Oral Presentation

Long-term Trend Analyses of Climatic Factors Influencing Autumn-Winter Migration by Mallards in Central, Mississippi, and Atlantic Flyways

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Extended Abstract: Research on effects of key weather stimuli influencing waterfowl migration during autumn and winter is limited. Therefore, we investigated relationships between changes in relative abundance of mallards (*Anas platyrhynchos*) and weather during fall-winter at mid-latitude locations in North America. We evaluated competing models to explain variation in changes in relative abundance of mallards at Missouri Conservation Areas and nearby (≤ 40 km) recorded temperature and snow cover data from the Historical Climatology Network (HCN), fall-winter 1995-2005. We determined a quadratic cumulative weather severity index (WSI) model, calculated as mean daily temperature -(^{0}C) + number of consecutive days with mean temperature ≤ 0^0C + snow depth + number of consecutive days with snow cover, generated greatest weight of evidence in explaining changes in relative abundance of mallards (Fig 1). We concluded the WSI reflected current and recent cumulative effects of temperature on energy expenditure by ducks and snow cover and wetland icing on food availability for ducks.

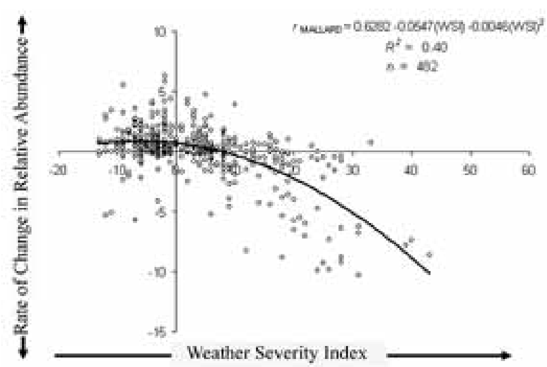

Figure 1. Relationship between rate of change in relative abundance of mallards (*Anas platyrynchos*) and a cumulative weather severity index (WSI) derived from Missouri Conservation Areas and nearby (≤ 40 km) Historical Climatology Network weather stations, 1995 – 2005.

Evidence suggests that increased numbers of waterfowl are remaining at northern latitudes throughout winter in the Mississippi Flyway (Yardley 2007, Brook 2009). Thus, we further investigated long-term trends in the developed WSI using HCN weather stations (n = 15) throughout northern and mid-latitude states in the Mississippi Flyway. We also investigated relationships between El Niño Southern Oscillation (ENSO) events and the WSI to determine if autumn-winter weather known to influence changes in mallard abundance at North American mid-latitudes could be forecasted using the Oceanic Niño Index.

We found a sinusoidal WSI trend from 1950-2008, although the 1990-2000s had an overall less severe WSI for longer durations compared to the 1950s-1980s, and this relationship was strongly defined in January (Fig 2).

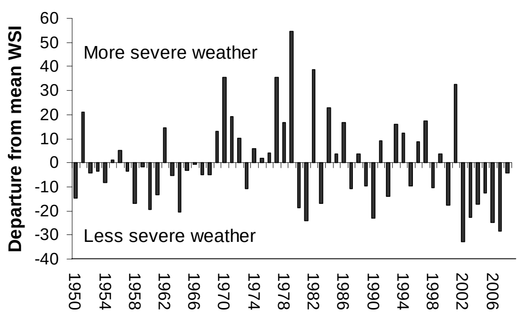

Figure 2. January weather severity index (WSI) departure from mean, 1950 – 2008.

While some research has indicated waterfowl wintering at increasingly northern latitudes in recent years (Link et al. 2006), others have concluded either no change or short-term changes in distribution (Otis 2004, Greene and Krementz 2008). Our results indicate that weather known to influence mallard migration at northern and mid-latitude locations in the Mississippi Flyway has been less severe since the 1990s. Thus, waterfowl may remain at northern latitudes throughout winter or delay migration to southerly areas in the Mississippi Flyway. Calculations of WSI are ongoing and long-term trends for northern and mid-latitude states in the Central and Atlantic Flyways will be included in final analyses and presentation.

In examining the role of ENSO, we found that a La Niña corresponded with a moderate WSI and El Niño with relatively low WSI. Variation in WSI was greatest with a neutral Oceanic Niño Index with a nearly equal chance of extremely high, moderate, and extremely low WSI (Fig 3).

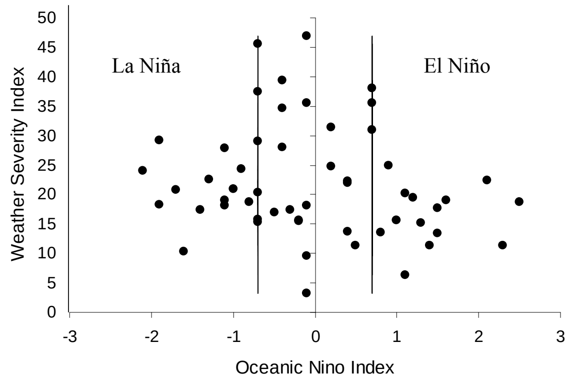

Figure 3. Relationship between the November-January average weather severity index and Oceanic Niño Index (ONI), 1950-2008. Area between solid bars indicates neutral ONI, positive ONI = El Niño events, and negative ONI = La Niña.

We encourage testing of the developed WSI at different waterfowl staging areas on mallards, other species, and at the individual bird level (e.g., telemetry monitored ducks) and use of the WSI in development of projections of the timing and extent of potential changes in distributions of waterfowl into the future under various climate change models. The WSI and detected changes in distribution of waterfowl may help guide planning and action of habitat conservation.

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