VARIATION AND AGE DETERMINATION IN A POPULATION OF ACORN WOODPECKERS

By Walter D. Koenig

Acorn Woodpeckers (*Melanerpes formicivorus*) are abundant throughout California, yet until recently little work had been done to clarify their behavior patterns or social organization. This is particularly surprising in view of the cooperative behavior of this species: birds live in permanently territorial family groups composed of 2 to 15 individuals of all ages and both sexes (MacRoberts and MacRoberts, 1976; Koenig, 1978). Future work on this unusual species will be increasingly dependent on birds of known age in studies of age-dependent dispersal, reproduction, and behavior.

In the course of work on the ecology and social organization of the Acorn Woodpecker at Hastings Natural History Reservation, Monterey Co., California, over 125 birds of known age and sex have been recaptured. As a guide to the aging of birds of unknown origin following the postjuvenal molt in the fall, as well as to document the pattern of variation, I report here on age and sex-dependent differences in several morphological and plumage characters within this population. The results should be applicable to populations throughout California and Oregon (*M. f. bairdi*). They do not, however, extend to other subspecies of the Acorn Woodpecker, all of which average smaller in size than birds in California (Ridgway, 1914).

METHODS

Birds used in this analysis were caught by a variety of methods between July 1974 and July 1978. The most common and successful ways were by mist netting in trees and catching birds at their roost holes. Because most nestlings in the Hastings population have been banded since 1972, many of the birds caught were of known origin and age. Acorn Woodpeckers are sexually dimorphic in crown color (Spray and MacRoberts, 1975); thus, sex can always be determined in birds that have undergone their postjuvenal molt.

Characters recorded on captured birds were weight, exposed culmen length, flattened wing length, total length of the (pulled) sixth primary, shape of the tip of the sixth primary (blunt, slightly blunt, slightly sharp, sharp [Fig. 1]), degree of tailspotting (none, slight [one or two small white spots or gold tips], heavy [Fig. 1]), and eye color (white, light pink, pink, dark). Sixth primary shape was determined for all birds at the same time by matching a pulled feather from each with one of four standards ranging from blunt to sharp. Eye color was determined subjectively at the time of capture.

For the purposes of this analysis "first-year" birds are those that have begun their postjuvenal molt up until their first wing and tail molt (approximately August following fledging to the following June). Juveniles

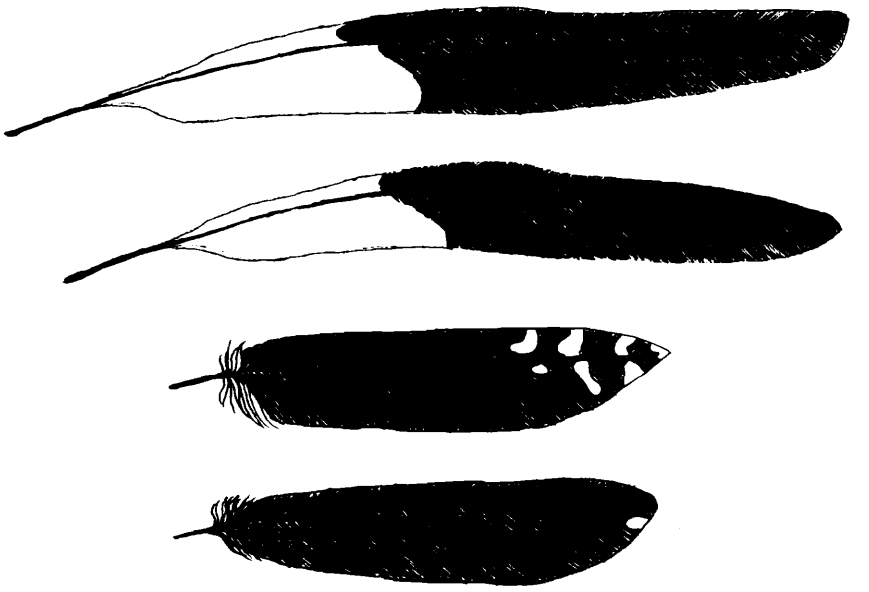

FIGURE 1. From top: a sixth primary with a blunt tip (from an adult), a sixth primary with a sharp tip (from a first-year bird), an outer rectrix with heavy tailspots (from a first-year bird), and an outer rectrix with slight tailspotting (from an adult). "Slightly blunt" and "slightly sharp" sixth primaries are intermediate to those illustrated here.

prior to the start of their postjuvenal molt are not included because they can be distinguished from adults by previously published criteria (Spray and MacRoberts, 1975). Birds that have molted their wing and tail feathers at least once are considered to be "adults." Additionally, a sample of second-year birds (adults up until the June two years following fledging) and birds older than second year were distinguished. No significant differences were found in the means of any of the characters between these two categories of adults for either sex. Thus, only two age classes (first-year and adult) are considered in the subsequent analyses. Daily and seasonal variations in weight were not considered because of the relatively small sample sizes available.

