State University of New York
College of Environmental Science and Forestry

2019 - 2020 early season duck migration forecast and research update

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Early season forecast

Summary:

1) We apply a published weather severity index (WSI) that predicts autumn-winter migration by dabbling ducks. The WSI includes effects of temperature and snow cover on duck migration. As such, we use seasonal forecasts that predict temperature and precipitation over eastern North America to make predictions about duck migration. We also use available weather forecast data to produce a weekly duck migration forecast based on our published WSI.
2) The NOAA used the Oceanic Niño Index (ONI) to predict above average temperatures through December in the Mississippi and Atlantic Flyways.
3) However, ONI is Neutral for Autumn-Winter 2019-2020, which reduces the utility of the NOAA forecast for predicting eastern North America winter weather and specifically the weather severity index for duck migration (see Schummer et al. 2010 and Schummer et al. 2014).
4) We also use published links between Arctic Sea ice coverage and Siberian snow cover with North American temperatures to make our predictions for 2018-2019.
5) Effects of Arctic Sea ice coverage and Siberian snow cover on North American temperatures are more pronounced later in winter.
6) Combined these factors make an early season duck migration forecast especially difficult. As such we suggest following our weekly duck migration forecast for timely updates and our late-season duck migration forecast for an update when more variables known to influence long-term weather in the Northern Hemisphere winter are available.
7) We predict warmer and wetter conditions than normal in the Mississippi and Atlantic Flyways through mid-December, and then increasingly common cold outbreaks into January.
8) Above normal precipitation and periods of snow and melt would create abundant and widespread habitat similar to what was observed during the 2018-2019 season, dispersing ducks and potentially making them difficult to pin-point on any given day.

Details:

The NOAA prediction for Fall 2019, based on the Oceanic Niño Index (ONI), is for above average temperatures through December in the Mississippi and Atlantic Flyways. However, we are in an ONI Neutral pattern for autumn-winter 2019-2020, which reduces the utility of the NOAA forecast for predicting eastern North America winter weather. However, there are links between summer Arctic ice cover and resulting Autumn-Winter weather in North America. Arctic sea ice minimum, which occurs in September, ranked second lowest in the 41-year satellite record, behind the record

minimum in 2012, and effectively tied with 2016 and 2017 (**Fig 1, Fig2**). The Weather Severity Index for autumn-winters 2012-2013, 2016-2017 and 2017-2018 ranked as the 36th, 39th, and 35th mildest WSI for November, December, and January, respectively, in our 40-year record, suggesting that the stage is set for another warm autumn-winter and mild WSI.

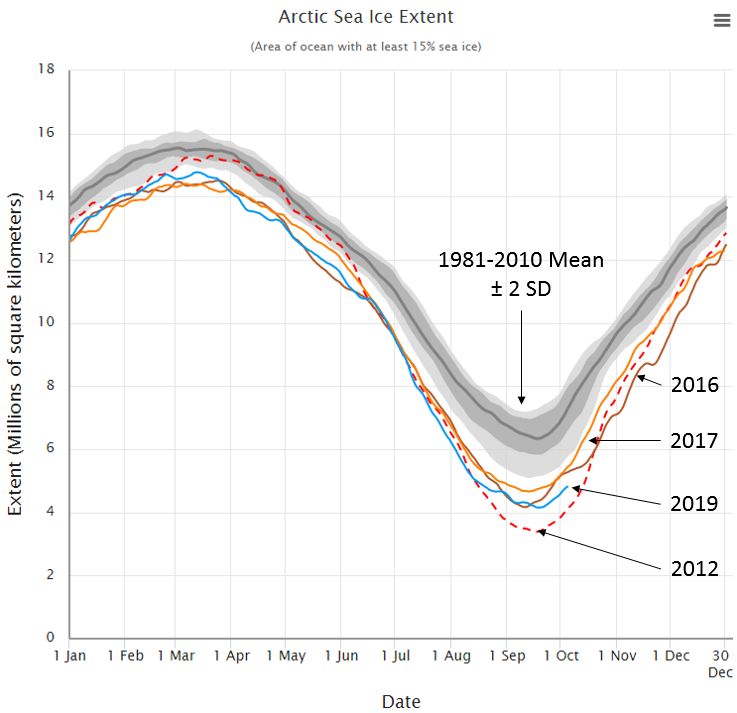

Figure 1. Arctic sea ice extent depicting 2019 in context with 2016 and 2017 (tied with 2019 for second least extent in 41-year satellite record), and 2012 (record low)

