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AGE AND SEX DISTRIBUTION IN INDIGO BUNTINGS

By DAVID W. JOHNSTON

Fundamental to an understanding of population dynamics is the availability of reliable data on numbers in the various sex and age groups of the population. For passerine birds such quantitative data are notably scanty in the literature for several obvious reasons—the territorial nature and subsequent spacing of birds during the breeding season, difficulties in obtaining unbiased numbers at any season, problems in sex and age identification of live birds, difficulties in amassing large samples, and the like. Through recent years of intensive research it has been possible to obviate most of these sampling problems in the Indigo Bunting (*Passerina cyanea*), a species that has received attention from bird-banders, ecologists, physiologists, and students of animal behavior. The present account is an assessment of this species' sex and age structure with special emphasis upon numbers obtained during the nonbreeding months.

As early as 1900 Jonathan Dwight pointed out distinctive plumage differences among first-year males, adult males, and females. Further, refining studies initiated by the present author and others (Blake, 1965) in the early 1960's revealed other diagnostic characteristics (skull, plumage, wing length, body weight) for autumnal Indigos of all sex and age groups (Johnston, 1965, 1967). By using combinations of these characteristics at that season, an investigator can separate live buntings with a high degree of accuracy into the four sex-age groups—first-year males, adult males, first-year females, adult females. Age groups in females proved to be the most difficult to separate, and we have noted previously (Johnston and Downer, 1968) the virtual impossibility of identifying with certainty the age of females after November or December. Thus, between mid-winter and early autumn, females cannot be separated into age groups but males can at all seasons. Ultimately some investigator might discover a consistent feature for separating the age groups of live females at any season.

SEX RATIOS

Several authors have previously expressed the view that males outnumber females in this species (Johnston, 1965; Taber and Johnston, 1968; Johnston and Downer, 1968). On the contrary, Blake (1969) asserted (p. 135): "At all events, I do not consider that we have any proof of an excess of males in the total population of the species." His conclusion was based chiefly upon a sample obtained in April and May in North Carolina, as he states: "The 25 returning birds are, 14 females and 11 males. Is the ratio of 1.27 females to one male actually different from a 1:1 ratio?" It is unfortunate that Blake was apparently unaware of the much larger samples that Mrs. Downer and I had already enumerated from Florida and Jamaica. So, to reinforce my earlier contention of an imbalanced sex ratio in this species, I have now taken the opportunity to comb the literature and canvass numerous bird-banders and other investigators to garner reliable and accurate numbers of each sex handled during the nonbreeding months. A compilation of these data (Table 1) includes records from television towers, a ceilometer, and netting operations from Pennsylvania to south Florida and Jamaica, in spring, autumn and winter months, and for specific locations, data amassed over several years. These cumulative data, I submit, should represent as unbiased a *total* sample as possible at the present time.

Out of 2,376 birds treated in Table 1, the high proportion of males (59%) does in fact provide substantial evidence "of an excess of males in the total population of the species." The ratio of 1.46♂:1♀ is significantly different from an expected 1:1 ratio. Essentially the same high proportion of males would be obtained even if the large sample from Jamaica were omitted. And, if we summarize data for spring months alone, inclusive of Blake's 1:1 sample, we still get a 1.4:1 ratio of males and females (403:289). Welty (1963) has reported a few other instances of males outnumbering females in passerines—House Sparrow (*Passer domesticus*),

TABLE 1. NUMBERS OF INDIGO BUNTINGS OBTAINED AT VARIOUS LOCATIONS

Location	Dates	Source	Number of	
			Males	Females
Television Towers				
Jackson, S. C.	Sept.-Oct., 1957	R. A. Norris	12	7
Leon Co., Fla.	April, 1965-1966	H. L. Stoddard	33	5
	Sept.-Oct., 1965-1967	H. L. Stoddard	28	62
	Sept.-Nov., 1958-1960	H. L. Stoddard	121	140
	Sept.-Oct., 1969	H. L. Stoddard	39	24
Nashville, Tenn.	Sept.-Oct., 1963-1967	K. Goodpasture	20	12
Ceilometer				
Warner Robins, Ga.	October 1954	D. W. Johnston	20	13
Mist Nets				
Montego Bay, Jamaica	winter, spring 1963-68	A. C. Downer	259	90
Homestead, Fla.	spring, 1965-1968	E. J. Fisk	31	31
Homestead, Fla.	winter, 1967-1968.	E. J. Fisk	49	51
Gainesville, Fla.	Oct., 1963-1966	D. W. Johnston	95	83
Charleston, S. C.	autumn, several years	T. A. Beckett	167	71
Charleston, S. C.	autumn, several years	W. McIntosh	37	6
Morgantown, W. Va.	spring, 1964-1969	G. A. Hall	78	26
Morgantown, W. Va.	autumn, 1964-1969	G. A. Hall	25	15
Lewisburg, W. Va.	autumn, 1969	C. O. Handley, Sr.	55	38
Clarksville, Pa.	Sept.-Oct., 1955-1966	R. K. Bell	19	7
Powdermill, Pa.	Apr.-May, 1961-1969	M. H. Clench <i>et al.</i>	127	94
Powdermill, Pa.	Sept.-Oct., 1961-1969	M. H. Clench <i>et al.</i>	63	56
Hillsboro, N. C.	April-May	C. H. Blake	134	133
TOTALS			1412	964
RATIO			1.46: 1.00	

Evening Grosbeak (*Hesperiphona vespertina*), Red-winged Blackbird (*Agelaius phoeniceus*), and Brown-headed Cowbird (*Molothrus ater*). In Alaska (both on the mainland and in the Aleutian Islands) the author and other observers have repeatedly noted the preponderance of male Lapland Longspurs (*Calcarius lapponicus*): sometimes four males will attend one female (during the breeding season). Thus, the demonstration of yet another population in which males outnumber females is not unique among passerine birds.

