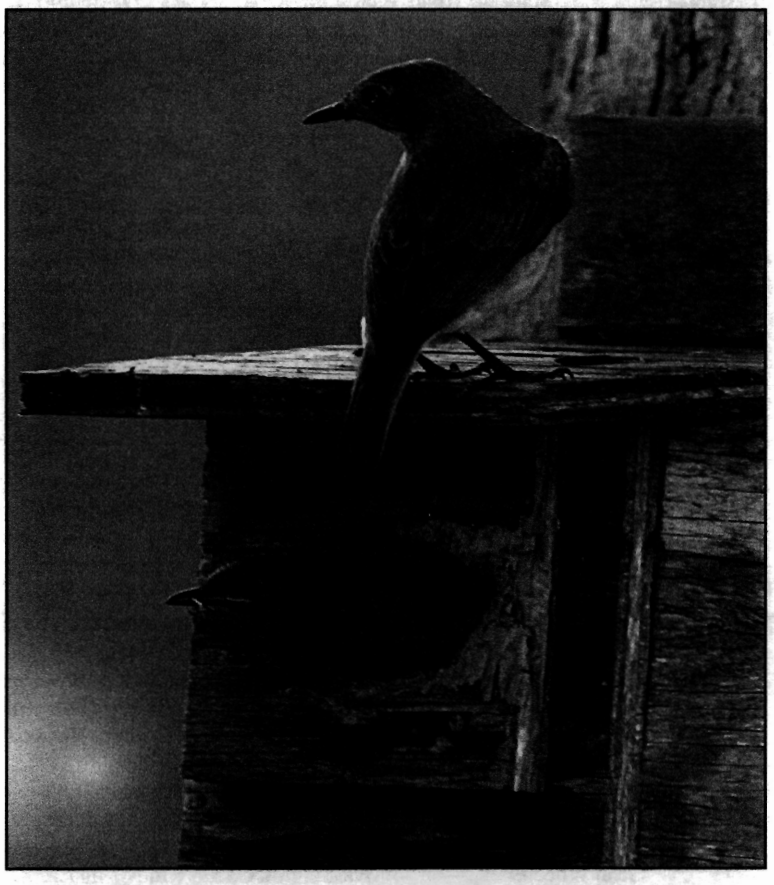
ISSN 0147-9725

MARYLAND BIRDLIFE



Bulletin of the Maryland Ornithological Society, Inc.

MARCH–JUNE 2003
VOLUME 59
NUMBERS 1–2

Cover: Eastern Bluebirds at nest box, Waldorf, MD, June 6, 2002. Photo © George M. Jett.

MARYLAND BIRDLIFE

VOLUME 59 MARCH–JUNE 2003 NUMBERS 1–2

SPRING ARRIVALS OF MARYLAND AND WASHINGTON, D.C. BIRDS

A preliminary evaluation of 100 years of record keeping and recommendations for their continued compilation

Sam Droege, Andrea van den Berg, and Elizabeth Keller

Abstract: The characteristics and usefulness of volunteer collected spring arrival dates are evaluated using data for 6 species of Maryland long-distance migrants (N=1502 observations) extracted from the 6 million archived Migration Observation Cards and from more recent efforts of members of the Maryland Ornithological Society. Arrival dates were found to have low variability from year-to-year. The Coefficients of Variation of arrival dates (with trends removed) for each species ranged from 4.8% to 7.9%. The range of days contained within the 95% confidence interval averaged only 10.2, 7.1, 2.2, and 5.1 for the 4 geographic regions inspected within Maryland. Arrival dates varied significantly among geographic regions within Maryland for most species. Three species showed no significant change in arrival date since the 1880's, two had shifted to later dates, and 1 to earlier. Arrival dates are easy to collect and precise enough to detect shifts in migration habits of many North American species. We suggest reinstating this collection system and list our recommendations for doing so.

The first arrival of birds each spring has been observed and recorded throughout history. Such arrivals were a marker for spring sowing (e.g., the Brown Thrasher, *Toxostoma rufum,* the farmer's "planting bird"), grist for the poet...

