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REVERSED SEXUAL DIMORPHISM IN TAIL LENGTH AND FORAGING DIFFERENCES IN WOODPECKERS

By LESTER L. SHORT

INTRODUCTION

The recent interest in sexual dimorphism, particularly in woodpeckers (Kilham, 1965; Selander, 1966; Ligon, 1968), has been concerned primarily with bill length differences in relation to sexual differences in foraging behavior. It is reasonable to devote attention to that part of the woodpecker's feeding apparatus most obviously related to feeding, the bill. Evidence mentioned by Selander (1966: 117) suggests that tail length might also be involved somehow in sexual dimorphism in foraging habits. Not only the bill and tail, but indeed all commonly measured structures of birds may be so involved, as suggested for wing length and tarsal length by Dilger (1956), and for hallux length by Keast (1968). I wish to present herein some data and views on sexual dimorphism in tail length in woodpeckers, particularly since it involves a reversal of the normal (male larger, with longer measurements) pattern of sexual dimorphism.

RESULTS

Data for Ridgway's (1914) samples that were composed of more than four birds show females exceeding males in tail length in the following forms: *Melanerpes hypopolius*, *M. striatus*, *M. formicivorus* (races *bairdi*, *striatipectus*), *Piculus auricularis*, *P. s. simplex*, *Celeus l. *loricatus*, *Dryocopus lineatus scapularis*, *Campephilus principalis* (both **principalis* and **bairdii*), *Campephilus guatemalensis* (races *guatemalensis*, **nelsoni*, **regius*), *C. melanoleucos malherbii*, *Xiphidiopicus percussus* (both *percussus* and *insulaepinorum*), *Veniliornis sanguinolentus* **oleaginus*, *V. kirkii neglectus*, *Dendrocopos villosus* (races *villosus*, *septentrionalis*, *orius*,*hyloscopus*, *sitkensis*, *icastus*), *D. pubescens* (**pubescens*, **medianus*, *nelsoni*, **homorus*, **glacialis*, **turati*), *D. scalaris* (*cactophilus*, *lucasanus*), *D. a. albolarvatus*, *Sphyrapicus ruber* (*ruber*, **notkensis*), *S. thyroideus*, *Picoides americanus dorsalis* and *P. arcticus*. Asterisks mark those forms in which females also exceed males in wing length; these include forms in which the difference between the sexes is very slight, and hence occasional samples might be expected to show "reversal" of the difference in both characters, and forms in which females indeed exceed males in both measurements. The latter

include perhaps *Campephilus principalis*, the races of *C. guatemalensis*, and some of the races of *Dendrocopos pubescens*. Although Ridgway's data suffer from lack of seasonal separation and perhaps geographic separation, they suggest that females of at least some races and species of woodpeckers have longer tails than do males. Of course other species and races not exhibiting such a difference according to Ridgway's limited data may in fact do so.

Data of my own and from literature other than Ridgway indicate that the following forms noted above do in fact show reversal sexual dimorphism in tail length: *Melanerpes hypopolius*, *M. striatus* (females' tails only proportionally, not absolutely, longer than males' tails), *Xiphidiopicus percussus* and *Dendrocopos pubescens medianus*. My data and data from other literature also indicate that this occurs in the following forms for which Ridgway's data are unclear or do not suggest it: *Dendrocopos nuttallii*, *D. scalaris eremicus* and *D. s. cactophilus* (females have proportionally but not actually longer tails than do males), *D. borealis*, and *Sphyrapicus varius*. I also have limited data suggesting such tail length dimorphism in other races of *D. pubescens* (e.g., *D. p. turati*) and in various races of *D. villosus* (including *D. v. sanctorum* and *D.v. villosus*), but the vast accumulation of data for these species by Henri Ouellet and Jerome Jackson, who are studying their variation, makes it prudent to await their findings.

