

A Method for Age Determination of Blue Jays in Northeastern United States and Southeastern Canada

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Current age-determining criteria for Blue Jays (*Cyanocitta cristata*) beyond the juvenal plumage rely on proper lighting in order to discern sometimes subtle color differences in the barring and brightness of blue in the wing plumage (Pyle, P., S.N.G. Howell, R.P. Yunick, and D.F. DeSante. 1987. Identification guide to North American passerines. Slate Creek Press, Bolinas, CA. 278 pp.). Because of the variability in the kind and quality of light available in the field, these color distinctions can, at times, be fraught with doubt and inaccuracy. Using data on measurements of the amount of white tipping of the flight plumage of known-age birds, I have developed a means of separating some members of the age classes by measurement.

METHODS

Using live captures and museum specimens, I measured wing chord (unstopped and unflattened) and tail length with a steel rule, graduated to 1 mm, to the nearest mm; and counted rectrices to determine variations from the normal count of 12. Also, I measured the length of the white tip, as shown in Figure 1, of each of the right rectrices (R) and each of the outer six right secondaries (S) to the nearest mm by measuring the distance from the base of the white to the tip of the feather. In those instances where the white tip was not symmetrical on the inner and outer vane, as in Figure 1, I used the shorter measurement; and on worn specimens where some of the vane had abraded leaving a protruding rachis, I measured to the tip of the remaining rachis. The sum total of the white tip measurements within each of the respective tracts gave what I termed a "secondary score" and a "rectrix score." Scores were not used on molting birds missing required feathers.

For study purposes, only data on birds of known age were used. Hatching-year birds (HY) were recognized by one or more of the following criteria: juvenal plumage, presence of body molt with no attendant flight feather molt, white mouth lining, retained portions of juvenal plumage (usually one to seven outer greater coverts), and where applicable, unquestionable dull blue-gray, unbarred wing plumage. Second-year birds (SY) were recognized by the last two criteria. After-hatching-year (AHY) and after-second-year (ASY) birds were recognized by the presence of symmetrical flight feather molt or by recapture history, thus leaving no doubt about their age. Data from multiple recaptures were used only when a molt intervened between captures. Birds in the HY and SY age groups were combined into a single age class referred to as HY/SY; and similarly, AHY and ASY birds were grouped to form the AHY/ASY age class.

Live specimens were captured and measured at either my home station at Schenectady, New York, or at my summer cottage at Jenny Lake near Corinth in northern Saratoga County, New York, during the period May 1982 to November 1987. At both locations, I was dealing with primarily resident populations. I used also museum data collected at the Museum of Comparative Zoology (MCZ) in Cambridge, Massachusetts, and at the American Museum of Natural History (AMNH) in New York City. I used specimens labelled *Cyanocitta cristata bromia* limited to northeastern United States and Canada. I used the sex data on the specimen labels for any comparison done by sex; but did not use the age designations on all labels, because the term "adult" included both SY and ASY birds. Instead, only recognizable HY/SY birds using the above criteria other than mouth color were used for any age analysis.

RESULTS AND DISCUSSION

I made approximately 7500 measurements on a total of 262 museum specimens and 410 banding captures. Some of the analyzed results are given in Table 1. The museum data, which were the only source of data on known males and females, were distributed geographically as follows: New England, 39.7%; New York, 31.7%; Canada (Ontario and eastward), 19.1%; and Pennsylvania/New Jersey, 9.5%.

Wing Chord and Tail Length - The wing chord (WC) means of the HY/SY and AHY/ASY age classes in Table 1 are significantly different from one another ($Z=7.643$, $P<0.001$); but because of extensive overlap, individual measurements are not useful in separating the two age classes. Similarly, males differ significantly from females ($Z=5.185$, $P<0.001$) but overlap considerably. I compared the WC means of live HY birds to those of museum HY's and found them not significantly different ($Z=0.4378$, $P=0.660$). Live birds averaged 133.12 mm ($SD=3.04$, $N=96$) while museum specimens averaged 133.38 mm ($SD=4.09$, $N=60$).

Tail length (TL) means in Table 1 differ significantly between age classes ($Z=9.382$, $P<0.001$) and between sexes ($Z=6.567$, $P<0.001$); but in both instances, individual measurements are not useful because of overlap. Additionally, I compared WC/TL ratios of the two sex classes and two age classes. The WC/TL ratio for males of mixed ages over the WC range of 129-142 mm was relatively constant in the range of 1.057 to 1.085, average = 1.073. Mixed-age females with WC's of 127-141 mm had WC/TL ratios from 1.056 to 1.127, average = 1.087, allowing little opportunity to identify sex by this criterion.