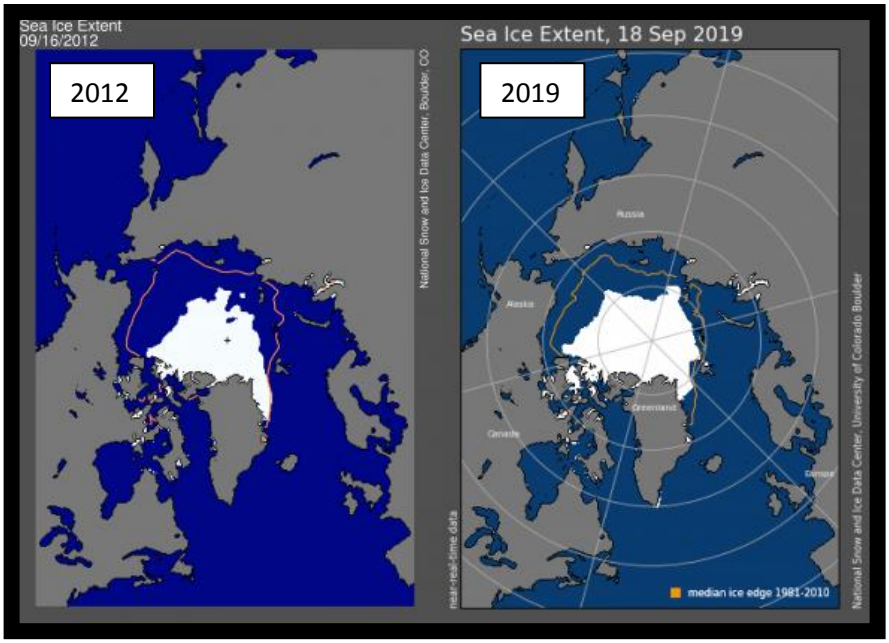

Figure 2. Image comparison of Arctic sea ice extent in September 2012 and 2019.

So, why does Artic sea ice in September matter for autumn-winter weather in the Mississippi and Atlantic Flyways? The extent of Artic sea ice greatly influences pressure systems across the Arctic which influences the polar vortex during winter. Essentially, the fewer strong high-pressure systems centered over the Northern Hemisphere, the less disruption to the polar vortex and cold air gets "locked" up north (**Fig 3a**). However, open leads in the ice, especially in the Barents and Kara Sea (**Fig 4**) and specifically in November, can begin the cycle of polar vortex disruption (**Fig 3b**).

