apparent, no studies connect the rise in average air temperature, freeze dates and the timing of migration. In addition, researchers don't know if warmer air temperatures in the fall boost duck energy levels, prompting them to delay migration, or if other changes, such as postponed snowpack accumulation, are factors that link the timing of waterfowl migration to climate change.

What is certain is that the work has just begun. Hunters, the outdoor industry and resource managers are not passive observers. They are expecting an answer to the deceptively simple question: Are ducks migrating later? And what's also certain is that they will hold policymakers and the scientific community accountable for answering, as they surely should.

U.S. average temperatures rising

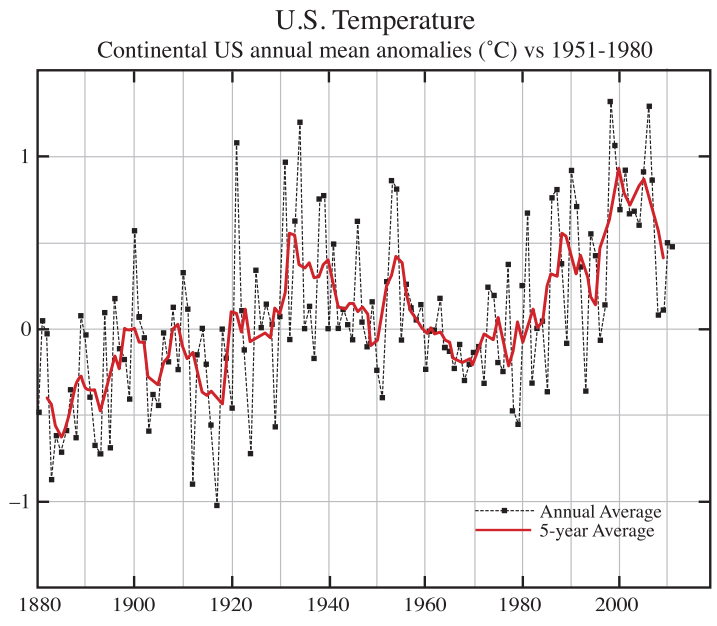

Figure 4: The annual and five-year running average surface air temperature in the contiguous 48 United States show a trend toward increasing warmth as compared to the temperature mean of 1951-1980

Source: NASA

U.S. temperatures rising fastest in winter

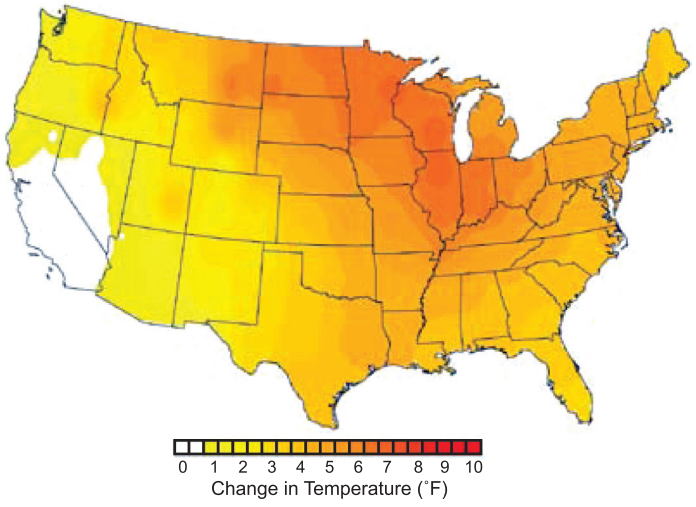

Figure 5: Temperatures are rising faster in winter than in any other season, especially in many key agricultural regions. As indicated by the map, the Midwest and northern Great Plains have experienced increases of more than 7ºF in average winter temperatures over the past 30 years.

Source: http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf page 76

Ice cover on Great Lakes declines over four decades

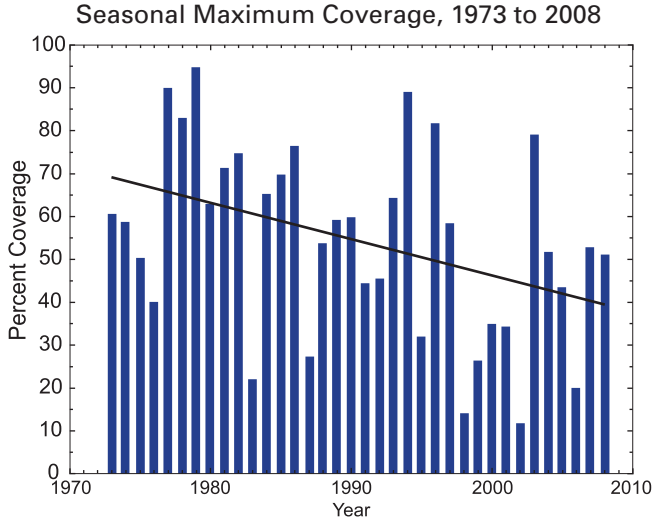

Figure 6: Available data for the extent of ice cover on the Great Lakes demonstrate that, while there are year-to-year variations, there clearly is a downward trend in the percentage of lake surface frozen in the past 40 years. Such data is consistent with records of warming temperatures and with shorter seasons of cold.

Source: http://downloads.climatescience.gov/sap/usp/prd2/usp-prd-midwest.pdf page 121

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