NEW SUBSPECIES OF BIRDS FROM THE LOWLAND PINE SAVANNA OF NORTHEASTERN NICARAGUA

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PINE forest reaches the southern limit of its natural distribution in the western hemisphere within the boundaries of Nicaragua, where three species of *Pinus—oocarpa, pseudostrobus,* and *caribaea*—occur. Pines are found in three separate areas in Nicaragua, two of which are montane. There is an isolated stand of *P. oocarpa* on the upper slopes of Volcán San Cristóbal and Volcán Casita, in the Department of Chinandega in the northwestern part of the country. All three species are found in scattered localities in the north-central highlands, which extend from the Honduras border south to the valley of the Río Grande de Matagalpa. *P. pseudostrobus* is the least common form and occurs only at elevations between 1,200 and 1,700 m; *P. oocarpa* is the most abundant montane species and is found from 600 to 1,700 m; *P. caribaea* is less widely distributed in the mountains and occurs at elevations from 400 to 900 m (Denevan, 1961; Taylor, 1963).

In northeastern Nicaragua, completely isolated from the montane forests, is a lowland pine savanna in which the altitude is generally less than 100 m and where only *P. caribaea* is found (Figure 1). This savanna covers most of the Comarca de El Cabo and extends south into the Department of Zelaya in a narrowing, irregular strip along the eastern edge of the Caribbean lowlands a short distance inland from the coast; the southernmost pines are found between the Laguna de Perlas and Bahía Bluefields. The savanna extends north beyond the Río Coco into eastern Honduras about as far as Cabo Camarón; its precise limits in Honduras have recently been determined, and it is not continuous with the upland pine forests of that country. Throughout the savanna there are islands and incursions of lowland evergreen rain forest, particularly along watercourses. A much more detailed discussion, with maps, of the ecology and distribution of pine forest and other major vegetation zones in Nicaragua is given by Taylor (1963); Parsons (1955) and Radley (1960) discuss at length the geography of the lowland pine savanna.

HISTORICAL INTRODUCTION

Although the lowland pine savanna of northeastern Nicaragua and adjacent Honduras constitutes a distinctive habitat, isolated from similar formations and utterly different from the adjacent rain forest, it has remained almost unknown ornithologically. The Río Coco (also known as the Río Segovia and the Wanks River), which forms part of the present boundary between Honduras and Nicaragua, was visited by C. H. Townsend from June to August, 1887, and a report on his collection of birds was made by Ridgway (1888). No precise locations or habitat descriptions were given, but Townsend's collection included species typical of pine savanna. Only a small num-

Figure 1. Lowland pine savanna about 35 miles northwest of Puerto Cabezas, Comarca de El Cabo, Nicaragua. Photograph taken in February, 1963.

ber of each was obtained, however, and many were in poor plumage. The locality was given in Ridgway's paper as the "Segovia River, Honduras," and subsequent checklists have often referred to this area as "southern Honduras." "Eastern Honduras" would be a more accurate designation, and as Townsend's specimens may have come from either bank of the river the records apply to northeastern Nicaragua as well. The English naturalist Merwyn G. Palmer collected some zoological specimens, including birds, along the same river in 1905. His bird collection was apparently sold to the dealer W. F. H. Rosenberg, and the specimens have subsequently been dispersed to various museums in Europe and North America. Many years later Palmer described his travels in a book, *Through unknown Nicaragua* (1945). In 1922, J. Fletcher Street collected birds for one day on the savanna near the town of Prinzapolca (Huber, 1932). I know of no other collections of birds made in this habitat until my first visit there in 1955. The professional collector W. B. Richardson, who resided in Nicaragua for much of his life and who obtained for British and American museums most of the bird and mammal specimens from that country, never collected in the lowland pine savanna.

Mention should be made of the great variation in spelling of place names in the savanna region. Most of the localities are named in the Miskito (Mosquito) Indian language, and maps of the area provide either English or Spanish phonetic approximations. For example, place names include the sound rendered in English as "wa" (i.e., Waspam); in Spanish, this is rendered as "hua" (Huaspam). As there is no standardization of English or Spanish rendering of sounds in the Miskito language, there are often several different spellings of the same place name—i.e., Leimus, Lemus, Laimos, etc. I have attempted to use the spelling most widely accepted at the locality itself at the time of my visit, and to place the localities by distance and direction from established communities such as Puerto Cabezas and Waspam.