Spring came with tiny lances thrusting,
And earth was clad in peeping green;
In russet bark, the twigs incrusting,
Tenderest blossom-points were seen;
A robin courier proclaimed good cheer:
Summer will soon arrive, for I am here.
—Wilbur Larremore, "Blossom Time"

...and duly recorded within the journals of naturalists. Not unexpectedly, such an obvious phenomenon attracted those whose love it is to organize the unorganized, and groups were formed in ornithological circles early on to centralize and document arrival dates. The result was the first continental bird monitoring program in North America and perhaps the world.

Initial efforts began with Wells W. Cooke, who coordinated volunteers throughout the Mississippi flyway: "Hoping that this attempt to enlarge our knowledge of the interesting subject of migration…" (Cooke 1882). That early effort was soon embraced by C. Hart Merriam

from within the newly constituted American Ornithologists' Union in the form of the Committee on Migration (AOU 1883), and the network expanded to encompass all of the United States, Canada, and portions of the West Indies. In the late 1880's the program passed from the Union to the federal government's Division of Economic Ornithology, where, by 1889, the number of correspondents had reached nearly 3000 (USDA 1936). The program was actively maintained within the federal government (but with dwindling numbers of observers) until 1970, resulting in a current collection of approximately 6 million handwritten cards.

In more recent times some state ornithological societies have continued to ask their members to track first arrival dates for migrants, but little beyond publication of yearly tabulations in state bird journals has been done with the data. Currently the only remaining organized collection of such information in North America, to our knowledge, is in Maine (Wilson et al. 2000). While millions of records have been collected involving thousands of observers, only a few summaries of these data have been produced. Of these, only five analyze changes in bird phenology over time in North America (Cooke, W.W. 1915, Temple and Carey 1987, Oglesby and Smith 1995, Bradley et al. 1999, Wilson et al. 2000). There have been no published evaluations of the technique.

In this paper we characterize and evaluate the systematic collection of first arrival dates for birds using 112 years of data from 6 species of long-distance migrants in Maryland. We discuss the characteristics of these data as well as their ability to accurately and precisely detect changes. Furthermore, we present ways to increase the value of the collection of this type of data and explore their implications for detecting global climate change and other phenomena related to bird migration dates.

Methods

First spring arrival dates were transcribed from the Migration Observer Cards kept at Patuxent Wildlife Research Center and from records collected in the 1970s and 1980s kept by the Maryland Ornithological Society. Each record represents an individual observer's earliest detection of the species within a given year. No additional information was available that indicated the extent of time each observer had available for observation within a year. Because of resource constraints, arrival data for only six species (1502 records, Table 1) were evaluated: Chimney Swift (*Chaetura pelagica*), Barn Swallow (*Hirundo rustica*), Great Crested Flycatcher (*Myiarchus crinitus*), Red-eyed Vireo (*Vireo olivaceus*), Wood Thrush (*Hylocichla mustelina*), and Scarlet Tanager (*Piranga olivacea*). These species were chosen to be representative of other Neotropical migratory landbirds, since they have a mix of migration strategies and comparable recent data from Maryland were available. Records were eliminated that had arrival dates later than late May or were unassigned to county. Records spanned the years 1877 to 1988.

All data were tested with a one-way ANOVA, and a Bonferroni Pairwise Post Hoc Test was used to evaluate pairwise comparisons at the P = 0.05 level of significance. Coefficients of Variation (CV) of dates of first arrival were calculated using the standard error of a linear regression (with date as the dependent variable and year as the independent variable) and then divided by the mean. All statistical tests were performed using Systat 7.0 (SPSS 1997). Log-transformations to better approximate a normal distribution were necessary for the Barn Swallow data only. The few data outliers identified in the Systat regression analysis (Leverage

values greater than 0.60) were eliminated from the dataset and the regressions re-calculated without them.

Geographic subregions were created to test if arrival dates were affected by geographic location. Grouping counties into elevation and latitudinal zones created four regions. Region 1 (Allegheny Plateau): Garrett County. Region 2 (Ridge and Valley): Allegany, Washington, and Frederick counties. Region 3 (Piedmont and Northern Coastal Plain): Carroll, Baltimore, Harford, Cecil, Montgomery, Howard, Anne Arundel, Prince George's, Calvert, Kent, Queen Anne's, Talbot, and Caroline counties, and Washington D.C. Region 4 (Southern Coastal Plain): Charles, St. Mary's, Dorchester, Wicomico, Worcester, and Somerset counties.