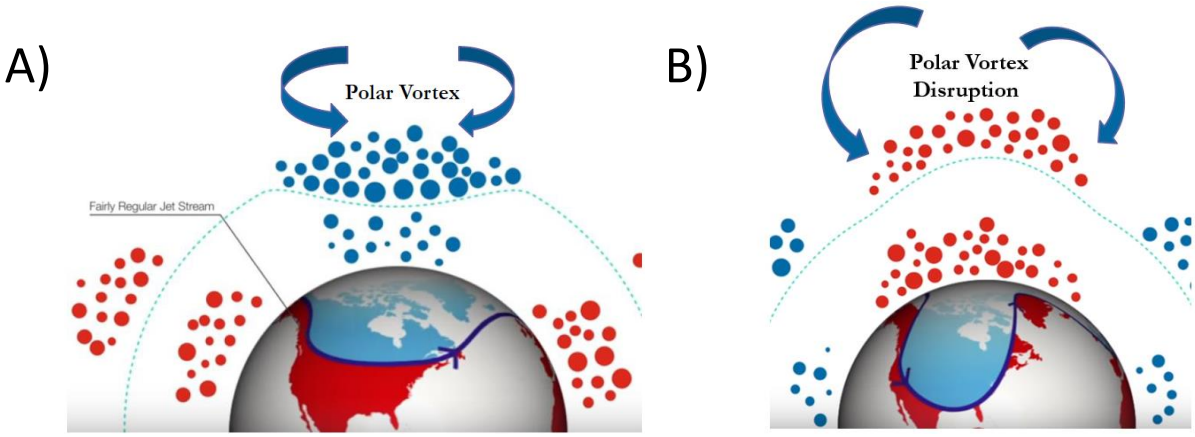

Figure 3. Depiction of a **a)** fairly regular jet stream without polar vortex disruption and **b)** typical cold outbreak into North America during a polar vortex disruption.

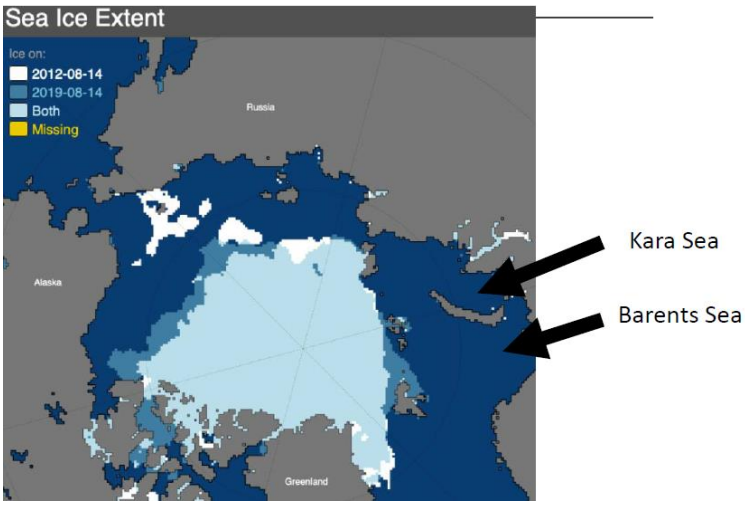

Figure 4. Locations of the Barents and Kara Sea

Lack of Arctic sea ice also sets the stage for October snowfall in Siberia, which, if it advances early and quickly enough during this time period, has a tendency to set up a cold and persistent high pressure system that is positioned to cause a polar vortex disruption that pours cold air down into eastern North America. This information was originally published in 2011 by Dr. Judah Cohen of Atmospheric and Environmental Research and followed up by a diversity of additional publications on this subject and others pertaining to seasonal forecasting during winter. See Judah's blog here. https://www.aer.com/science-research/climate-weather/arctic-oscillation/.

As such, we also can look to snow cover advance in Siberia during October as an indicator for the 2019-2020 season in the Mississippi and Atlantic Flyways. While we are much too early to make a final judgement on what the entirety of October will provide, the moisture available because of the substantial lack of ice on the Pacific side of the Arctic and weather cold enough to cause snow, has created early and substantial snow cover in western Siberia in the last week (**Fig 5**).