RESULTS

Table 1 summarizes measurements of weight, exposed culmen length, flattened wing length, and length of the sixth primary for Acorn Woodpeckers of known age and sex. Also listed are values for the degree of sexual and age dimorphism exhibited by each character. First-year males are significantly smaller than adult males in all four characters, whereas first-year females, although consistently smaller than adult females, are significantly so only in culmen length and the length of the sixth primary. Both first-year and older birds are sexually dimorphic in culmen

TABLE 1.

Age and sex variation in quantitative characters of Acorn Woodpeckers.[1]

	Males		Females		Percent sexual dimorphism[2]		Percent age dimorphism[2]	
	First-year	Adult	First-year	Adult	First-year	Adult	Males	Females
Weight (g)	78.7 ± 3.5 (21)	82.9 ± 4.2 (47)	77.7 ± 3.1 (17)	78.1 ± 5.4 (39)	0.4	2.0***	1.7***	0.2
Exposed culmen (mm)	29.9 ± 1.7 (19)	32.0 ± 1.2 (47)	28.5 ± 1.7 (15)	29.6 ± 1.2 (36)	4.7*	7.5***	6.6***	3.7*
Flattened wing length (mm)	142.1 ± 1.7 (7)	148.1 ± 2.6 (34)	144.6 ± 2.7 (5)	146.6 ± 4.0 (31)	−1.7	1.0	4.1***	1.4
Total length sixth primary (mm)	125.0 ± 2.0 (8)	129.8 ± 2.6 (22)	124.7 ± 3.5 (3)	128.6 ± 2.3 (17)	0.2	0.9	3.7***	3.0*

[1] Mean ± SD (n).

[2] Calculated as [(larger value − smaller value)/larger value] × 100; negative if ♀♀ > ♂♂ or first-year > adult. Weight dimorphism calculated for $\sqrt[3]{wt}$. Significance tested using 2-tailed *t*-test; * = $P < 0.05$, *** = $P < 0.001$.

TABLE 2.

Tailspotting among known-aged Acorn Woodpeckers.

	First-year (n = 35)	Adult (n = 85)
None	29%	71%
Slight	49%	22%
Heavy	23%	7%
χ^2 (df = 2)	18.5***	

*** $P < 0.001$.

length, whereas only adults are dimorphic in weight, and neither age class is significantly dimorphic in wing length.

Table 2 lists the percent of birds in each age class with various degrees of tailspotting. A highly significant difference exists between the two age classes: 71% of adults have black tails whereas 72% of first-year birds have either slight or heavy tailspotting. First-year and adult birds also differ significantly in the shape of their sixth primaries (Table 3). Of the first-year birds 82% have "sharp" or "slightly sharp" primaries whereas 77% of adults have "blunt" or "slightly blunt" primaries. No significant difference in these characters was found between the sexes in either age class.

TABLE 3.

Shape of the sixth primary among known-aged Acorn Woodpeckers.

	First-year (n = 28)	Adult (n = 77)
Blunt	4%	39%
Slightly blunt	14%	38%
Slightly sharp	21%	13%
Sharp	61%	10%
χ^2 (df = 3)	35.1***	

*** $P < 0.001$.

Table 4 lists the distribution of eye colors for adult and first-year birds. Although a significant difference in the distributions exists between age classes, nearly all birds had either "white" or "light pink" eyes. Birds that have dark eyes can generally be considered to be first year; however, few birds retain this character for more than a month or so beyond their postjuvenal molt. At Hastings, only one first-year bird retained a noticeably dark eye beyond October following fledging; however, this bird retained its dark eye throughout its life of over four years. Thus, eye color, at least on the gross level at which it was quantified here, is of little use for aging purposes.

All characters examined, with the exception of eye color, vary with age. In order to determine the best set of characters to discriminate

TABLE 4.

Eye color of known-aged Acorn Woodpeckers.

	First-year (n = 18)	Adult (n = 51)
White	50%	47%
Light pink	33%	49%
Pink	0%	4%
Dark	17%	0%
χ^2 (df = 3)	10.0*	

* $P < 0.05$.

between first-year and adult birds, a stepwise discriminant function analysis was performed on data for males, for which the larger sample size was available (7 first-year and 27 adults with complete data). Variables used were wing length, weight, culmen length, degree of tailspotting (coded 1 to 3), and shape of the sixth primary (coded 1 to 4). All five variables contributed significantly to the discriminating power of the analysis (Table 5). Success at classifying known-aged individuals based on the discriminant function coefficients derived by the analysis was good: 97% (33 of 34) of all individuals were correctly classified.