Data from Regions 2 and 3 were combined for analyses of change over time as there were no differences in arrival times within a species between these two regions. Lowess smoothed plots of first arrival dates across years were created to visually portray any non-linear changes (tension = 0.3).

Results

Table 1 (page 6) lists the average arrival date with the associated confidence interval for each species across the four regions. There were significant differences in the average spring arrival dates among this group of species ($F_{5,1267} = 247.8$, $P < 0.0001$). Post hoc tests showed that all species had different mean arrival times ($P<0.05$) from one another with the exception of Scarlet Tanagers and Great Crested Flycatchers. Figure 1 (page 7) presents LOWESS smoothed plots of change over time in arrival date for the sixspecies. Data for Barn Swallows have been log-transformed.

Barn Swallow

No differences were found in arrival dates among regions for Barn Swallows ($F_{3,264}=1.504$, $P=0.214$). Regression analysis demonstrated that recorded arrival dates occurred earlier with time ($F_{1,217} = 13.092$, $P < 0.0001$).

Chimney Swift

Significant differences in arrival date occurred among regions ($F_{3,297} = 7.507$, $P < 0.0001$) between far western Maryland and all other regions as well as between the Ridge and Valley and Southern Maryland counties ($P < 0.05$). Differences in arrival dates ranged from 9-15 days later between far western Maryland and the other regions. No significant time-related trends were found ($F_{1,254} = 0.051$, $P = 0.822$).

Red-eyed Vireo

Significant differences among the regions in arrival date were detected ($F_{3,233} = 6.376$, $P < 0.0001$) with birds from far western Maryland arriving later and the Eastern Shore counties earlier and a similar pattern between the Ridge and Valley and southern Maryland counties ($P > 0.05$). Arrival dates were 4-8 days later in far western Maryland than the other regions. No trends were detected across time in arrival date ($F_{1,202}=0.034$, $P=0.854$).

Scarlet Tanager

Significant differences in arrival date exist among regions ($F_{3,235} = 4.877$, $P = 0.003$). Significant regional differences (5-7 days earlier) occurred between the Southern Coastal Plain counties and all other regions. Regression analysis detected no significant trend over time ($F_{1,207} = 0.178$, $P = 0.673$).

Great Crested Flycatcher

No significant differences were found among regions ($F_{3,191} = 0.952$, $P = 0.417$) in arrival date, but there was a significant trend towards a later arrival in Maryland over time ($F_{1,146} = 4.458$, $P = 0.036$).

Wood Thrush

No significant differences among regional arrival dates were detected ($F_{3,270} = 1.994$, $P = 0.115$). However, there was a significant trend toward later average arrival in the spring over time ($F_{1,237} = 13.375$, $P < 0.0001$).

REGION

Date / Mean (N) / 95% Confidence Interval

SPECIES	1	2	3	4
Chimney Swift	May 2	Apr. 17	Apr. 19	Apr. 23
	121.8 (6)	106.5 (30)	109.3 (226)	112.5 (30)
	127.1–116.6	110.6–102.4	110.4–108.2	114.5–110.5
Barn Swallow	Apr. 21	Apr. 14	Apr. 14	Apr. 12
	111.2 (9)	103.6 (30)	103.5 (189)	102.3 (39)
	120.0–102.5	108.7–98.4	105.1–102.0	105.4–99.1
Great Crested	May 5	May 4	May 4	May 2
Flycatcher	124.7 (9)	124.4 (21)	123.9 (127)	121.5 (38)
	127.6–121.7	129.1–119.8	125.4–122.5	124.3–118.8
Wood Thrush	May 2	Apr. 29	Apr. 28	Apr. 29
	122.3 (8)	118.7 (29)	117.7 (210)	118.8 (26)
	126.6–117.9	121.1–116.3	118.5–116.9	121.5–116.2
Red-eyed	May 7	May 4	May 1	Apr. 29
Vireo	127.3 (8)	123.5 (24)	120.6 (180)	118.8 (25)
	132.3–122.2	126.3–120.8	121.5–119.8	120.9–116.8
Scarlet	May 7	May 5	May 4	Apr. 29
Tanager	126.6 (7)	124.7 (23)	123.9 (186)	119.3 (22)
	130.8–122.4	126.8–122.5	124.9–123.0	121.9–116.6

Table 1. Data for numeric (Julian Day) non-leap year arrival dates in Maryland.