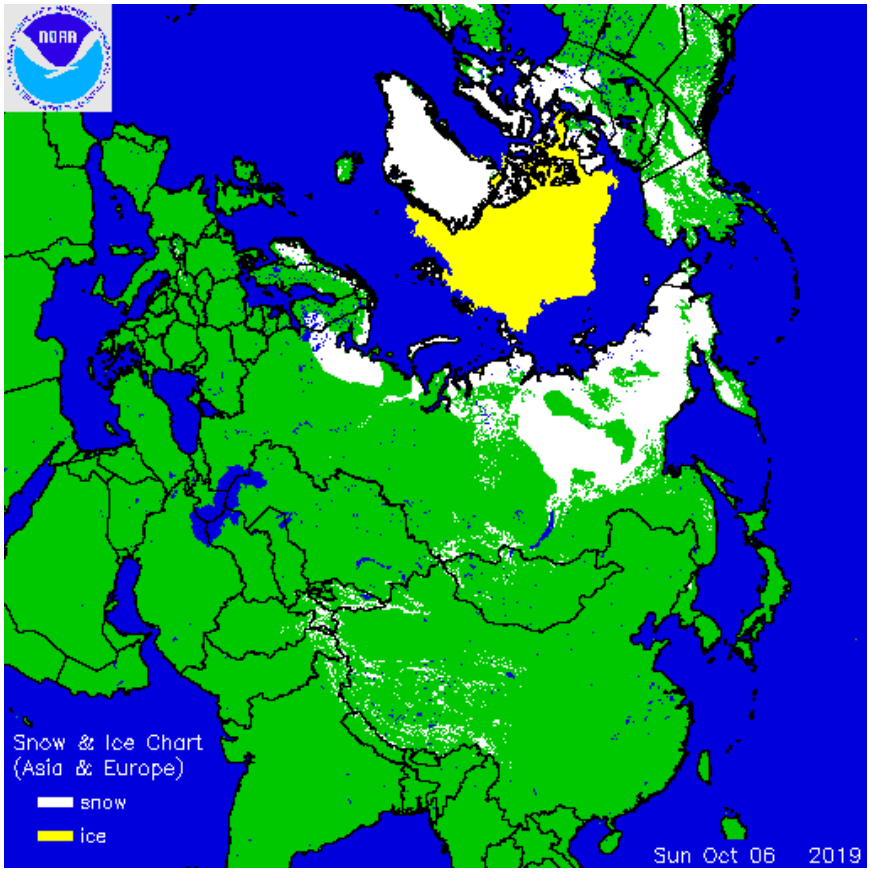

Figure 5. Snow and ice cover in the Northern Hemisphere, 6 October 2019.

Collectively, we watch the snow cover in Siberia in October, ice cover in the Barents and Kara seas in November and the Arctic Oscillation (the direct and near-term measure of the potential for polar air outbreaks into eastern North America) to make our seasonal forecasts.

Combined, we think the early season low Arctic sea ice is generally indicative of an especially warm planet and this heat energy will take some time to dissipate leading to a warmer than normal October – December. This period of atmospheric changes is also likely to bring abundant rains to portions of eastern North America, with greatest likelihood in the mid-Atlantic coast. However, the stage is also set for the potential for cold outbreaks in the Mississippi and Atlantic Flyways, most likely in January. However, we warn that cold and snow followed by strong warming would create abundant floodwaters at northern and mid-latitudes and would hold and disperse ducks at these latitudes. We predict that if persistent cold is going to occur it will most likely follow the regular duck season in February and March.

Research update:

Our lab continues to pursue our duck migration research in 4 thematic areas:

1) What type of weather causes ducks to migrate?
2) Has that weather changed through time?
3) If the weather that causes ducks to migrate has changed, what are the implications for waterfowl enthusiasts and support for wetlands conservation?
4) And, we work with climatologists to apply climate change models to predict future distributions of waterfowl, opportunities for waterfowl enthusiasts, and support for wetlands conservation.

What type of weather causes ducks to migrate?

These data are published in several outlets including the Journal of Wildlife Management, Wildlife Society Bulletin, and PLOS One.

Has WSI changed through time?

The simple answer to that is yes. The WSI remains variable from year to year, but the WSI has become increasingly milder from 1979 – 2019 in the Mississippi and Atlantic Flyways (**Fig. 6**)

