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## FOOT-SCUTES IN NORTH AMERICAN OSCINES

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Although presence or absence of scutes on the legs of passerine birds has been widely noted (e.g., Rand, 1959; Dorst, 1960), scutes on the feet have been generally neglected. Recent studies on oscines (Clark, 1972, 1974) revealed that foot-scutes often vary taxonomically, and the goal of this report is to summarize new data on 222 species from Canada and the U. S. Such information potentially contributes to adaptive and systematic analyses (Clark, 1974) and can aid, together with foot size and color, in identifying the isolated feet sometimes found among the remains of prey.

I studied the large scutes on the acropodium and distal end of the acrotarsium because (1) in some families they vary relatively little intraspecifically (Clark, 1972), and (2) adequate samples of study skin specimens were available. Sufficient numbers of embalmed or frozen specimens have not been available to enable equivalent studies on other surfaces of the feet, but Blaszyk (1935), Staaland (1964), Clark (1972, 1973), Lennerstedt (1974, 1975 a,b,c) and Leisler (1975) have discussed these body regions for oscines, mainly from Europe.

### MATERIALS AND METHODS

I examined more than 8,000 study skins, plus some embalmed specimens and wild birds captured for banding. Table 1 lists the genera studied. Although the described features are usually visible with a hand lens, I often used a dissecting microscope. Reference to statistically significant differences indicates a probability of less than 0.01 in a Chi-square test.

### SCUTES OF THE ACROPODIUM AND DISTAL ACROTARIUM

To compare foot-scutes I first describe those of the Rufous-sided Towhee (*Pipilo erythrophthalmus*), a species chosen for its relatively large size, low intraspecific variation, and wide North American distribution. A new terminology enables a concise presentation of data on foot-scutes.

At the distal end of the acrotarsium lie five transversely elongated scutes, termed A through E from proximal to distal (Fig. 1). Scute A is typically larger than B. Scute C, often a useful landmark, medially meets a proximo-distally elongated scute X. Scute D medially contacts the most proximal scute of a row along the inner toe (II). Scute E, an important landmark, lies at the proximal end of the middle (III) and outer (IV) toes.

TABLE 1.

Genera examined with number of species if more than one per genus

Alaudidae: *Eremophila*; Hirundinidae: *Tachycineta*, *Iridoprocne*, *Riparia*, *Stelgidopteryx*, *Hirundo*, *Petrochelidon*, *Progne*; Corvidae: *Perisoreus*, *Cyanocitta* (2), *Aphelocoma* (2), *Cyanocorax*, *Pica* (2), *Corvus* (4), *Gymnorhinus*, *Nucifraga*; Paridae: *Parus* (7), *Auriparus*, *Psaltriparus*; Sittidae: *Sitta* (4); Certhiidae: *Certhia*; Chamaeidae: *Chamaea*; Cinclidae: *Cinclus*; Troglodytidae: *Troglodytes* (3), *Thryomanes*, *Thryothorus*, *Campylorhynchus*, *Cistothorus* (2), *Catherpes*, *Salpinctes*; Mimidae: *Mimus*, *Dumetella*, *Toxostoma* (5), *Oreoscoptes*; Turdidae: *Turdus*, *Ixoreus*, *Hylocichla*, *Catharus* (4), *Sialia* (3), *Myadestes*; Sylviidae: *Poliophtila* (2), *Regulus* (2); Motacillidae: *Anthus*; Bombycillidae: *Bombycilla*; Ptilonotidae: *Phainopepla*; Laniidae: *Lanius* (2); Sturnidae: *Sturnus*; Vireonidae: *Vireo* (8); Parulidae: *Mniotilta*, *Protonotaria*, *Limnithlypis*, *Helmitheros*, *Vermivora* (7), *Parula* (2), *Peucedramus*, *Dendroica* (18), *Seiurus* (3), *Oporornis* (4), *Geothlypis* (2), *Icteria*, *Euthlypis*, *Cardellina*, *Wilsonia* (3), *Setophaga*, *Myioborus*; Ploceidae: *Passer*; Icteridae: *Dolichonyx*, *Sturnella* (2), *Xanthocephalus*, *Agelaius* (2), *Icterus* (6), *Euphagus* (2), *Quiscalus* (3), *Molothrus* (2); Thraupidae: *Piranga* (4); Cardinalinae: *Cardinalis* (2), *Pheucticus* (2), *Guiraca*, *Passerina* (4), *Spiza*; Carduelinae: *Hesperiphona*, *Carpodacus* (3), *Pinicola*, *Leucosticte*, *Carduelis* (5), *Loxia* (2); Emberizinae: *Arremonops*, *Pipilo* (4), *Calamospiza*, *Passerulus*, *Ammodramus* (2), *Ammospiza* (2), *Poocetes*, *Chondestes*, *Aimophila* (5), *Amphispiza* (2), *Junco* (3), *Spizella* (6), *Zonotrichia* (4), *Passerella*, *Melospiza* (3), *Calcarius* (3), *Plectrophenax*.