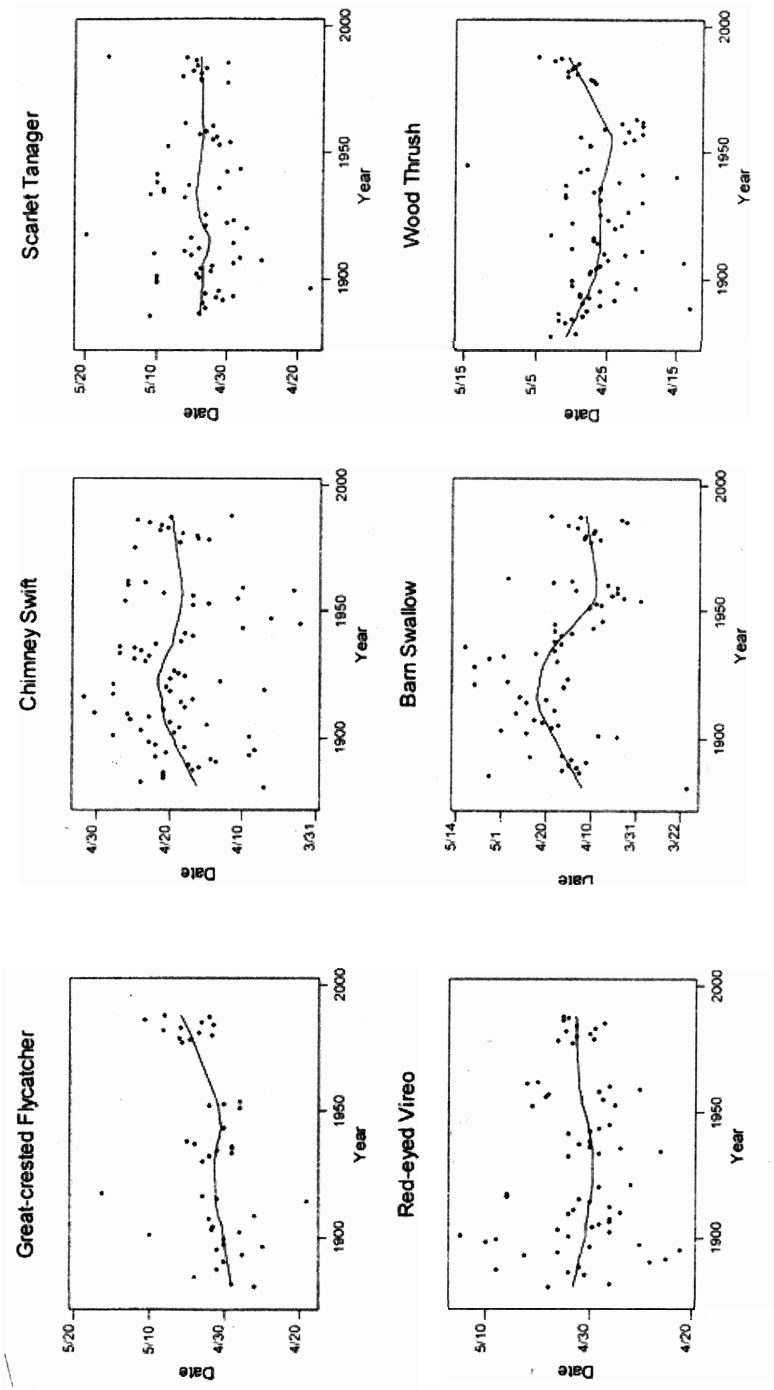


Figure 1. LOWESS smoothed plots of change over time in arrival date. Data for Barn Swallows have been log-transformed.