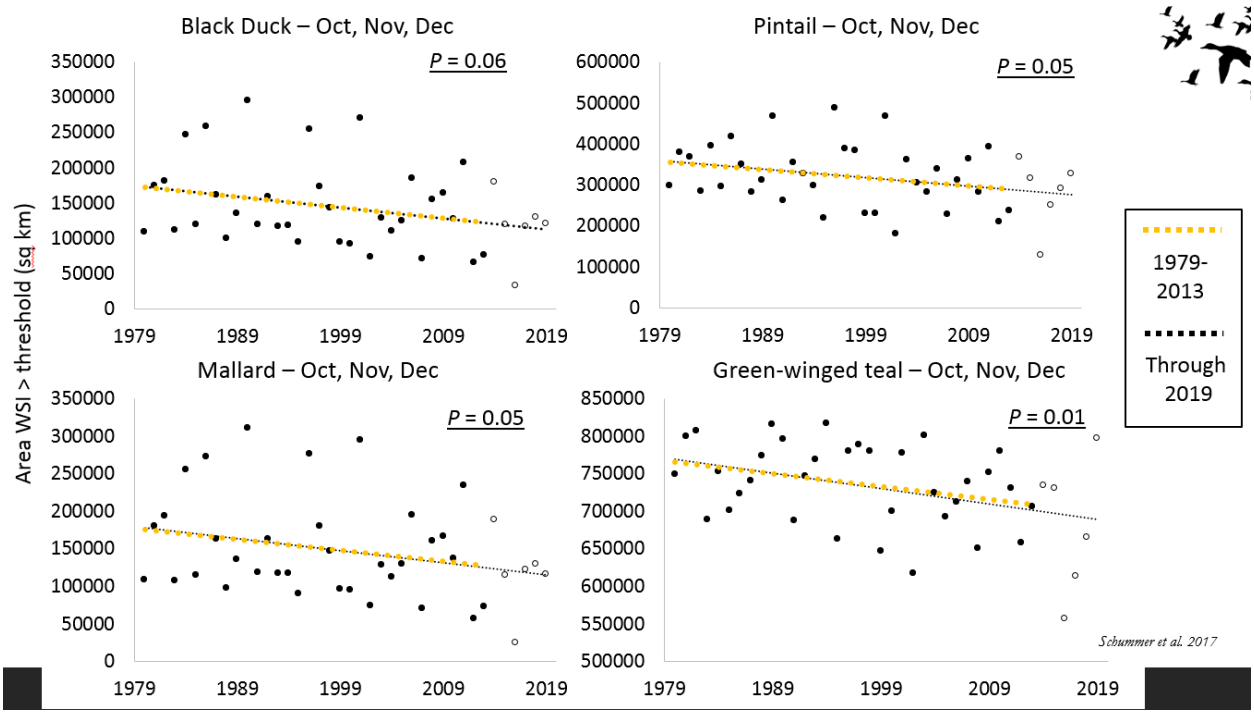

Figure 6. Changes in area (sq km) where the WSI is great enough in the Mississippi and Atlantic Flyways to cause migration of ducks to southern latitudes, 1979 – 2018 (adapted from Schummer et al. 2017). Closed circles are 1979 – 2013 and open circles are updated through 2019. Note, trend line remain similar with the addition of 6 years of data following the Schummer et al. 2017 analysis.

Using the Upper Mississippi River Great Lakes Joint Venture estimate of 1,570.7 duck use days/sq km we calculated that declining WSI allows a minimum of 1,654,720 ducks to remain at northern and mid-latitudes that would have once been available to more southern waterfowl enthusiasts.

Again, the WSI is variable through time, but the most and least severe years are becoming less severe (**Fig. 7**), suggesting that within the variation in WSI, climate is shifting in North America towards warmer conditions with less snow during October-January, the period of autumn duck migration.