Examination of data at my disposal for specimens of Nuttall's Woodpecker (*Dendrocopos nuttallii*) disclosed that the average tail length of adult females exceeded that of adult males. Mensural data for this species are to be presented more fully elsewhere (Short, MS), but those for tail length may be summarized here. Briefly, the mean tail length of females exceeded that of males by from 0.23 to 1.28 mm in 10 samples numbering from nine to 51 birds per sex, per sample (overall total—265 ♂♂, 226 ♀♀). The samples represent four geographic areas of California and Baja California, and three seasonal groupings (August-November, December-March, April-July). Insufficient material in two seasonal samples from one area left 10 rather than 12 samples. All birds were adults. Molting (primaries, rectrices) birds and specimens with broken or inordinately worn tails (a few specimens mainly taken in June and July) were excluded. Concordance in the direction and size of the difference (females' tails 1% longer than those of males) between the sexes among all 10 samples is deemed significant. A Student's T-test analysis of one of the larger samples (December-March southern California sample, mean 65.81 mm for 51 ♂♂, 66.68 mm for 45 ♀♀) indicated a difference statistically significant at the $P = 0.98$ level. This difference is significant also when one considers that the wings of males average 0.6 mm (all samples averaged, males thus have wings about 0.6% longer than those of females) longer than those of females. Also, males are about 3% heavier than females (38.3 gm versus 37.6 gm for females, sample sizes 15 and 13, in winter; and 39.7 gm versus 38.2 gm, sample sizes 24 and 15, respectively, in spring). Finally, the bills of males average 8%

longer than those of females (Short, MS). Two points worthy of note that I will not elaborate upon herein are: 1) in the Nuttall's Woodpecker the difference in tail length is presumably genetically determined, for fall samples (fresh-plumaged birds) exhibit the same degree of dimorphism in tail length as do spring samples; and, 2) my studies demonstrate a distinct seasonal variation in wing length (due to wear), tail length (due to wear) and bill length (due to wear, differential growth, or both). This seasonal variation indicates that it is unwise to pool specimens taken throughout the year into one sample (some recent woodpecker studies have included fall, winter, spring and summer birds in such composite samples), because it increases variability and hence minimizes actual differences between samples.

The Ladder-backed Woodpecker (*D. scalaris cactophilus*, *D. s. eremicus*), a close relative of *nuttallii*, does not exhibit reversal of sexual dimorphism in tail length, but, relative to other measurements and to weight, females have a proportionally longer tail than do males. Briefly, males weigh about 12% more than females, they have strikingly longer bills (15% greater in length than in females), and moderately (3%) longer wings, but their tails are but 1.5% longer than those of females (some pertinent data were presented by Short, 1968).

The Red-cockaded Woodpecker (*Dendrocopos borealis*) exhibits reversal of sexual dimorphism in tail length and probably also in wing length. A single locality sample of *D. b. borealis* obtained from Portland, Florida, was composed of 10 males and 11 females taken in winter. Females have bills about as long as those of males (mean 12.98 for females, 13.12 for males) but their tails average 2.07 mm longer (77.51 versus 75.44 mm) and their wings 2.18 mm longer (120.18 versus 118.00 mm) than those of males. A Student's T-test gave P values of 0.96 and 0.98 for the tail length and wing length difference, respectively. The following data were obtained from samples taken in winter (December-March) within the ranges of the respective subspecies noted (specimens from the northern peninsular Florida area of intergradation were excluded):

		N	*Mean Wing Length*	*P*	*N*	*Mean Tail Length*	*P*
D. b. borealis	♀♀	32	119.06	.75	32	77.43	.99
	♂♂	31	118.43		31	75.99	
D. b. hylonomus	♀♀	39	114.09	.75	38	75.68	.99
	♂♂	49	113.61		47	74.14	

Although the data are unclear for wing length, they indicate that females of this species have on the average longer tails than males. Ligon's (1968) study of this species ignored tail length and his other data are inconclusive because he did not segregate his samples seasonally. Ligon's results were based on data from 54 "Florida" specimens and observations of 16 foraging birds in the vicinity of Gainesville, Florida. Unfortunately, he made no mention of the fact that two morphologically distinct populations (considered subspecies by Wetmore, 1941; they clearly differ in wing length, whether or not one chooses to treat them as subspecifically distinct) of Red-cockaded Woodpeckers occur in Florida, and that Gainesville is in the area of intergradation between them.

A winter sample of 29 males and 32 females of *Dendrocopos pubescens medianus* from southern New York and Connecticut demonstrates that females have longer tails than do males, although their wings and bills are somewhat shorter than those of males. The difference is not very great, with a mean of 57.81 mm for males and 58.95 mm for females, but it is significant at the $P = 0.95$ level. A small Newfoundland sample supposedly of the same subspecies suggests a similar difference in tail length, but females also had longer wings (but a shorter bill) than did males (wing length 94.21 mm, average for 14 late spring females, and 92.58 mm for 12 late spring males, a difference which is significant at the $P = 0.98$ level). Data from small samples suggest that in at least some populations of the Downy Woodpecker the difference in tail length (and wing length) may be the result of differential wear through the year, with the sexes nearly alike in fall and most unlike (females' tails longer) in the late spring.

