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SEX IDENTIFICATION IN BLACK-CAPPED CHICKADEES

In Black-capped Chickadees, *Parus atricapillus*, as in many species of birds, the males and females are very much alike in plumage color and general appearance. To be able to recognize sex differences in survival, site-fidelity, dispersal tendencies and other aspects of population ecology, it was necessary to find a way to determine sex in the chickadees at the UWM Field Station. I have been able to use wing measurements for this, i.e., the length across the "chord" of the unflattened wing from the wrist joint to the tip of the longest feather. This paper explains how the accuracy of this technique was verified.

At the UWM Field Station we have been banding chickadees since 1965, and color banding since 1967. Since 1970, I have conducted an intensive study of the population ecology of this species involving observations of the winter flock organization, dominance orders in flocks, territorial behavior in spring and summer, nesting success, dispersal of fledged young and survival of young from summer to winter. The objective is to understand how the chickadee population is regulated. The population occupies 750 acres of upland forests and bog forests and, at any one time, consists of 200-300 birds, virtually all color-banded for individual recognition. M.S. and R.W. Ficken and many students have also been using this population for detailed study of behavior and vocalizations.

From 1965 to 1976 we obtained wing chord data for 1484 individual chickadees. The criteria used for sexing these are given below in order of reliability:

1. Direct examination of gonads at autopsy of birds killed in trapping or other accidents. We have few accidental deaths and therefore few data of this kind.
2. Observation of cloacal protuberance (males) or incubation patch (females) in birds trapped during the breeding season. We have few data of this kind because we do little trapping during the breeding season.
3. Incubation behavior in nesting pairs. It is well known that only the female incubates in this species (the male does not have an incubation patch). Thus, in a nesting pair, the bird that stays inside the nest cavity for long periods is the female, the attendant bird (who exhibits such characteristic behavior as bringing food to the incubating bird) is the male.
4. The "begging" call ("Broken dee" call of Ficken, *et al.* 1978) which is given by the female from late April until about the time the eggs hatch in early June. We have never observed a known male giving this call. However, I have found when teaching this call to students that it requires some experience to

distinguish and recognize. Especially at the end of the begging call season, it sometimes grades into a variant of the common "chickadee-dee" call. Also, this call can probably not be distinguished by ear from the begging call of the young when they have left the nest. Fortunately, there is seldom a time overlap between the adult female begging calls and the juvenile begging calls.

5. Territorial defense as indicated by loud and repeated singing, by the aggressive or threat call (referred to by Odum 1942 as the dominance note, by Ficken *et al.*, *op. cit.*, as the "gargle"), or by fights and chases at the territory boundaries. Males generally respond to playback of a tape-recorded chickadee song by singing loudly and approaching the recorder. Females respond by approaching, but do not sing. These behaviors have to be treated cautiously since females occasionally sing in special situations and sometimes engage in chases or fights. However, repeated observations of these safely identify the bird as a male.
6. Close association with a bird that can be sexed by criteria 1-5. A bird that is definitely the mate of a begging bird must be a male, while one that is definitely the mate of a bird showing strong territorial behavior is a female. Likewise, since many of our birds have been observed through several breeding seasons, it is possible to extrapolate forward or backward through time. For example, birds A and B were observed last year as a mated pair, but with no observations to indicate which was the male or which the female. This year bird B has disappeared (presumably dead) but A is paired with C which is observed "begging." Therefore A is a male, and bird B must have been a female.

Using these criteria, I was able to establish definitely the sex of 451 of the 1484 banded chickadees: 255 males and 196 females. The difference in numbers is due to the fact that the criteria for males are easier to observe than those for females. An analysis of these in terms of wing chord measurements is shown in Table 1.

Section A of the table shows the wing chords of the 1484 individual birds at the time they were first trapped, regardless of age or season. In fact however, the majority of the birds were in the first year of life, for the simple reason that since 1969 or 1970 virtually all the adults in our study area have already been banded when they were juveniles. Section A of the table also shows the subset of birds for which sex has been established, along with the means and standard errors for each sex.

Section B shows the results for birds that were known to be juveniles, by molt and plumage characteristics when trapped in July or August, or by lack of skull ossification when trapped in September-November. The means are not significantly different from those given in Section A. Ninety percent of the birds with wing chords 62 mm or less are females, and 90% of those with wings 65 or over are males. Fifty, or 27%, of all the birds have wing lengths of 63 or 64.

Section C shows the results for adult birds, when the wing chord was measured in the fall following the first breeding season. The change between juvenile and adult mean wing chords is 65.1 to 65.9 for males and 61.9 to 62.7

Table 1 Analysis of wing length by sex and age

	Wing chord in mm.											Total
	≤ 59	60	61	62	63	64	65	66	67	68	≥ 69	
A. All birds, 1965-1976, when first trapped.	44	117	198	255	206	214	206	160	64	16	4	1484
Confirmed males			4	14	34	57	61	56	23	6		255
Confirmed females	10	32	51	53	27	22		1				195
	Males: $\bar{x} = 64.75 \pm 0.10$											} 451
	Females: $\bar{x} = 61.64 \pm 0.10$											
B. Juveniles Only.												
Confirmed males			2	4	10	20	26	27	14	3	1	107
Confirmed females	1	10	19	27	11	9		1				78
	Males: $\bar{x} = 65.08 \pm 0.15$											} 185
	Females: $\bar{x} = 61.89 \pm 0.15$											
	62 mm or less: 57/63 are F, 90.4%											
	66 mm or over: 71/72 are M, 98.6%;											
	65 mm or over: 91/101 are M, 90.1%											
C. Adults Only.												
Confirmed males					8	16	37	40	27	15	6	149
Confirmed females	1	1	22	31	28	20	12	2				117
	Males: $\bar{x} = 65.88 \pm 0.12$											} 266
	Females: $\bar{x} = 62.73 \pm 0.13$											
	62 mm or less: 55/55 are F, 100%;											
	63 mm or less: 83/91 are F, 91.2%.											
	66 mm or over: 88/90 are M, 97.8%;											
	65 mm or over: 125/139 are M, 89.9%											

for females, a difference of 0.8 mm in each case. These differences are highly significant, $P < 0.001$ according to t-tests. In adults 100% of the birds with wings 62 or less are females, and 90% of those with wings 65 or over are males. Again 27% of all birds are in the 63-64 mm wing length range.

The upshot of this is that, knowing the age of most of the birds we trap, we can use the wing chord method to determine the sex of about 73% of them with a high degree of confidence. Birds with wing chords of 63 or 64 mm can not be sexed, although subsequent behavioral observations generally confirm what is evident in Section C, that most of these birds are large females.

Mosher and Lane (1972) suggested that male chickadees had a broader black throat patch than females, and the black head patch in males was more pointed in shape, posteriorly. They claimed 100% accuracy in determining sex on these bases. In 1973 and again in 1975, I and several students tested the Mosher-Lane method. Although we were able to guess the sex correctly in 60-70% of the trials (in other words, somewhat better than would be expected by chance), the problem is that no individual bird could be sexed with confidence, whereas in the wing chord method 73% of the individuals can be sexed with a confidence of 90% or better. Other investigators have also failed to substantiate the Mosher-Lane method, although all agree that there must be some slight sexual differences in the shapes of the black throat and head patches. However there is probably overlap between the sexes in these features, just as there is in wing length.

LITERATURE CITED

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