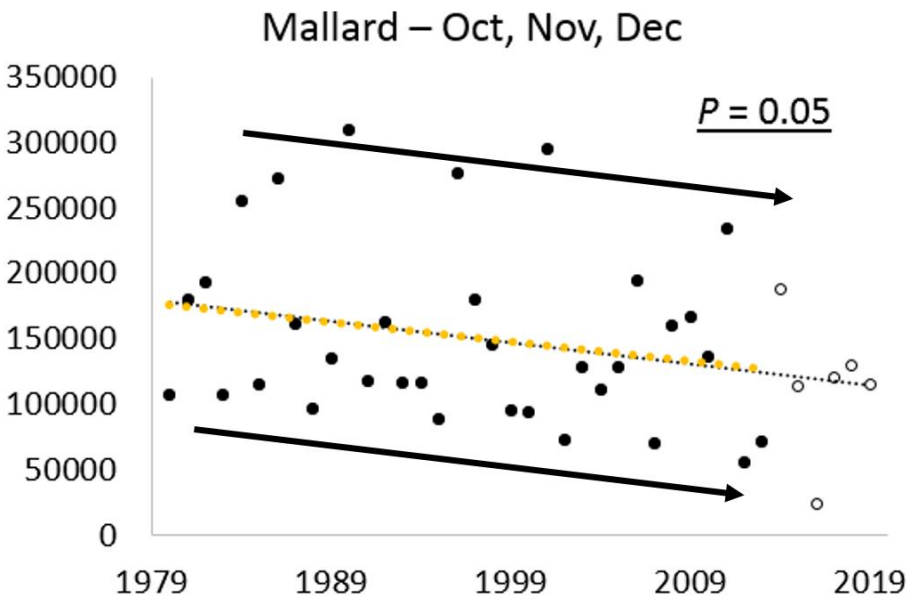

Figure 7. Depiction of the most and least severe years are become less severe as indicated by the top and bottom dark arrows.

Variation in WSI through time also suggests utility in seasonal and weekly forecast of duck migration for waterfowl enthusiasts and those charged with managing wetland habitats for migratory waterfowl in a timely manner.

What are the implications for waterfowl enthusiasts and support for wetlands conservation?

This is likely the most important question, because waterfowl hunters provide broad and substantial support for conservation and stimulus to rural economies, we began modeling if there was a link between duck harvest and hunter participation with WSI. We started in Louisiana, Mississippi, and Alabama because if effects were going to be apparent, they would manifest in this part of the world first.

This area also has a substantial percentage of the waterfowl hunters in North America.

As such, we investigated if mallard harvest and numbers of days afield were influenced by WSI in Louisiana, Mississippi, and Alabama (**Figs. 8 and 9**). Preliminary results, at a relatively gross scale, suggest that mallard harvest increases with increasing WSI and hunters in this region, on average, hunt 1.6 more days on the most than least severe WSI years.

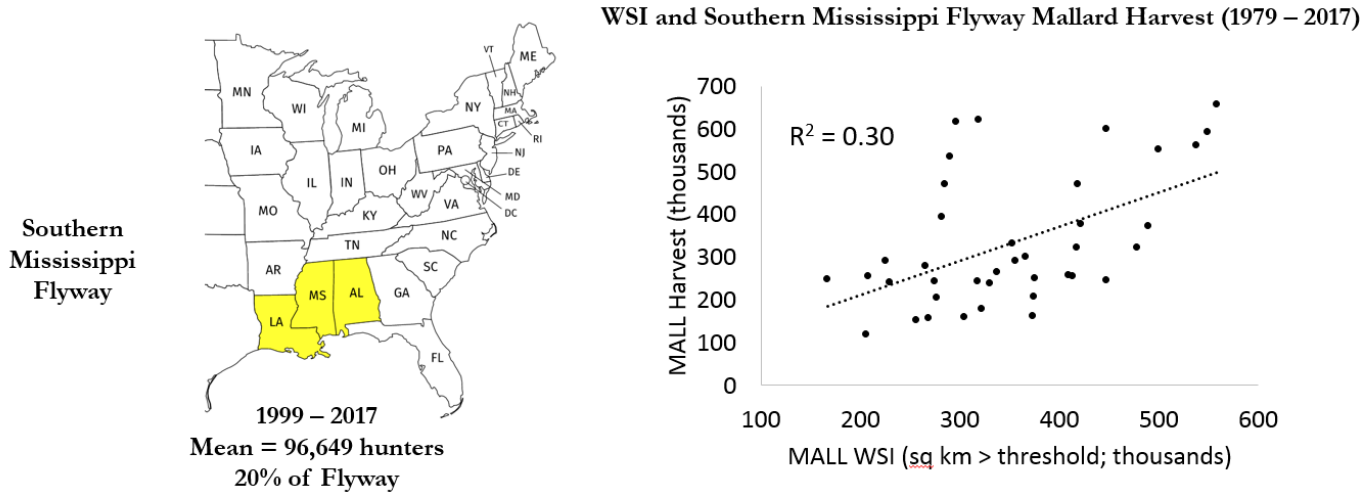

Figure 8. Relationship between Mississippi and Atlantic Flyway mallard WSI in November, December and January 1979 – 2017 on mallard harvest in the southern Mississippi Flyway.