Along toe II, scute counts begin immediately distal to C, whereas counts on toes III and IV start immediately distal to E. The Rufous-sided Towhee typically has 9 scutes on toe II, 10 on III, and 8 on IV (Fig. 2). Scutes termed caps (stippled in Figs. 1 and 2) lie near the joints of the toes and are major landmarks. The proximal cap of toe III is an especially useful landmark, ordinarily separated by one scute from E.

I initially found great individual variation in counts on the hallux (toe I) and hence did not study that toe further.

#### INDIVIDUAL AND TAXONOMIC VARIANTS

All species exhibit individual variation and some are highly variable; hence I routinely examined at least six specimens, and often many more, for each species. The same kinds of variation can occur either intraspecifically or interspecifically, depending on

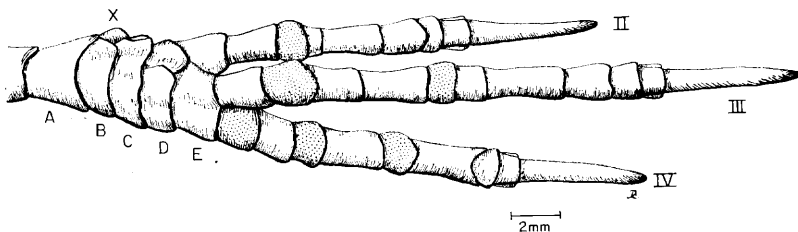


FIGURE 1. Dorsal view of the foot of a Rufous-sided Towhee (*Pipilo erythrophthalmus*). Caps are indicated by stippling. See text for details.

the particular taxonomic groups. For example, scute E is commonly either divided or intact, i. e., varied, in Cardinals (*Cardinalis cardinalis*) but is typically intact in Rufous-sided Towhees and typically divided in Rose-breasted Grosbeaks (*Pheucticus ludovicianus*).

Variants include divisions of scutes C, D, or E, all of which often occur in certain thrushes (Turdidae; Fig. 3). C, D, and E are termed varied when they are commonly either intact or divided within a taxon, as is scute E in Cardinals.

The number of scutes per toe is designated by the Roman numeral of that toe followed by a hyphen and the count, e. g., IV-9 signifies nine scutes on the outer toe. Variation in number of scutes per toe within a taxon is designated by listing common variants separated by commas, e. g., "II-7, 8, 9" indicates that 7, 8, or 9 scutes occur commonly on the inner toe. In certain taxa, e. g., all wrens (Troglodytidae), two narrow contiguous scutes occur in the region of the proximal cap on toe IV (Clark, 1974: Fig. 1); this condition is recorded as "ds" (double scute). Other differences in number of scutes on particular sections of a toe can be specified by the number proximal or distal to particular caps.