The Robinson Lumber Company of New Orleans, Louisiana, has for many years engaged in logging operations in northeastern Nicaragua through a subsidiary, the Nicaraguan Long Leaf Pine Lumber Company ("Nipco"), with headquarters in Puerto Cabezas. Through the courtesy of the Robinson family and the company personnel in Nicaragua, I was able to make collections in the lowland pine savanna in early February, 1955, and in late January and early February of 1962 and 1963. I was accompanied in 1955 by J. G. Montrello, in 1962 by J. E. Zoeger and O. M. Buchanan, Jr., and by Buchanan in 1963. Studies on the birds and other vertebrates of this region are in progress, and the present paper deals only with those birds that appear to represent undescribed forms.

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I am especially appreciative of the indispensable aid and cooperation of members of the Robinson family of New Orleans, La., and the "Nipco" personnel in Nicaragua. Of the latter group, special thanks are due to Mr. William Barry, Mr. and Mrs. Douglas Seale, and Mr. R. M. Abel for their friendly assistance in every possible way. During an extended stay in Nicaragua in 1961–62, the staff of the Escuela Nacional de Agricultura y Ganadería and its Director, Ing. J. Antonio Mora R., assisted the field work at every stage. Col. Alfonso Mejía Chamorro, Ministro de la Guerra, Marina y Aviación, provided the necessary permits with the most cordial efficiency. Srta. Clara Murphy of La Nica Airlines was especially helpful in expediting shipments of equipment and specimens, and many other Nicaraguan friends provided all manner of aid and information. Lastly, I am particularly grateful to my field companions, O. M. Buchanan, Jr., and John E. Zoeger, without whose participation this study would not have been possible.

DESCRIPTIONS OF NEW SUBSPECIES

Six new subspecies of birds, all of which are largely or exclusively confined to the lowland pine savanna, are described below. In the following accounts, all measurements of specimens are in millimeters, all wing measurements are of the chord, all weights are in grams, and all names of colors that are capitalized follow the system of Villalobos as modified in the

TABLE 1

SAMPLE SIZE (N), RANGE, MEAN (M), STANDARD DEVIATION (SD), STANDARD ERROR OF THE MEAN (SE), AND COEFFICIENT OF DIFFERENCE (CD) FOR WING (W) AND TAIL (T) MEASUREMENTS

Species and subspecies			*N*	*Range*	*M*	*SD*	*SE*	*CD**
Falco sparverius								
nicaraguensis	♂ ♂	W	9	160.3–178.8	167.3	5.63	1.88	
	♀ ♀	W	9	167.9–176.6	172.7	2.74	0.92	
tropicalis	♂ ♂	W	14	168.4–175.3	172.2	2.28	0.61	0.52
	♀ ♀	W	10	177.8–189.6	181.6	3.51	1.11	1.42
Pyrocephalus rubinus								
pinicola	♂ ♂	W	10	69.5–71.8	70.7	0.76	0.24	
	♂ ♂	T	11	49.3–53.4	51.4	1.12	0.34	
	♀ ♀	W	9	65.4–69.5	67.7	1.41	0.47	
	♀ ♀	T	8	48.5–51.8	50.5	1.29	0.45	
blatteus	♂ ♂	W	29	69.7–74.8	73.2	1.18	0.22	1.29
	♂ ♂	T	28	51.7–56.1	54.6	1.33	0.26	1.31
	♀ ♀	W	7	68.7–73.6	71.6	1.51	0.56	1.33
	♀ ♀	T	7	52.6–56.0	54.4	1.34	0.51	1.50
Sialia sialis								
caribaea	♂ ♂	W	12	93.8–98.4	96.0	1.41	0.40	
	♂ ♂	T	8	60.9–65.6	63.1	1.57	0.56	
	♀ ♀	W	7	90.4–96.9	93.8	2.62	0.99	
	♀ ♀	T	5	58.0–62.3	60.3	1.56	0.70	
meridionalis	♂ ♂	W	28	95.7–103.5	99.1	1.96	0.36	1.07
	♂ ♂	T	13	62.7–67.1	65.0	1.29	0.36	0.67
	♀ ♀	W	19	95.4–100.7	98.2	1.32	0.30	1.12
	♀ ♀	T	9	60.0–64.0	62.4	1.37	0.46	0.72
Piranga flava								
savannarum	♂ ♂	W	8	85.2–90.7	88.5	1.91	0.68	
	♂ ♂	T	8	67.2–73.3	69.9	2.16	0.76	
	♀ ♀	W	7	83.7–89.8	86.6	1.97	0.75	
	♀ ♀	T	6	65.6–73.2	68.8	2.45	1.00	
figlina	♂ ♂	W	12	89.5–95.2	93.5	1.51	0.44	1.47
	♂ ♂	T	12	72.4–78.6	74.8	1.79	0.52	1.24
	♀ ♀	W	11	86.8–93.8	91.1	1.92	0.58	1.16
	♀ ♀	T	10	67.2–76.9	73.7	2.80	0.88	0.94
testacea	♂ ♂	W	9	88.0–95.3	90.7	2.26	0.72	0.70
	♂ ♂	T	9	72.0–77.5	74.3	1.91	0.64	1.07
	♀ ♀	W	8	86.0–90.0	87.3	1.27	0.45	0.22
	♀ ♀	T	8	69.8–77.8	72.9	2.29	0.81	1.26
albifacies	♂ ♂	W	12	91.3–100.9	96.1	2.58	0.75	1.69
	♂ ♂	T	12	70.7–79.8	74.7	2.88	0.83	0.95
	♀ ♀	W	5	88.1–93.9	93.0	3.14	1.40	1.25
	♀ ♀	T	6	73.2–78.0	75.8	1.73	0.71	1.67