Data in the literature indicate that tails of females exceed in length those of males of *Melanerpes hypopolius* (Selander and Giller, 1963: 252, 262), *Melanerpes striatus* (Selander and Giller, 1963: 262; however, according to Selander, 1966: 117, only longer proportional to wing length), *Xiphidiopicus percussus* (Selander and Giller: 262), and *Sphyrapicus varius* (Ganier, 1954: 37; females' wings also exceed those of males in his sample).

DISCUSSION

What is the functional significance of this difference between the sexes in tail length? Selander (1966: 117) mentions a suggestion of Ernst Mayr that interspecific differences in relative tail length may "be related to differences in texture of the trunks and limbs on which the woodpeckers forage." While this may be a factor, I believe that at least some interspecific and intraspecific differences in tail length were explained by Richardson (1942: 357). Briefly, he reasoned that a woodpecker which excavates (excavating is used here to mean the delivery of blows with the bill in a persistent, repetitive manner, resulting in exposure of wood below the surface) on a tree requires a strong prop for the driving head and bill; a relatively short tail functions as a prop by serving to push outward and upward through the hip joint hinge. To quote Richardson,

"Such action would be less effective in a trunk climber with a long (*or longer*) supporting tail, because the ventral angle of the rectrices to the median angle of the body would be larger" (italics mine). Thus, the relatively and even actually shorter tail of males of at least *Dendrocopos pubescens, D. nuttallii, D. scalaris* and *Melanerpes striatus* may be related to their foraging on trunks and major branches of trees to a greater extent than do females. The latter, foraging more often by probing and surface gleaning on smaller branches and branchlets, have less need for a prop, and perhaps more need for a longer tail to assist in maintaining their balance. Walter Bock has called to my attention (pers. comm.) the fact that small branch and twig-feeding woodpeckers grip the surface with their feet (grasping around the twig) in a manner different from that of a trunk-forager. The tail may function differently in such circumstances, perhaps also accounting for the longer tails of females of some species. Of course, there is considerable overlap in foraging habits of the sexes, as noted by various authors, and as suggested by the small difference in tail length between the sexes. For example, in California and Baja California I have observed both sexes of four species of *Dendrocopos* (*pubescens, villosus, nuttallii, scalaris*) foraging mainly in branchlets of budding cottonwoods (*Populus*) for a period of two weeks or so in the spring. Nevertheless, to the extent that there exists a tendency for sexual differences in foraging, there may be a corresponding difference in tail length.

Studies are needed to fully document and test this hypothesis. In particular, the case of *Dendrocopos borealis* requires further study to clarify this apparent exception (Ligon, 1968) to the view just developed. Data presented herein demonstrate that females of this species have longer tails than do males. This sexual difference in tail length suggests a difference in foraging site. Ligon (1968) detected such a difference, but in the opposite direction from that which I would expect, that is, with females foraging more frequently than males on the main trunks of trees. His sample may have been an unusual one for the species. It also is possible that the females of this species exceed the males in body size, as suggested by their apparently longer wings as well as their longer tails. If so, their tails simply may be proportional to their larger size. However, it should be noted that in all three samples at my disposal the tail:wing ratio of females averaged about 1% greater than that of males; presumably, if body size alone were a major factor, the tail:wing ratio should be similar in both sexes. Other factors may be involved, as for example the foraging mode of the species. Ligon (*op. cit.*) noted that females feeding on the trunk tend to use their feet in pulling off pieces of bark. Their tails may not be used in the manner of most woodpeckers during foraging of this type. According to Ligon (1968: 207) males foraging on small limbs "often peck directly," thus apparently differing from the females and requiring the use of the tail as a prop somewhat as in other species. It would be interesting to have more data regarding the mode of foraging of male and female Red-cockaded Woodpeckers.