For conciseness, I have usually listed neither uncommon variants nor frequencies of common variants. My intent is to describe representative individuals and not the full range of variation for each taxon.

For certain taxa, structural differences limit the use of the descriptive system based on the Rufous-sided Towhee. Moreover, for certain families, great individual variation in the A to E region precludes concise description. Furthermore, where equivalents for scutes C and E were uncertain, I could not count scutes on toes II and IV, because these counts require unambiguous recognition of C and E. Scutes on toe III could still be counted with the proximal cap as a landmark. Where equivalence of scutes in the A to E region is uncertain, I have for conciseness, without implying homology, designated the scute at the base of the two outer toes as E.

#### TAXONOMIC COMPARISONS

Larks (Alaudidae), swallows (Hirundinidae), corvids (Corvidae), titmice (Paridae), nuthatches (Sittidae), creepers (Certhiidae), and vireos (Vireonidae) differ in the A to E region in varied ways so greatly from *Pipilo* that the descriptive code is often not easily applied. Swallows often appear to have one less row of transverse scutes than the five (A through E) in *Pipilo*, whereas some corvids, some nuthatches, and creepers often have an extra scute row relative to *Pipilo*. Larks, swallows, corvids, titmice, nuthatches, creepers, and vireos all have a divided E, except for the varied E in some Verdins (*Auriparus*; Clark, 1974). All these families except Vireonidae have a conventional proximal cap on toe III, thus enabling the following scute counts for that toe: Alaudidae, III-8; Hirundinidae, III-9, 10; Corvidae, III-9 to 12 (often 10 or 11, but sometimes 9 in *Corvus* and usually 11 or 12 in *Perisoreus*); Paridae,

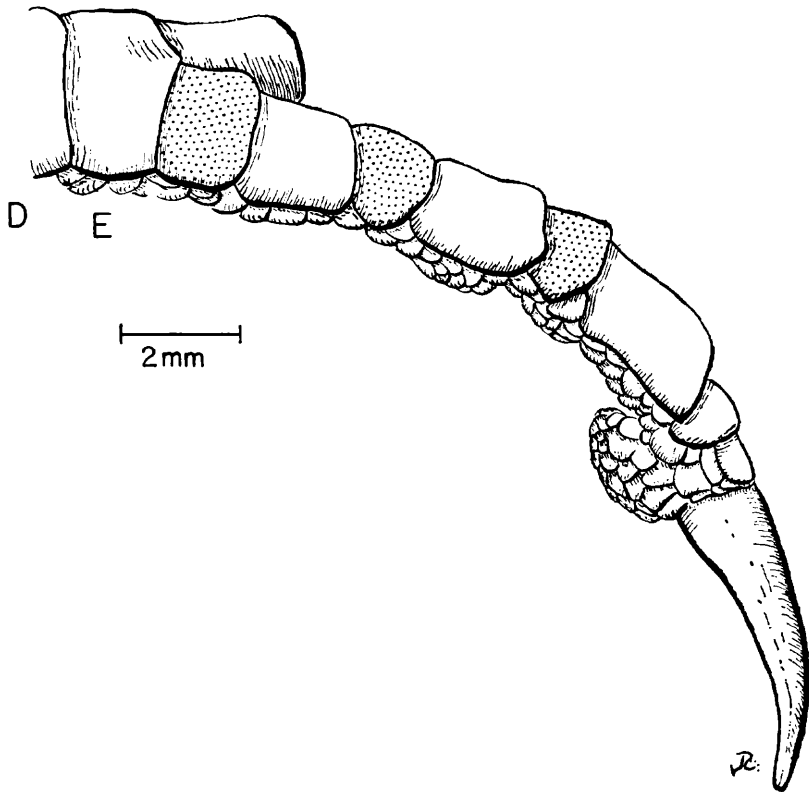


FIGURE 2. Lateral view of toe IV of a Rufous-sided Towhee. Caps are indicated by stippling.

