J. Field Ornithol., 62(1):40–45

# EFFECTS OF LAPAROTOMIES ON WINTERING WHITE-THROATED SPARROWS AND THE USEFULNESS OF WING CHORD AS A CRITERION FOR SEXING

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Abstract.—We examined (1) the effects of laparotomies on the behavior, condition, and survival of wintering White-throated Sparrows *Zonotrichia albicollis*; and (2) the degree to which the sexes are distinguishable on the basis of wing chord alone. Laparotomized individuals did not differ from controls in dominance status, fat level during midwinter, range size, tendency to be trapped, or return rate to the study area in a subsequent winter. However, laparotomized birds were significantly more likely than controls to become winter residents of the study area. Future sexing of White-throated Sparrows by laparotomy might be unnecessary in many cases, because sex can be determined correctly for 91% of all birds solely on the basis of wing chord.

## EFECTO DE LAPAROTOMÍAS EN INDIVIDUOS INVERNALES DE *ZONOTRICHIA ALBICOLLIS* Y LA UTILIDAD DE MEDIDAS DEL ALA PARA DETERMINAR EL SEXO DE LAS AVES

Sinopsis.—Examinamos el efecto de laparotomías en la conducta, condición, y supervivencia de individuos invernales de *Zonotrichia albicollis* y además el grado en que puede determinarse el sexo de las aves utilizando medidas del largo del ala. Individuos laparatomizados no difirieron del grupo control en su condición de dominancia, niveles de lípidos durante el invierno, tamaño del área utilizada, tendencia de ser atrapados y tasa de regreso al área de estudio en inviernos subsiguientes. Sin embargo, los individuos experimentales tuvieron una tendencia mayor y significativa en convertirse en residentes invernales al compararse con el grupo control. El determinar el sexo en estas aves mediante una laparotomía podría ser innecesario en la gran mayoría de los casos debido a que éste, en el 91% de las ocasiones, se puede identificar mediante medidas del largo del ala.

Often in behavioral or ecological studies of birds, it is important to know the sexes of the individuals studied. Many species can be sexed on the basis of plumage, size, behavior, or presence of external sexual structures. In others the sexes are similar enough, especially during winter, that such characters are absent or unreliable. In the latter case, laparotomies are often performed to examine gonads directly.

Laparotomies are widely used in captive and field studies (Bailey 1953, Fiala 1979, Ketterson and Nolan 1986, Risser 1971, Wingfield and Farner 1976), but the effects of this procedure are not well known. Based on anecdotal information or recaptures of birds, previous studies have concluded that laparotomies have no severe effects on the survival (Ketterson and Nolan 1986, Wingfield and Farner 1976) or breeding biology (Bailey 1953, Wingfield and Farner 1976) of small passerines. However,

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no study to date has looked in detail at the behavior and condition of free-living birds after laparotomies. Even subtle effects of laparotomies on behavior and condition could complicate a behavioral or ecological study that used them.

We investigated the effects of laparotomies on the behavior, condition, and survival of a wintering population of the migratory White-throated Sparrow (*Zonotrichia albicollis*). We then used the data on sex acquired by laparotomy to determine the reliability of wing chord length as an indication of sex in this species.

## METHODS

Our study of the effects of laparotomy was carried out from November 1984 through April 1985 at the Mason Farm Biological Reserve in Chapel Hill, North Carolina. During this period, we captured 447 White-throated Sparrows in a study area that contained 17 six-celled treadle traps spaced at roughly 25-m intervals along a linear hedgerow (see Piper and Wiley 1989). Trapping was conducted 2–3 times each week, and most individuals were captured repeatedly (mean number of captures per individual = 7.7 ± 8.1 SD, $n$ = 447).

At the time of its first capture of the year, we took each bird to a processing station and placed it in a holding cage for up to 1 h (usually for a much shorter period). Next, it was held in the hand for 2–5 minutes during weighing, measuring of wing chord (nearest 0.5 mm), and scoring of subcutaneous fat in the furcular and abdominal regions (see Piper and Wiley 1990a). We measured the unflattened wing chord as described and illustrated by Pyle et al. (1987). Finally, we tossed a coin to determine whether the bird would be laparotomized or returned to its holding cage without further processing. Unlaparotomized birds thus constituted controls to which laparotomized birds could be compared.