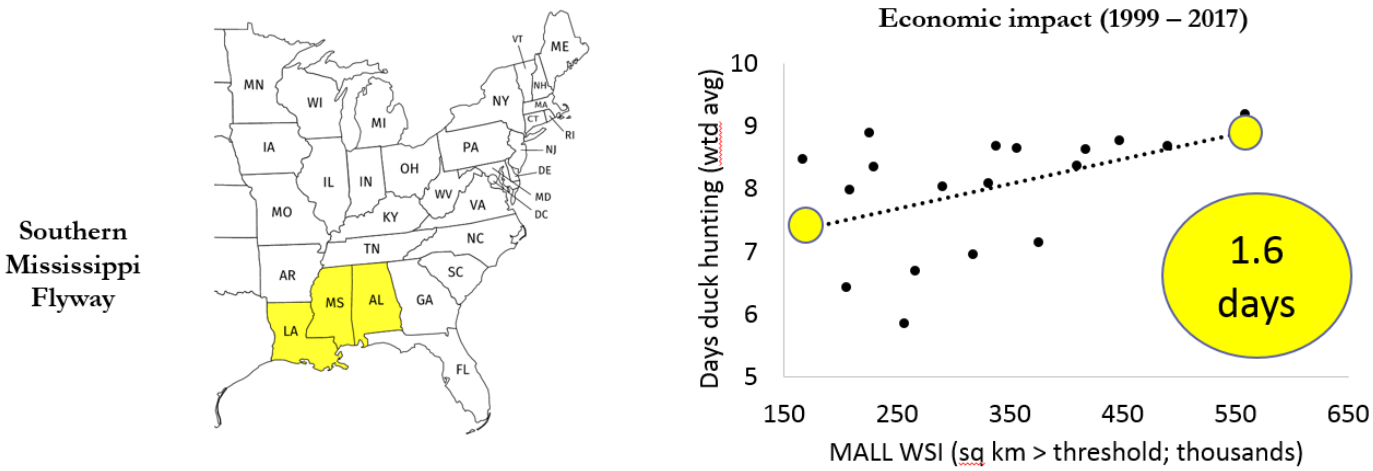

Figure 9. Relationship between Mississippi and Atlantic Flyway mallard WSI in November, December and January 1999 – 2017 (period of available Harvest Information Program data) on days duck hunting by duck hunters in the southern Mississippi Flyway.

We further estimate that a decrease in hunting by 1.6 days × $50 per trip × 96,649 hunters would lead to a $7.7 million loss to economies of this region. How this ultimately influences support and funding for waterfowl and wetland conservation is unknown, but of concern.

Application of climate change models to predict future distributions of waterfowl, opportunities for waterfowl enthusiasts, and support for wetlands conservation.

We just began investigating how milder WSI may influence opportunities for waterfowl enthusiasts, and support for wetlands conservation, but have not yet started to predict changes under climate change scenarios. However, we have modeled how distributions of waterfowl may change with a changing environment and those articles can be found in the Journal of Climate and PLOS One.

The punchline is that the snow season is predicted to be compressed into a shorter period, with continued increased temperature throughout autumn duck migration and prediction for later migration out of northern latitudes. For the Great Lakes region, by the end of the 21st century (2080 – 2099) dabbling ducks are predicted to migrate approximately 1 month later than they would have during the period, 1980 – 1999 (**Table 1**). Specifically, the model predicts that on some years, mallards and black ducks won't need to leave the Great Lakes region for southern locales because the weather will be warm enough for them to remain.

Table 1. Change in timing of dabbling duck migration from late 20th century for mid- and late-21st century out of the Great Lakes region towards southern locales of eastern North America.

Duck Species	Mean Migration Date: Late 20th Century	Change: Mid-21st Century Minus Late 20th Century	Change: Late 21st Century Minus Late 20th Century
Black Duck	10 Dec (Late Migrant)	+19 days	+33 days, if ever
Wigeon	16 Oct	+15 days	+27 days
Gadwall	5 Nov	+13 days	+24 days
GW Teal	15 Oct	+16 days	+25 days
Mallard	9 Dec	+19 days	+40 days, if ever
Pintail	4 Nov	+12 days	+23 days
Shoveler	2 Oct (Early Migrant)	+15 days	+29 days