A similar analysis on male data using only the three most important variables (wing length, tailspotting, and shape of the sixth primary) yielded similar results. Because none of these three characters is significantly sexually dimorphic, a third discriminant function analysis was performed using all birds, regardless of sex, and these three variables alone. In this latter analysis, 80% (8 of 10) of first-year birds and 94% (50 of 53) of adults were correctly classified for a total success of 92%.

Using these results as a guideline, I have drawn up a key for aging Californian Acorn Woodpeckers (Table 6). With this key, 9 of 10 first-

TABLE 5.

Relative importance of five variables for discriminating first-year from adult Acorn Woodpeckers.

Variable	*F*-value	Standardized discriminant function coefficient	Significance
Wing length	38.2	1.48	<0.001
Tailspots	5.6	−0.58	<0.001
Shape of sixth primary	6.2	0.72	<0.001
Weight	5.0	0.59	<0.001
Culmen length	1.5	−0.35	<0.05

TABLE 6.

Key to aging of Acorn Woodpeckers (*Melanerpes formicivorus bairdi*) between October and June.[1]

A. Flattened wing length < 145.5 mm (estimated wing chord < 142 mm)
   1. No tailspotting
      a. Sixth primary sharp or slightly sharp ..... First-year
      b. Sixth primary blunt or slightly blunt ..... Adult
   2. Slight tailspotting
      a. Sixth primary not blunt ..... First-year
      b. Sixth primary blunt ..... Adult
   3. Heavy tailspotting ..... First-year

B. Flattened wing length ≥ 145.5 mm (estimated wing chord ≥ 142 mm)
   1. Tailspots present and sixth primary sharp ..... Unknown (no cases found)
   2. No tailspots *or* sixth primary not sharp ..... Adult

[1] Between June and October first-year birds are distinguishable by the criteria discussed in Spray and MacRoberts (1975). Any bird molting remiges or rectrices between October and December is an adult. Beginning in late June or July, one-year-old birds begin to molt; thus aging past that time is unreliable.

year birds and 51 of 53 adults were correctly classified. Given an approximate age ratio of 1 first-year to 4 adults during the winter months (Koenig, 1978), a bird classified as "first-year" by the key has approximately an 86% probability of being correctly aged, whereas a bird determined to be "adult" has a 97.5% probability of actually being one.

DISCUSSION

Previously, Troetschler (1974), on the basis of museum skins, proposed that at least 85% of Acorn Woodpeckers with tailspots were first-year and suggested that tailspotting and bill length were together adequate to separate most first-year birds from adults. She also suggested that eye color might provide a reliable indicator of age as well. The results presented here do not support these conclusions in this population. Eye color did not vary consistently with age. Bill length, although age-dependent, was the least valuable of five variables tested for discriminating between known first-year and adult birds. Finally, tailspotting, although also age-dependent, is not as reliable as suggested by Troetschler. Given an approximate age ratio of 1 first-year to 4 adults in the population, it can be estimated from Table 2 that a bird with no tailspots picked randomly from the population has a 91% probability of being an adult; however, a bird with slight or heavy tailspotting has only a 45% probability of being in its first year. Thus, the presence of tailspots is by itself not a reliable indicator of age. This agrees with the earlier qualitative conclusions of Spray and MacRoberts (1975).

No single variable by itself discriminated well between age classes. This failure was due to (1) the relatively high proportion of adults (20

to 30%) that retained characters such as tailspots and sharp primaries found predominantly among first-year birds and (2) other factors such as plumage wear that may eliminate tailspots prematurely. However, a combination of wing length, degree of tailspotting, and shape of the sixth primary is sufficient to age correctly 90 to 95% of all birds (80 to 90% of first-year birds and 94 to 97% of adults).

In addition to these variables, other characters may be of use in aging particular individuals. Any sign of a symmetric age difference in the remiges (usually the secondaries) indicates that the bird has undergone an arrested molt (Spray and MacRoberts, 1975) and is therefore an adult. Also, new body feathers combined with worn remiges and rectrices indicates a first-year bird (Spray and MacRoberts, 1975).

SUMMARY

Acorn Woodpeckers exhibit several age and sex-related differences in morphological and plumage characters. Of these characters, wing length, tailspotting, and shape of the sixth primary do not vary sexually and are the most efficient and reliable characters needed to determine age. Other characters may be useful in particular circumstances, but, in general, no single character can reliably separate first-year from adult birds during the fall and winter following the postjuvenal molt.

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