We carried out laparotomies as described by Wingfield and Farner (1976). Briefly, a bird was held in the left hand so that both its legs and wings were immobilized by the fingers (see diagram in Bailey 1953). The right hand held fine, angled surgical scissors used to cut the very thin layer of skin covering the abdominal region between the last two ribs, an area with little or no intracostal muscle. Forceps were then used to tease between the ribs and to push a loop of intestine ventromedially, exposing the gonads. We used goose-necked penlights clipped to our shirts to illuminate the area inside the abdominal cavity.

Laparotomies generally lasted 1–5 min and, with few exceptions, resulted in little or no bleeding. The membranous air sac was often punctured. Most birds remained quiet and motionless, though alert, during the procedure. Afterwards, we returned birds to their holding cages where both they and controls remained for 5–30 min after processing. Birds were then taken to the locations where they had been captured, checked for alertness and released.

We compared laparotomized birds with controls in six respects: (1) change in fat levels, among birds recaptured within a week of processing;

(2) tendency to become winter residents of the study area (birds trapped over at least a 60-d interval) or dispersers (birds trapped over an interval of 10 d or less), among unbanded birds captured before 31 December; (3) return rate for the following winter, among birds that became residents in the study area; (4) dominance status, by adding to a regression equation used previously to predict dominance (see Piper and Wiley 1989) a variable to indicate whether a bird was laparotomized or not; (5) number of times recaptured between the time of the laparotomy and spring migration; and (6) range size, as computed from trapping records (Piper and Wiley 1990b). Because we were unable to make all measurements on all birds, sample sizes for statistical tests varied.

A sample of 729 laparotomized individuals, trapped from 1983–1984 through 1986–1987, was used to determine the accuracy with which sex could be predicted from length of wing chord.

## RESULTS

*Effects of laparotomies on White-throated Sparrows.*—Recaptures of birds after laparotomy and observations from blinds revealed that the skin usually healed completely with a week and that birds seldom favored legs adjacent to the incision. Moreover, there was no indication that laparotomies affected either short-term fat storage or long-term survival. Fat levels during the week after initial processing did not differ significantly ($t = 1.0$, df = 149, $P > 0.2$) between laparotomized birds (mean change in fat scores = $-0.45 \pm 1.24$ SD, $n = 76$) and controls (mean change = $-0.24 \pm 1.33$ SD, $n = 75$). Among residents, 45 of 109 (41%) laparotomized sparrows returned the subsequent year, compared to 40 of 99 (40%) controls.

Laparotomized individuals were similar to controls in four behavioral characteristics. First, laparotomized birds (mean percentage of opponents dominated = $46.4 \pm 25.4$, $n = 101$) did not differ from controls (mean = $46.9 \pm 27.4$, $n = 94$) in dominance status ($F_{1,176} = 2.2$, $n = 181$, $P > 0.1$). Second, among individuals with five or more captures, the length of time between first and second captures did not differ ($t = 1.22$, df = 186, $P > 0.2$) between laparotomized birds (mean length of time = $12.5 \pm 17.2$ days SD, $n = 99$) and controls (mean = $9.8 \pm 12.5$ days, $n = 89$). Third, among residents, there was no difference ($t = 0.91$, df = 213, $P > 0.2$) in total number of captures between laparotomized birds (mean = $12.3 \pm 8.5$ SD, $n = 116$) and controls (mean = $13.4 \pm 9.3$ SD, $n = 99$). Finally, range sizes in the two groups did not differ significantly ($t = 0.35$, df = 189, $P > 0.5$).

The only detectable effect of laparotomies was on the residence status of White-throated Sparrows. Laparotomized birds (73% residents, $n = 81$) were significantly more likely to remain as winter residents of the study area than were controls (56% residents, $n = 87$; $G = 5.03$, $n = 168$, $P < 0.025$).

*Usefulness of wing chord length to determine sex.*—Our measurements showed that: (1) the distribution of wing chord length in White-throated

