

Explanation

After reading about Cooper's hawks possibly moving laying dates earlier, I wanted to see if we saw similar trends in peregrine falcons. I downloaded a complete banding dataset from the Midwest Peregrine Falcon Society's website (<http://midwestperegrine.umn.edu/>). I removed the following records:

- All hacked birds
- All augmented birds
- All birds with no hatch dates

I broke the data into states and verified early and late 'outlier' dates against the Midwest Peregrine Society's annual reports, websites with historical timelines, and news articles. I found less than ten records where hatch dates had been substituted with lay dates or band dates. I was able to substitute correct dates by finding original data in MPS annual reports. There were six sites where dates had been transposed (ie. 2501 instead of 2015). I fixed these as well.

Once the data was cleansed, I was left with 5,253 records spanning 1987 to 2016. I decided to break the data into five-year periods by state. This allowed me to use larger recordsets than would be possible with either annual or location-based data, and yielding higher-quality information in the process. Most states had nesting peregrines by 1992, so that became the first five-year period. Data was grouped into northern and southern tiers and broken down further by state, with the exception of Michigan. Michigan was broken into upper and lower peninsulas. The upper peninsula was grouped with the northern tier of states and the lower peninsula was grouped with the southern tier of states. The grouping also helped answer questions about how latitude, regional weather patterns, and population types might influence nesting chronology.

I chose to use hatch dates to ask whether peregrine falcons were beginning to nest earlier because they yielded the most records and because they seemed likely to be the most accurate date related to nesting chronology. While banding dates are highly accurate, falcons may be banded any time between about 14 and 38 days, introducing a great deal of variability unrelated to nesting chronology. Banders that don't know the age of a falcon at banding estimate it based on experience and the book *Guide to management of Peregrine Falcons at the eyrie*, an excellent academic source. The same banders also age peregrines year after year, reducing another potential source of variability.

Observations

In general, northern sites hatch later than southern sites. The average hatch date for each state across all years is shown in the table below. Unsurprisingly, Canada and Minnesota hatch the latest, while Indiana and Kentucky hatch the earliest. The upper and lower peninsulas of Michigan may be classified in the same state, but they are not in the same latitude or region, so I split them in two.

State	Average hatch date by state
Canada	June 1
Minnesota	May 19
Wisconsin	May 15
MI - UP	May 27
North Dakota	May 27
Nebraska	May 23
Iowa	May 13
MI - LP	May 10
Kansas	May 8
Ohio	May 7
Missouri	May 5
Illinois	May 4
Indiana	May 4
Kentucky	April 30
<i>Table 1: Average hatch date for each region</i>	

Falcons are hatching earlier than they were when the banding program began. Excluding the pre-1992 dataset, which is quite small and consists primarily of falcons in Minnesota, the average hatch date has moved forward by five days, from May 16 to May 11. If the pre-1992 dataset is included, the average hatch date has moved forward by eleven days, from May 21 to May 11.

Five-year time period	Average hatch date (5,253 records total)
Pre-1992	May 21
1992-1996	May 16
1997-2001	May 15
2002-2006	May 14
2007-2011	May 11
2012-2016	May 11
<i>Table 2: Average hatch date, five-year periods</i>	

These two tables average hatch dates over five-year periods. They compare each region’s last five-year average first hatch date with the region’s overall average first hatch date. Four regions saw hatch move significantly earlier. Six saw them move slightly earlier. Two saw no change. Two saw them move slightly later, although in one of those states, the overall movement was still towards an earlier hatch. The northern tier of regions saw more change than the southern tier of regions. The numbers in parenthesis indicate the total number of records for each region.

	CAN (311)	MN (1657)	WI (1060)	MI – UP (11)	ND (72)	NE (45)	IA (180)
Pre-1992		May 22					
1992-1996		May 20	May 18				May 17
1997-2001	June 2	May 18	May 14	June 6	June 1	June 13	May 14
2002-2006	June 1	May 19	May 17		May 25	May 18	May 14
2007-2011	May 31	May 18	May 10		May 26	May 14	May 8
2012-2016		May 18	May 10	May 17	May 27	May 11	May 10
Average	June 1	May 19	May 15	May 27	May 27	May 23	May 13
Difference	-1	-1	-5	-10	0	-12	-3

Table 3: Average hatch date for northern tier regions, five year periods

	IL (378)	IN (499)	OH (544)	MI – LP (137)	KY (245)	MO (98)	KS (16)
Pre-1992							
1992-1996	April 26	May 5	May 14	May 14		May 14	May 9
1997-2001	May 7	April 30	May 8	May 6	May 16	May 6	
2002-2006	May 8	May 3	May 1	May 14	April 28	May 4	
2007-2011	May 5	May 10	May 7	May 7	April 24		May 10
2012-2016	May 8	May 3			April 22	May 11	May 6
	May 4	May 4	May 7	May 10	April 30	May 9	May 8
	+4	-1	0	-3	-8	+2	-2

Table 4: Average hatch date for southern tier regions, five year periods

Lay and hatch dates change in individual nests according to a number of factors, including male and female mate changes, territorial competitions, re-clutching following failure of a first clutch, and unknown reasons. The first hatch date in any individual nest may move forward or backward any given year by more days than is reflected in the larger dataset. For example, falcon 987-86136 nested at Minnesota Power and Light’s Clay Boswell facility between 1993 and 1997. During that time, first hatch fluctuated from 6/20 to 5/22 – considerably more than the average change date over that period, or in Minnesota overall. Falcon Mae nested at Xcel Energy’s King plant from 1991 to 2002 (her nest was augmented in 1990, so we didn’t include it). She had a 31-day window that went from April 29 to May 30, although she tended to float around early May more often than not. In many but not all cases, large changes in chronology (15 days or more) occurred following a mate change.

Despite the variability in any given nest, there is a clear trend toward earlier laying and hatching between 1987 and 2016. It raises some questions that would be interesting to explore.

- What factors are influencing the shift?
- What does the correlation between temperature and onset of laying look like?
- Have nests in remote locations experienced more shift? It would be interesting to compare the Lake Superior populations against more urban populations in their respective states and provinces.
- Why is Illinois bucking the trend by steadily moving earlier?
- Do individual falcons generally move laying and hatch earlier as they age?