The WC/TL ratio of HY/SY birds averaged 1.073 (range = 1.061-1.100) and for AHY/ASY birds averaged 1.049 (range = 1.037-1.066). The decrease in this ratio from HY/SY to AHY/ASY is caused by a larger increase in TL (average difference 6.1 mm) relative to WC (average difference 3.6 mm) at the time of prebasic flight feather molt. While the overlap of these averages is limited to the area of 1.061 to 1.066 between the lower HY/SY

range and upper AHY/ASY range, the overlap among individuals prevents WC/TL ratio from being a useful age-determining criterion.

Rectrix Score - Blue Jays show wide variation in the amount of white tipping of their rectrices. Both age classes and both sex classes show a wide range of rectrix scores (RS) in Table 1. The mean RS of mixed-age males is significantly different from that of mixed-age females ($Z=5.944$, $P<0.001$); but that of the HY/SY age class is not significantly different from that of the AHY/ASY class ($Z=1.291$, $P=0.197$). In both instances, the extent of overlap renders individual RS's useless as an age- or sex-determining criterion. These results imply that while rectrix score varies widely from individual to individual, there is not pronounced change in an SY individual undergoing its first renewal of its flight plumage at the time of its second prebasic molt.

I compared mean RS's to WC lengths to assess whether the combination of criteria would separate the two age classes or two sex classes. Larger birds of both sexes had higher RS's, and at any given WC, the average scores overlapped. They varied from an average RS of 99 at WC = 129 mm, increasing to 108 at WC = 141 mm for females; and 99 and 117 for males over the same WC range. Rectrix scores for the two age classes were similarly co-mingled with the means increasing from 96 to 115 over the WC range of 128 to 141 mm, with no reliable separation of the two age classes.

Secondary Score - The secondary score (SS) means in Table 1 show a very significant difference between the HY/SY and AHY/ASY age classes ($Z=13.337$, $P<0.001$), but not a significant difference between male and female ($Z=1.121$, $P=0.263$). These results are the opposite of the differences found previously with rectrix score where there was no significant change in score with age ($Z=1.291$, $P=0.197$), but there was a significant difference in score by sex ($Z=5.944$, $P<0.001$).

These results on SS imply that at the second prebasic molt (first renewal of the flight feathers) or at subsequent molts, Blue Jays acquire lengthened white tips to the outer six secondaries. From recapture data on 22 individuals, the evidence suggests that this lengthening occurred in most,

but not all, individuals entirely at the second prebasic molt. Nine of 11 HY/SY birds showed increased SS's at that molt, followed by no substantial subsequent change; while two individuals showed large increases at that molt, followed by small incremental increases in subsequent plumages involving two additional molts. Eleven of the 13 AHY/ASY birds showed no substantial change following further molt, while two showed a subsequent increase.

As with rectrix score, I compared SS to WC and found, as before, that larger birds in both age classes had larger SS's. The degree of separation of SS between the two age classes was greater than that of rectrix score among the two classes. At WC = 129 mm, AHY/ASY birds scored, on average, 18 points higher than HY/SY birds, and 21.5 points at WC = 140 mm.

S1 and S2 White Tip - I analyzed further secondary white tip measurements for two reasons: (1) secondary scores suggested a possible useful connection to age identification; and (2) the time-consuming experience of taking a full complement of measurements (13 per individual bird), or even a limited set based on secondaries only (six per individual bird), convinced me that a quicker, simpler method was needed to save time. Thus, my attention was focused on the first two secondaries (S1 and S2) as a means of distinguishing age.

Referring to Table 1, there is a significant difference in the mean values of the S1 white tip length for the two age classes ($Z=11.220$, $P<0.001$). The greatest significant difference of all the measurement comparisons I made during the study exists in the mean values of the S2 white tip length between age classes ($Z=13.566$, $P<0.001$).

I examined the certainty with which specific white tip lengths identified birds of known age, and determined the percentage of each age sample that was recognizable by each particular white tip length. The results are given in Table 2. As an example, 97.2% of the birds sampled that had S1 white tip lengths of one, two, or three mm (3 mm or less in Table 2) were known HY/SY birds and 2.8% were AHY/ASY. This criterion of 3 mm or less applied to 16.7% of the 210 HY/SY birds measured. Increasing the S1 white tip length to 5 mm

or less applied to 64.3% of the 210-bird sample, and 96.4% of them were HY/SY. At a white tip length of 10 mm or more, 95.0% of the birds meeting this criterion were AHY/ASY, and the criterion recognized 24.5% of the sample of 155 AHY/ASY birds.