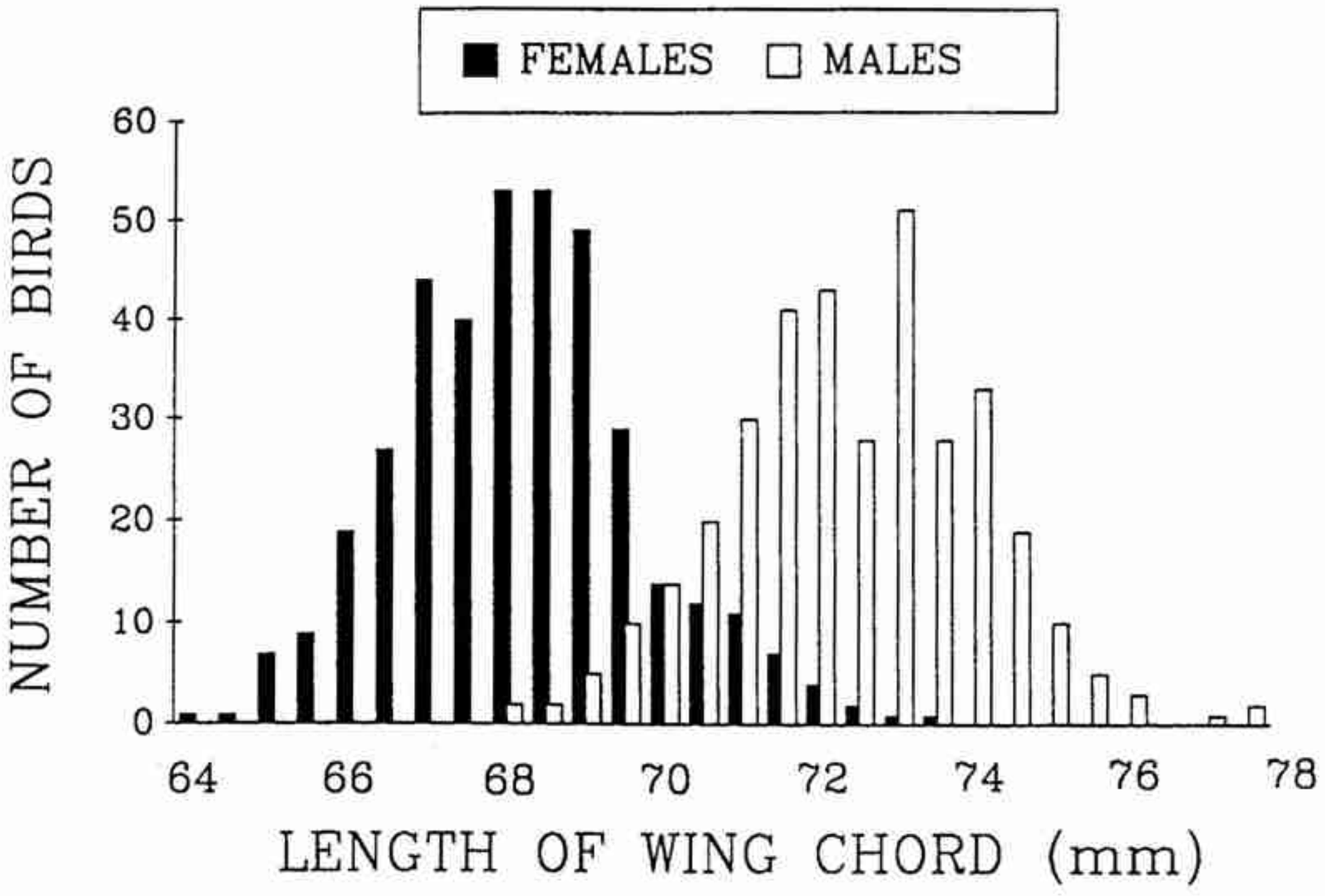


FIGURE 1. Distribution of unflattened wing chord length in males ($N = 348$) and females ($N = 381$).

Sparrows is highly bimodal (Fig. 1), and (2) this character can be used to distinguish the sexes with considerable accuracy (see Table 1). Although wing chord tends to increase somewhat between the first and second winters of life (mean wing chord for first-winter and for older birds = 69.7 ± 2.5 mm SD, $n = 288$ and 70.6 ± 2.7 mm SD, $n = 369$, respectively), knowledge of age-class does not improve the ability to sex White-throated Sparrows.

## DISCUSSION

*Use of laparotomy on free-living birds.*—Although commonly regarded as a dangerous and difficult procedure (e.g., see Richner 1989), laparotomy can, in fact, be performed swiftly and easily on White-throated Sparrows and does not result in obvious detrimental effects on condition or survival (see also Bailey 1953, Ketterson and Nolan 1986, Wingfield and Farner 1976). Moreover, the lack of an effect of laparotomies on dominance status, range size and frequency of capture indicates that at least some important aspects of behavior do not change as a result of the procedure. For these reasons, laparotomy appears to be acceptable for many field and laboratory studies.