While I have particularly emphasized sexual dimorphism in tail length, the smaller number of instances suggesting a similar dimorphism in wing length may be of significance. Keast (1968: 772) has mentioned Dilger's (1956) suggestion that "short tarsi and long wings may be favored in birds foraging on twigs and thin branches, and long tarsi and short wings in those using rigid perches." I would add that a long tail also might function in such a way. Thus, all of the avian structures (wings, tail, bill, tarsus) routinely measured by students of geographical and individual variation may be subjected to forces of selection relating to the special foraging modes of woodpeckers, and all of them should be considered with respect to sexual dimorphism in foraging habits.

It is possible that differential action of the sexes in excavation of the nesting cavity in the spring may enhance the tail length difference between the sexes (if the male excavates mostly), or diminish this difference (if the female excavates mostly). Individuals of both sexes usually excavate roosting cavities of their own at other times of the year, so that nesting cavity excavation is not the only deep excavation that the birds undertake. In the Downy Woodpecker the female accomplishes most of the nesting cavity excavation according to Kilham (1962: 130). My data suggest that the difference in tail length between the sexes of the Downy Woodpecker exists in the spring, at the time when nesting cavities are being excavated. I believe that a constant (for the year, or a part of the year), small foraging difference between the sexes is more likely to account for a sexual difference in tail length than is a single, short-term difference between the sexes in the relative amount of time given to excavation of a nesting cavity. The fact that the difference in tail length between male and female Nuttall's Woodpeckers is constant throughout the year lends support to this view.

Differences in foraging behavior between the sexes in woodpeckers have been demonstrated for *D. villosus* (Kilham, 1965), *D. borealis* and *D. arizonae* (Ligon, 1968), *Melanerpes striatus* and *Melanerpes aurifrons* (Selander, 1966); I have data indicating such differences in *D. nuttallii* and *D. scalaris* (Short, MS). In all of these cases except *D. borealis* the sexes differ significantly, sometimes (*e.g.*, *M. striatus*) markedly, in bill length. I have shown above that tail length differences also occur in at least some of these species (see also Selander, 1966: 117, for females of *M. striatus*, which have a proportionally longer tail than do males). Indeed, although there may not be as marked differences in tail length as in bill length, the former may be as prevalent in woodpeckers as is the latter. In any event, the tail length dimorphism is exceptional because it involves a reversal of the normal situation in which males are larger and exhibit greater measurements.

I suggest that future studies of woodpeckers should include a careful analysis of sexual differences in wing length, bill length, tail length and tarsal length. Wherever these differences are of unusually great magnitude, or involve sex reversal, then sexual foraging differences will be suggested. Analyses should be undertaken to distinguish between differences relating to foraging methods and those

relating to foraging sites, for Ligon's (1968) data suggest that natural selection may favor sexual differences in either, or in both.

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SUMMARY

Female woodpeckers of certain species, including *Dendrocopos nuttallii, D. borealis*, at least one race of *D. pubescens*, and probably *Melanerpes striatus, M. hypopolius, Xiphidiopicus percussus*, and *Sphyrapicus varius*, have tails that are longer than those of males. This is an unusual case of reversal of sexual dimorphism in the Picidae, for males are generally larger than females (with greater measurements of wings, bills and other body parts). A possible functional explanation for the longer tail of females is the use of the tail as a supporting prop for excavating, requiring a shorter tail in males that do more excavating. The slightly longer tail of the female may serve less as a prop, and more as a balancing organ when females feed on smaller branches and branchlets. Natural selection relating to foraging may affect the wings, tail, legs and feet, as well as the bill of woodpeckers in various ways. Enhanced sexual dimorphism, and reversed sexual dimorphism are two possible results of selection favoring increased intraspecific variation.

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The American Museum of Natural History, New York, New York 10024.

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A HOOP-NET TRAP FOR PASSERINE BIRDS

By KENNETH H. LARSEN

A program to investigate the relationship of the house finch (*Carpodacus mexicanus*) to soft fruit damage has necessitated capturing large numbers of the species for banding and other studies. It was learned that they were easily trapped in the modified Australian crow traps similar to the one described by Aldous (1936) if a 1¼″ entry slot was used in a plywood entry-ladder. These panel-type traps are used at our permanent trapping locations, but they are cumbersome and difficult to move to new trapping sites.

As a result, portable traps of a new design, based on the same concept of a depressed entry ladder, were constructed and have been used during the past 3 years at this station. The main features of the trap are the ease with which it can be erected and dismantled, its light weight, and its compactness when collapsed, requiring much less space for either storing or transporting.