Coefficient of Variation

The percent CVs for arrival dates for each species varied from 4.8 to 7.9% (Table 2). The range of days contained within the 95% confidence interval for each species averaged only 10.2, 7.1, 2.2, and 5.1 for regions 1-4 respectively (Table 1).

Species	*Error*	*Mean (Julian Day)*	*CV*
Barn Swallow	0.104	4.634	.022
Chimney Swift	8.598	108.949	.079
Great Crested Flycatcher	8.465	124.000	.068
Red-eyed Vireo	5.774	120.975	.048
Scarlet Tanager	6.230	124.019	.050
Wood Thrush	6.060	117.799	.051

Table 2. Standard errors (taken from regressions of arrival date), means, and CVs for six species in selected counties in Maryland (see text). Data for Barn Swallows are natural log-transformed.

Discussion

First arrival dates of spring and fall birds have been and will continue to be recorded by birdwatchers and students of nature. Ornithological societies and clubs have, in the past, organized the collection of arrival dates and compiled them in regional journals, though that practice has now largely ended. From the samples investigated in this study it is clear that spring arrival dates are highly predictable events. When sample sizes are large, regional estimates vary only by 2-3 days on average. Such predictability when calculated in terms of the coefficient of variation yields CVs of first arrival dates across years averaging just 5.9%. Compared to average CVs of population counts across years for passerines (57%), other vertebrates (frogs 93%, small mammals 60%, and non-salmonid fishes 71%), and even plants (21%). Arrival dates are remarkable in their lack of variation from year to year (Gibbs et al 1998). Such low variability permits the detection of small shifts in average arrival date.

Despite their consistent detectability, ease of collection, and potential for detecting shifts in migration patterns, few bird clubs publish useful data. Additionally, while a number of these societies have collected some information about migration dates in the past, a casual survey of bird-watching societies and clubs across the continent indicates that almost none of them do so now; with the exception of a program in Maine with over 100 observers (Herbert Wilson, pers. comm.). The few other arrival dates that are published are usually the anomalous ones, arrivals so early as to be noteworthy but not a useful characterization of arrival patterns.

Recommendations for Collecting and Summarizing Arrival Date Information

Systematic and standardized compilation of arrival dates does have relevance and is an activity that bird-watching clubs can readily compile. Furthermore, the existence of 6 million records of arrival, departure, and migration records archived at Patuxent Wildlife Research Center from the late 19th century creates a means of assessing over 100 years of changes in those patterns. Similar data for quantitative comparisons for this length of time are not available for assessing population changes.

We feel that the following points need be considered in creating a relevant and comparable migration date recording system; without such information, reports of migration dates will either be unusable because variances and sample sizes were absent or biased because changes in observer behavior over time lead to false increases or decreases in dates.

1. Reports need to be summarized geographically by county (or other relatively small geographic regions) to account for variations in arrival dates by latitude, altitude, and proximity to large water bodies.

2. Reports summarizing arrival dates may report the earliest records for arrivals, as that is usually of interest to birders, but, more importantly, also need to report the average arrival date, the total number of lists that reported the species (not simply the total number of lists submitted), and the standard deviation or confidence interval for the records. Such summaries allow comparisons of change of average arrival date to be made among time periods and locations.

3. A database housing all the records, observer names, exact localities, and arrival and departure dates would, in the long run, present the greatest flexibility in making long-term comparisons across time and with other geographic sites.

4. While perhaps difficult to extract from observers, an indication from them of the number of days they had available during the season to detect arrival dates (perhaps even a calendar of availability) would decrease the bias towards recording later arrivals that trips away from the region would create. Alternatively, observers could be asked to not record arrival dates they feel may be misleading because they were away from the area. It is important to emphasize that these records should be a reflection of the first arrivals of species into an area rather than a mere recording of the species on a trip away from their primary place of observation.

5. A centralized program and database run through a web site would be an ideal way to coordinate the wide-scale collection of such data throughout the continent.

Arrival Dates as a Measure of Global Change

Long- and short-term shifts in arrival dates are potentially related to changes in climate and associated plant and insect populations. Depending upon the cues that migratory birds

use to determine when and how quickly they migrate, the impacts of climate change could be expressed as shifts in arrival times. This paper is not a fair investigation of such shifts as its focus is methodological. However, the 100+ years of data for the six species chosen are worthy of some comment.