*The effect of laparotomies on residence status.*—The tendency of laparotomized birds to remain as residents of the study area shows that laparotomies did have ecological consequences, though the reason for the sedentary habits of laparotomized birds is unclear. The lack of differences

TABLE 1. Success rates of different criteria for identifying males and females on the basis of wing chord alone.[a]

| Sexing criteria (in terms of wing chord) | % of females correctly identified ($N = 381$) | % of males correctly identified ($N = 348$) | % of all birds assignable to a sex-class ($N = 729$) |
|---|---|---|---|
| ≤70.0 mm = ♀<br>>70.0 mm = ♂ | 89.5 | 91.9 | 100 |
| ≤69.0 mm = ♀<br>≥71.0 mm = ♂ | 92.0 | 97.3 | 84.4 |
| ≤68.0 mm = ♀<br>≥72.0 mm = ♂ | 96.3 | 99.0 | 54.1 |
| ≤67.0 mm = ♀<br>≥73.0 mm = ♂ | 98.0 | 100 | 32.9 |
| ≤66.0 mm = ♀<br>≥74.0 mm = ♂ | 100 | 100 | 12.9 |

[a] Choice of sexing criteria determines both the accuracy with which sparrows can be assigned to a sex-class and the proportion of all individuals that can be assigned. For example, use of the topmost criterion (if ≤70.0 mm, then female; if >70.0 mm, then male) allows 100% of all sparrows to be assigned to a sex-class, but results in only 89.5% of all females and 91.9% of males being assigned to the proper sex-class. In contrast, the third criterion (if ≤68.0 mm, then female; if ≥72.0 mm, then male) permits only 54.1% of all birds to be assigned but yields success rates of 96.3% and 99.0%, respectively, among females and males.

in fat levels and in captures between laparotomized birds and controls suggests that this group did not remain in the study area because of poorer condition.

There are at least two possible explanations for the higher residency among laparotomized birds. First, the rupturing of the air sac, which often occurred during laparotomy, might have hindered flight for several days and thus made it physically difficult for birds to move far from the study area. Second, the tendency of sparrows to remain in the study area after laparotomy might have reflected a more general tendency of birds to become sedentary as a response to injury or disease. For example, Westneat (1986) found that White-throated Sparrows subjected to muscle biopsy 4–6 weeks before spring migration were recaptured more often than controls. He suggested that the wound resulting from the biopsy, which did not appear to hinder normal flight and had healed at least 2 weeks before a bird should have migrated, might have nonetheless caused a delay in migration.

We cannot ascertain whether birds that left the study area migrated long distances or merely dispersed short distances, and therefore we are unable to determine the exact nature of the effect of laparotomies on movements. However, the effect of laparotomies on residency was strong among birds first trapped in November (74% residents, as compared to 50% residents among controls; $G = 6.53$, $n = 106$, $P < 0.025$) and disappeared among birds first captured in December (71% residents among

laparotomized birds, 68% residents among controls; G = 0.08, $n = 62$, $P > 0.5$). This seasonal pattern might indicate that White-throated Sparrows, which only began to arrive in the study area in October and did not achieve large numbers until December, actually tended to curtail migration after laparotomy.

Though laparotomies appear to have little or no effect on captive birds or permanent residents, their potential effect on dispersal and/or migration must be considered in studies of free-living birds.

*Use of wing chord length to sex White-throated Sparrows.*—In most species of passerines, there is enough overlap in wing chord between the sexes that birds cannot be sexed accurately by means of this measure alone (North American Bird Banding Manual, Volume II, 1977). However, the overlap between the sexes in wing chord is sufficiently small in White-throated Sparrows (see Fig. 1) that relatively rapid and accurate sexing is possible (see Table 1). Although the usefulness of our sexing criteria would depend on geographic variation in wing length, there are no reports of such variation in this well-studied species. Thus, it appears that sexing of most White-throated Sparrows can be accomplished easily and without laparotomy.

## ACKNOWLEDGMENTS

We thank D. Westneat, S. Clarke, A. Foley, A. Ayers, M. Archawaranon and M. Wiley for help in the field. This research was supported in part by grants from the Frank M. Chapman Memorial Fund and Sigma Xi and is a contribution of the Behavioral Research Station at Mason Farm Biological Reserve.

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Received 11 Sep. 1989; accepted 19 Feb. 1990.