* In each case comparison is with the newly-described subspecies.

A.O.U. Handbook of North American Birds, vol. 1 (Palmer, 1962). A brief discussion of lighting conditions under which colors were compared is given in the Appendix of the present paper.

When appropriate, measurements are analyzed statistically (Table 1) and are also expressed as Dice-square diagrams (Figures 2–5). The coefficient of difference (C.D.: difference between means of two samples/

sum of their standard deviations) is a statistic proposed by Mayr, Linsley, and Usinger (1953) as an index of the degree of overlap between samples. These authors suggest a C.D. value of 1.28 as a minimum for subspecific recognition on the basis of size; they emphasize, however, that this is an arbitrary figure and that biological and biogeographical factors must also be given strong consideration.

Falco sparverius nicaraguensis, new subspecies

Type.—Adult female, UCLA no. 51498, taken 12 miles NW of Puerto Cabezas, elevation about 33 m (100 ft.), Dept. of Zelaya, Nicaragua, on 26 January 1962, by O. M. Buchanan, Jr.; weight 79.5 g; largest follicle 3 mm in diameter; original no. 1057.

Diagnosis.—Similar to *F. s. tropicalis* but smaller (Table 1), with less sexual dimorphism in color and size; Tawny (hazel) crown patch lacking altogether in males and usually lacking in females (much reduced if present); males average slightly paler than males of *tropicalis* on crown, back, and wings; females tend to have increased amounts of Dark Gray (slate) on wing coverts and to have the dark barring of the scapulars and back reduced and paler, causing a somewhat masculoid appearance. Measurements of the type are as follows: wing, 167.9; tail (worn), 104.3; tarsus, 32.2; culmen (chord, from cere), 11.6.

Range.—Known thus far only from the lowland pine savanna of northeastern Nicaragua from Puerto Cabezas northwest to the Río Coco, but probably occurs throughout the savanna from extreme eastern Honduras south to the vicinity of the Laguna de Perlas, Nicaragua.

Remarks.—A series of nine males and nine females was collected in 1962 and 1963 at numerous localities along a logging road that runs through the savanna from Puerto Cabezas to the village of Leimus, 15 km west of Waspam, Comarca de El Cabo, on the south bank of the Río Coco. American Kestrels (a name that I prefer over "Sparrow Hawk") are abundant in this region, and in February, 1963, we estimated an average of one bird seen per odometer mile along the road. In late January and early February many kestrels were paired and copulations were noted frequently; in fact, three pairs were collected immediately after mating was observed. No nesting activity was seen, however, and it appears that the time of our visits coincided with the earliest part of the breeding season. Size of testes in males ranged from 4 × 2 to 5 × 4 mm, and the largest follicles in females were from 1.0 to 3.0 mm in diameter.

In working out the distinctions between *F. s. nicaraguensis* and *F. s. tropicalis* I have examined a series of 44 birds identified as the latter subspecies from Chiapas, Guatemala, and Honduras. The following remarks will, I hope, serve to clarify the status of *tropicalis* as well as that

of *nicaraguensis*. Difficulties arise, as *F. s. sparverius* is a common migrant and winter visitant in much of Central America. Specimens from Central America that can be considered resident birds with reasonable certainty are those taken from May into August, and these are mostly birds in juvenal plumage and adults in very worn plumage and/or in molt. Color and size comparisons of these specimens with those from other populations must therefore be made with particular care. Confusion has also resulted from certain published statements and measurements, including some accompanying the original description of *F. s. tropicalis*, and a brief review is in order.