S2 white tip lengths showed similar results: At a measurement of 7 mm or less, 61.2% (vs. 64.3% for S1) of the HY/SY birds in the sample could be recognized at a reliability of 95.6%. At 13 mm or more, 24.1% (vs. 24.5% for S1) of the AHY/ASY birds were recognized at a reliability of 95.1%.

I tested whether combining S1 and S2 white tip lengths would improve reliability or applicability and found that at a combined S1 and S2 score of 13 or less, the applicability increased to 66.7% for the HY/SY class, but reliability dropped below 95% to 94.4%. The overlap range of combined S1/S2 scores of 14-19 accounted for 23.8% of the HY/SY class and 58.3% of the AHY/ASY class; while at scores of 20 or greater, 38.1% of the AHY/ASY class was recognized, but at only 93.8% reliability. The combined S1/S2 score offered no advantage over S1 and S2 tip length individually. I made also a comparison of the combined S1/S2 score with WC and found no improvement in reliability or applicability.

Since the Bird Banding Laboratory requires that any age- or sex-determining method apply with a certainty of at least 95%, an S1 white tip length of 5 mm or less meets that criterion and recognized 64.3% of the known HY/SY sample. An S2 white tip length of 7 mm or less recognized 61.2% of the same sample; and an S1 white tip length of 10 mm or more, or S2 of 13 mm or more, recognized 24.5% and 24.1% respectively, of the known AHY/ASY birds in my sample at 95% or greater certainty.

Rectrix Counts - Most rectrix counts were normal. However, one bird out of 147 (0.7%) AMNH specimens had 14 rectrices, one pair more than normal. Among 116 MCZ specimens, 9.5% had one or more rectrices missing. Three birds missed one right rectrix, six missed one left rectrix, and one each had total counts of only seven and nine rectrices. I could not be certain, but presumed that most, if not all, of these losses were collecting or handling losses, and most likely not occurring

naturally. From 140 live Jenny Lake specimens, I found two (1.4%) with 13 rectrices; and from 146 Schenectady specimens, three (2.1%) with 13 rectrices (a total of 1.7% from both samples). One specimen had ten rectrices.

The Schenectady bird with ten rectrices was banded 27 April 1981 as an ASY bird, prior to the start of this study. The rectrix count of ten was discovered on recapture on 18 May 1983 when the bird was at least four years old. Four molts later, when it was recaptured on 27 May 1987, the count was verified. There were no vacant follicles apparent, nor gaps in the rachis spacing at the bases of the rectrices. The feather patterning suggested that pair two was missing.

Four of the five birds with 13 rectrices had one extra on the right side. I failed to note the side affected on the fifth bird. Four of these birds were captured as HY's in July and September (two apiece), and the fifth was a May SY bird. The two July captures were made on the same day at Jenny Lake at a time when Blue Jay broods were fledging and it was not uncommon to catch groups of siblings from individual broods as they pursued a parent that came to feed. These two captures may have been broodmates. One of them was recaptured 6 September 1987 following one rectrix molt and the rectrix count of 13 was again noted.

White Tipping - Normally white tipping occurs on rectrices two through six. An occasional individual (10 out of 549, 1.8%) had white tipping on R1, and all of these birds were in their second basic plumage or beyond. From eight of those that were measured, five had 2 mm tips and three had 3 mm tips; and from seven of known sex (six males and one female), the males averaged more white in the tail than the females, in keeping with the earlier findings.

A slightly larger percentage of birds (10 of 402, 2.5%) exhibited white primary tipping 1 to 4 mm in length. Five of these birds were tipped on P1, three on P1-2, and two on P1-3. All were in their second basic plumage or beyond; and among five of known sex, four were specimens labelled female and one male.

SUMMARY

An examination of wing chord length, tail length, and the white tip lengths on secondaries and rectrices of known-age and known-sex Blue Jays disclosed the following:

(1) Males averaged significantly larger than females, and AHY/ASY birds larger than HY/SY birds in wing chord and tail length; but because of substantial overlap of individual measurements, neither parameter could adequately separate age or sex classes.

(2) Males averaged significantly more white in the tail (rectrix score) than females, but large birds of both sexes had more white than did small birds of both sexes, and the two sexes could not be separated by this measurement. The two age classes did not differ significantly in amount of white in the tail.