Despite low variances and concomitant high ability to detect even small changes in average arrival date, no changes in arrival dates were noted for three species (Red-eyed Vireo, Scarlet Tanager, and Chimney Swift). Of the remaining three, two were detected later in the spring (Great Crested Flycatcher and Wood Thrush) and only one (Barn Swallow) was detected earlier in the spring.

With a complete data set for all species and all regions of North America more thorough analyses of patterns of change can occur. What species are increasing, decreasing, or stable? Are those patterns associated with the migration guild of the species (e.g., neotropical migrant, short-distance, forest-wintering, scrub-wintering, aerial feeder)? Are the yearly fluctuations associated with weather on the wintering grounds, on the migration route, at the arrival point? Are conditions of wintering bird habitats or the average number of winter days associated with these changes? Rates of northward migration for each species can be calculated if data are collected throughout the continent and similar divinations of those patterns in conjunction with climatic variables are evaluated.

There is irony in the history of migration counts. Just when the possible importance of this, the oldest avian monitoring program in the continent, is documented it ceases to exist. While the collection of these data would appear moribund, it should be noted that a small project in Maine collected 15,000 arrival records over their first four years (1994-1997; Wilson et al. 2000), an indication that while collection of arrival dates has largely stopped the interest has not.

Acknowledgments

We would like to thank Bob Ringler for access to the Maryland Ornithological Society's files and Chandler S. Robbins for access to the Migration Observer Card files. Chandler S. Robbins and Herbert Wilson also provided numerous useful comments on an early draft of this paper.

Literature Cited

American Ornithologists' Committee. 1883. The American Ornithologists' Union. Bull. Nuttall Ornithol. Club. 8:221-226.

Bradley, N.L., Leopold, A.C., Ross, J., and W. Huffaker. 1999. Phenological changes reflect climate change in Wisconsin. Proc. Natl. Acad. Sci. 96:9701-9704.

Cooke, W.W. 1882. Bird migration in the Mississippi Valley. Forest and Stream 19:283-284, 306.

Cooke, W.W. 1915. Bird migration. USDA Bull. No. 185. 47 pp.

Crick, H.Q.P., C. Dudley, D.E. Glue, and D.L. Thomson. 1997. UK birds are laying eggs earlier. Nature 388:526.

Emberlin, J., J. Mullins, J. Corden, W. Millington, M. Brooke, M. Savage, and S. Jones. 1997. The trend to earlier Birch pollen seasons in the U.K.: A biotic response to changes in weather conditions? Grana 36:29-33.

Gibbs, J. P., S. Droege, and P. Eagle. 1998. Computers in biology: monitoring populations of plants and animals. BioScience 48:935-940.

Oglesby, R.T. and C.R. Smith. 1995. Climate change in the Northeast. Pages 390-391. *In* LaRoe, E.T., G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac eds. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. U.S. Department of the Interior, National Biological Service, Washington, DC. 530 pp.

Sparks, T.H. and P.D. Carey. 1995. The responses of species to climate over two centuries: an analysis of the Marsham phonological record, 1736-1947. J. Ecol. 83:321-329.

SPSS, Inc. 1997. Systat 7.0: New statistics. SPSS. Chicago, Ill.303 pp.

Temple, S.A. and J.R. Cary. 1987. Climatic effects on year-to-year variations in migration phenology: a WSO research project. Passenger Pigeon 49:70-75.

USDA, Bureau of Biological Survey. 1936. To all bird migration observers of the biological survey. Bird Migration Memo. No. 1.

Wilson, W.H., Jr., D. Kipervaser, and S.A. Lilley. 2000. Spring arrival dates of Maine migratory breeding birds: 1994-1997 vs. 1899-1911. Northeastern Naturalist 7:1-6.

Sam Droege, USGS PWRC, BARC – EAST. Bldg 308, 10300 Baltimore Ave., Beltsville, MD 20705

Andrea van den Berg, Van Galenstraat 16, 6826 RZ Arnhem, The Netherlands

Elizabeth Keller, Weissenbruchweg 16, 2102 AG Heemstede, The Netherlands