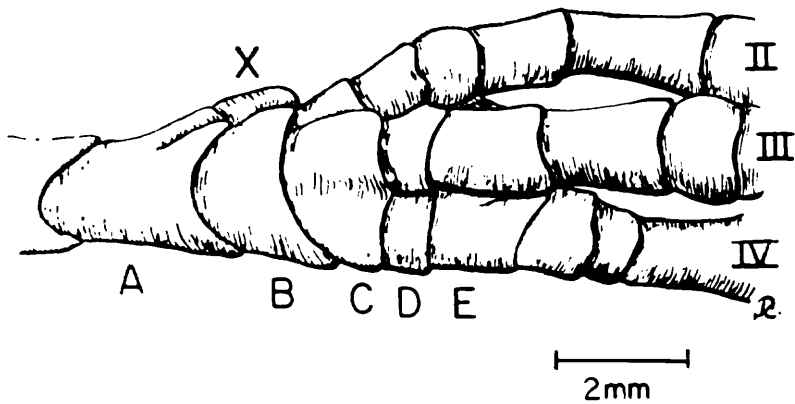


FIGURE 3. Dorsal view of the A to E region of a Hermit Thrush (*Catharus guttatus*). Note divided scutes C, D, and E.

III-9, 10; Sittidae, III-10, 11, but typically 12 in the White-breasted Nuthatch (*Sitta carolinensis*); Certhiidae, III-11, 12. Vireos are unusual in typically lacking a conventional cap in the proximal position on toe III.

For other North American families and subfamilies, Table 2 summarizes many findings in a generalized way, and additional details follow.

TABLE 2.  
Generalized summary of foot-scute variations.

Taxon	Scute			Scutes per toe			ds
	C	D	E	II	III	IV	
Chamaeidae	i	v	d	9	9,10	9	a
Cinclidae	v	v	d	11	10,11	9	p
Troglodytidae	i	v	d	8 to 10	11	9,10	p
Mimidae	i,v	i,v	i,d	10	11	9 to 11	p
Turdidae	v	v	d	9 to 11	10,11	9 to 11	p
Sylviidae	i,d	v,d	d	8,9	10	8,9	a
Motacillidae	d	v	d	9	11	8,9	a
Bombycillidae	d	v	d	9,10	10,11	9	a
Ptilonotidae	v	a	i	9	10	8,9	a
Laniidae	v	v	d	9	10	8	a
Sturnidae	i	i	d	10,11	11	10	p
Parulidae	i,d	i,d	i,d	9	10,11	8,9	a
Ploceidae	v	v	d	9	10	8	a
Icteridae	v	v	d	9	10	8,9	a
Thraupidae	v	v	d	9	10	8,9	a
Cardinalinae	i,v	v	d	9	10	8,9	a
Carduelinae	d	v	d	7 to 9	9,10	7 to 9	a
Emberizinae	i,v,d	i,v	i,d	8,9	9,10	8,9	a

Abbreviations: i, intact; v, varied; d, divided; a, absent; p, present.

Troglodytidae.—Wrens, other than *Catherpes* and *Salpinctes*, are unusual in typically lacking a conventional cap on toe II and in the distal position on toe IV.

Mimidae.—Most North American mimid species have intact C, D, and E. However, the Gray Catbird (*Dumetella carolinensis*) varies in C and D and has a divided E (Clark, 1972: Fig. 2). Among the mimids, the Gray Catbird and Curve-billed Thrasher (*Toxostoma curvirostre*) are exceptional in frequently having IV-11 as well as IV-9, 10.

Turdidae.—In thrushes, the count for III is often 11, except for III-10 in the Gray-cheeked Thrush (*Catharus minimus*) and III-10, 11 in bluebirds (*Sialia*). *C. minimus* thus differs notably from the three other *Catharus* species.