(3) Abnormal rectrix counts of ten (one bird), 13 (five birds), and 14 (one bird) were noted in 1.6% of a combined sample of 433 live birds and museum specimens; 1.8% of a combined sample of 549 birds showed white tipping of 1-3 mm on R1 (normally only R2-6 are tipped); and 2.5% of 402 birds had white tipping of 1-4 mm on P1 up to P3 (normally the primaries are untipped).

(4) Males did not differ significantly from females in the amount of white tipping of the secondaries, but the two age classes showed significant differences in secondary score and individual tip lengths of S1 and S2. S1 white tip lengths of 5 mm or less and S2 tip lengths of 7 mm or less identified 60-65% of HY/SY birds with over 95% reliability; and S1 white tip lengths of 10 mm or more and S2 tip lengths of 13 mm or more identified 24% of AHY/ASY birds with 95% reliability. These criteria augment existing ageing criteria which rely on subtle differences in wing plumage coloration and should be especially useful under conditions of poor light.

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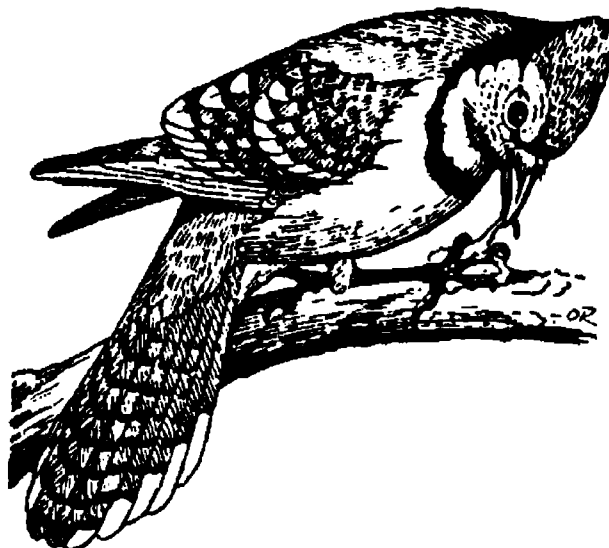


Table 1. Selected measurements on Blue Jay age and sex classes.

Parameter	HY/SY				AHY/ASY			
	Mean	SD	Range	N	Mean	SD	Range	N
Wing Chord, mm	133.2	3.48	125-143	156	136.6	3.03	130-144	82
Tail Length, mm	124.1	4.62	113-134	156	130.2	4.85	119-142	82
Rectrix Score*	104.4	13.05	73-147	175	106.7	14.20	80-154	93
Secondary Score*	53.0	9.33	27-84	124	74.9	13.08	53-124	86
S1 White Tip Length, mm	5.10	1.45	2-9	126	7.73	1.80	4-13	85
S2 White Tip Length, mm	7.15	12.68	3-12	126	10.94	2.18	7-18	85
	Males of All Ages				Females of All Ages			
Wing Chord, mm	135.5	3.83	126-143	138	132.3	4.97	125-141	91
Tail Length, mm	126.3	5.49	112-140	138	121.7	5.00	111-135	91
Rectrix Score*	107.7	12.86	79-142	138	98.0	11.57	71-133	93
Secondary Score*	67.3	14.96	40-95	62	57.9	13.41	35-98	50

* - Sum total in mm of the measured white tips of the designated feathers on the bird's right side.

Table 2. White tip measurements of Blue Jay secondaries.

<u>Age Class</u>	<u>Feather</u>	<u>Length of White Tip, mm</u>	<u>Reliability*</u>	<u>Applicability **, %</u>	<u>N</u>
HY/SY	S1	3 or less	97.2	16.7	210
	S1	4 or less	98.8	40.5	210
	S1	5 or less	96.4	64.3	210
	S1	6 or less	88.4	83.8	210
AHY/ASY	S1	9 or more	91.7	42.6	155
	S1	10 or more	95.0	24.5	155
HY/SY	S2	5 or less	100.0	19.2	214
	S2	6 or less	98.9	40.2	214
	S2	7 or less	95.6	61.2	214
	S2	8 or less	92.9	85.5	214
AHY/ASY	S2	11 or more	90.6	59.3	162
	S2	12 or more	93.1	41.4	162
	S2	13 or more	95.1	24.1	162

* - The term "reliability" refers to the percentage of birds in the sample of known designated age.

** - The term "applicability" refers to the percentage of the measured sample whose age class was recognized by the designated wing tip length.

Figure 1. Variations in white tip measurements of Blue Jay remiges and rectrices