It is virtually impossible to obtain quantitatively meaningful and unbiased data on sex ratios of Indigo Buntings during the breeding season. This is because the males are so conspicuous and the females so inconspicuous. Despite these problems in the summer I believe that males outnumber females. A scrap of supporting evidence was obtained at Fanning Springs, Florida on 14 July 1964. Bill Colson and I set up a mist net, accompanied by dummy male and recorded song, in the middle of what we believed to be one male's territory. A short distance from the net was an Indigo nest with an incomplete clutch of two eggs. Within five minutes we caught in the net one female and three adult males, only one of which had been previously identified on this particular territory. Quite likely the other two males were unmated "surplus" birds. Additional circumstantial evidence gathered over the past ten years supports this proposition because on frequent occasions mates for territorial singing males could not be located despite intensive searches.

AGE RATIOS

Quantitative data are also largely unavailable to demonstrate the proportion of adult males to first-year males in a population at any season, chiefly because most investigators do not or can not distinguish between the two age groups. In the autumn, as might be expected, migrating first-year males outnumbered adult males by about 2:1 in a few locations of northern Florida (Johnston, 1965). A total sample gathered throughout the late winter and spring months of several years at Montego Bay, Jamaica showed 48 adult males and 77 first-year males, all netted at the same station (Johnston and Downer, 1968). I am unaware of published accounts containing large numbers taken during the breeding season, but in June and July, I have frequently collected adult and first-year males from adjacent territories, both age groups having equally enlarged testes and cloacal protuberances. Even though mated females were not located in these instances, it appears likely that the first-year males were actually breeding.

DISTRIBUTION

Differential timing in migration of the sex and age groups has been suspected or reported previously. For example, from the island of Jamaica in March and April, it was apparent to Johnston and Downer (1968) that males tended to migrate northward before the females. And on the Dry Tortugas, the report by Bennett (fide Taber and Johnston, 1968) of hundreds of males and only three females supports the contention of differential migration of the sexes in spring. Also, Blake (1969) and others have reported the arrival of males before females in the spring in eastern North America. In an attempt to seek any migratory patterns of the sex and age groups in autumn, I have amassed (Table 2) data from a single location (WCTV tower in north Leon Co., Fla.). One must assume that the tower is random with respect to sex

TABLE 2. INDIGO BUNTINGS KILLED AT WCTV TOWER,
LEON CO., FLA. IN AUTUMN

Dates	N	Number and percent of males	Number and percent of adults
Sept. 20-30	27	16 (59%)	13 (48%)
Oct. 1-10	130	63 (48%)	77 (59%)
Oct. 11-20	56	19 (34%)	32 (57%)
Oct. 21-31	16	3 (19%)	4 (25%)

and age of all birds killed and that Indigos of all sex and age groups pass over this particular site. If these conditions are fulfilled, the data in Table 2 suggest that males in autumn tend to migrate before females. Less conclusive would be a statement concerning the migration of first-year birds before adults. At this location during the height of migration the data merely suggest that adults are somewhat more abundant than the first-year birds. Murray (1966) concluded that immature passerines do not travel separately from adults, a conclusion which at present appears likely for Indigo Buntlings.

There is, finally, some evidence that males tend to migrate further south than females. In Jamaica, for example, our several years of intensive netting and banding operations yielded a male to female ratio of nearly 3:1 (Table 1). Further north, at Homestead, Fla., Mrs. E. J. Fisk has reported an almost equal sex ratio in both winter and spring periods. At her banding site many of the banded buntlings proved to be sedentary throughout the winter months, and there was no appreciable influx of "new" birds in the spring.

Given the evidence that male Indigo Buntlings as a whole outnumber females, one is faced with seeking an explanation. It is tempting at this point to propose simply that natural selection favors males, but the mechanics of selection is certainly obscure. In a discussion of such matters Welty (1963) suggests that "very probably the sexes are often differentially vulnerable to predators . . ." For Indigo Buntlings this explanation appears not to be the case because certainly the more numerous and conspicuous males (loud vocalizations, behavior, coloration, exposed singing perches) would be more vulnerable to predation. Despite the loss of some nests to snakes and rodents, it is not likely that any significant number of adult females are captured by these predators. Similarly I know of no clear evidence to prove differential mortality associated with the hazards of migration or molt or breeding.

I would like to propose here an alternative hypothesis, one that can neither be proved nor disproved at the present time. Perhaps an inequality of sex ratio occurs early in a bunting population, at the time of fertilization or oviposition or fledging. That is, differential mortality could easily occur in pre-fledging stages.

Admittedly, this explanation simply relegates the question to a "lower level" but it is not unreasonable.

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A POLYGYNOUS HOUSE WREN

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In Baltimore, Maryland, in 1946, a male House Wren (*Troglodytes aëdon*) had two mates simultaneously in nest boxes about 45 yards apart. Kendeigh (1941:47) found that 6 percent of the males he studied in Ohio were polygynous and outlined the instances. There appear to be no other accounts in the literature, although Kessel (1950:112) mentions that polygyny has also been observed in New York state.

My male and his first mate were color-banded; I can only assume that the female at his second box was the same bird throughout the season. Each female nested twice and three of the nestings were successful. I watched the four for 105 hours—the first female's nest 29 1/2 hours, second nest 40 hours; second female's first nest 27 hours, second nest 8 1/2 hours. The boxes were at No. 4608 Springdale Avenue, where I then lived, and No. 4702, three houses west. Neither box could be seen from the other.