Sylviidae.—*Polioptila* usually has an intact C with a varied D, and *Regulus* commonly has both C and D divided. Both genera typically have a divided E and lack a ds. In *Polioptila* a conventional cap is often absent on II, with II-8. *Regulus* typically has II-9. Among these four species only the Golden-crowned Kinglet (*R. satrapa*) typically has IV-9 (Clark, 1974).

Parulidae.—C is usually intact but often divided in *Mniotilta*, and relatively varied in *Protonotaria*, *Dendroica caerulescens*, *D. fusca*, and *Myioborus picta*. D is usually intact, but divided in *Peucedramus* (Clark, 1974) and varied in *Mniotilta*. In most species E is divided, but the Yellow-breasted Chat (*Icteria virens*) is exceptional with an intact E (Clark, 1974). In parulids the count for toe II is usually 9 but sometimes 8. Toe III usually has 10 scutes, but is especially varied in *Seiurus* (Table 3), often has 11 in *Peucedramus*, and typically 11 in *Icteria* (see also Clark, 1974). *Seiurus* illustrates the occurrence of statistically significant differences between each of three congeners. In parulids the IV count is usually 8, but sometimes 9, and is typically 9 in *Peucedramus*.

TABLE 3.

Number of individuals with two (typically III-9) versus three (typically III-10) small scutes adjacent to the claw of toe III in *Seiurus*

Species	Number of scutes	
	2	3
<i>S. aurocapillus</i>	73	16
<i>S. noveboracensis</i>	55	34
<i>S. motacilla</i>	12	18

Icteridae.—Usually the IV count is 9, but 8 is more common in *Sturnella* (Clark, 1974).

Cardinalinae.—C is usually intact except in *Pheucticus* and *Spiza*, in which C is varied. E is typically divided though many Cardinals have an intact E (Clark, 1974).

Carduelinae.—In *Carpodacus* counts for toe IV differ significantly between all three species (Table 4); the Purple Finch (*C. purpureus*) differs from other carduelines in having a majority of individuals with IV-9. The Redpoll (*Carduelis flammea*) has relatively low counts of II-7, 8, 9; III-9, and IV-7, 8. Redpolls often lack a conventional cap at the distal position on toe IV.

Emberizinae.—In all except *Calcarius* and *Plectrophenax*, C, D, and E are typically intact (see also Clark, 1972, on E) with II-9, III-10, IV-8, but exceptions are (1) a high frequency of IV-9 in Abert's Towhee (*Pipilo aberti*; Clark, 1974), (2) II-8 and III-9 as typical for Grasshopper Sparrows (*Ammodramus savannarum*), (3) III-9, 10 for Sharp-tailed Sparrows (*Ammospiza caudacuta*) and (4) the divided C of Fox Sparrows (*Passerella iliaca*; Clark, 1974: Fig. 3).

TABLE 4.

Number of individuals with three (typically IV-8) versus four (typically IV-9) scutes distal to the most distal cap on toe IV in *Carpodacus*

Species	Number of scutes	
	3	4
<i>C. purpureus</i>	7	38
<i>C. cassinii</i>	32	13
<i>C. mexicanus</i>	60	6

In *Calcarius* and *Plectrophenax* C and D are varied, although C is frequently intact; they also have a divided E, II-8 or 9, III-9, and IV-8.

## DISCUSSION

Despite individual variation in foot-scutes within each species, many taxonomic differences are detectable among the oscines. However, the overall range of variation is limited, e.g., in scute counts along the toes (Table 2), and overlap can occur between taxa that are probably not closely related taxonomically, e. g., Bombycillidae and Carduelinae. Hence caution is necessary in using foot-scutes for systematic or identification purposes. The new data presented here should provide an improved basis for future studies analyzing adaptations of the feet and comparing North American oscines with those from other geographic areas.

## SUMMARY

Foot-scutes of the Rufous-sided Towhee (*Pipilo erythrophthalmus*) are compared with those of 221 other species of North American oscines. New examples of differences between congeneric species involve the genera *Catharus*, *Sciurus*, *Carpodacus*, and *Carduelis*.

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