Griscom (1930) described *tropicalis* on the basis of six specimens taken in late May, 1924, by A. W. Anthony at Antigua, Chimaltenango, Guatemala, a locality that is now a popular tourist resort about 13 miles west of Guatemala City. The confusing statement that *tropicalis* "would appear to be confined to the arid portion of the Rio Motagua Valley" (thus excluding the type locality) was later corrected by Griscom (1932) to "resident in the pine forests of the Altos of Guatemala, at lower elevations."

I have examined the six birds of Griscom's original series, four of which are at the AMNH and two of which are now at the MCZ. Dr. W. E. Lanyon has kindly provided supplemental information on the AMNH series. The type of *tropicalis* (AMNH 393671), an adult male, was collected on 20 May and is in very worn body plumage although the primaries do not appear to be heavily abraded at the tips; the tail is quite worn. My measurements of this specimen are: wing, 175.3; tail, 116.8. Friedmann's (1950: 743) wing measurement of 174.5 doubtless refers to the type. Griscom (1930), however, gave measurements for the wing of males as 162–171. His series included "2 ♂ ad., 1 ♂ imm."; presumably the type was one of the adults, and the other must be MCZ 145663, which has a wing measuring 171.3. AMNH 393670, an immature male with the remiges in molt and the longest primaries incompletely grown (still ensheathed proximally), has a wing length of 162. Evidently Griscom gave measurements for these latter two males but somehow neglected to include the measurement of the type.

Griscom gave the wing length for three females of *F. s. tropicalis* as 173–182. AMNH 393669, an immature female, has a wing length of 171 (Lanyon, *in litt.*), but the remiges are in a stage of molt similar to that of the immature male mentioned above. This specimen must be the basis for Griscom's figure of 173 as the low extreme, because neither the single adult female in the original series nor any taken subsequently has a wing length of less than 178. AMNH 393672, a young female, has remiges that are only partly grown and the wing measures only 125. MCZ 145664, an adult female, has a wing length of 180.0 according to my measurements, and this is reasonably close to Griscom's maximum figure of 182.

Bond (1943), in his extensive review of variation in *Falco sparverius*, points out that wing length is the most reliable measurement indicative of size in this species. Bond found no significant difference in wing length between immatures and adults, and he stressed the general unreliability of tail, tarsus, and beak measurements. I have therefore considered wing length as the most important mensural character. Out of the series of 44 birds identified as *F. s. tropicalis*, there are 14 males and 7 females, collected from May through August, from which reliable wing measurements may be obtained; these are included in Table 1 (see below for explanation of the number 10 given for the sample of females).

The series of males includes both immatures and adults that have measurements within 1 mm of the maximum and minimum figures, and the series of seven females includes four birds that may be immatures and three (including the smallest and largest ones) that are adult or subadult. The samples were therefore not divided into age groups. The largest bird (CM 135211, female, wing 189.6) was taken at Siguatepeque, Comayagua, Honduras, on 31 July 1951. It was acquiring fresh plumage; the inner primaries are freshly grown in and the outermost, older ones, including the longest, are only slightly worn. Both the date of collection and the stage of molt indicate strongly that this was a resident bird and not a migrant.

Swann (1920) described a subspecies *F. s. guatemalensis* and designated as the type a specimen from Capetillo, Sacatepequez, Guatemala. This is now MCZ 92772. Griscom (1930) and Bangs (1930) stated that Swann's type was a migrant *F. s. sparverius* but did not discuss the basis of the identification. Dr. R. A. Paynter has reexamined this specimen and informs me that there is no date or sex on the original label, but that the bird is an immature male with some Tawny on the crown and a flat wing measurement of 190 mm. This figure confirms the opinion that the specimen does not represent the small resident form, although another bird (MCZ 92774; see below) in Swann's series from Capetillo seems to be an example of *F. s. tropicalis*.

Griscom's (1930) description of color in *tropicalis* was based on a few worn and immature specimens, and examination of a larger series requires some changes. The following redefinition is a slight modification of that of Friedmann (1950). Compared with *F. s. sparverius*, *tropicalis* averages darker dorsally in both sexes, matching the darker examples of *sparverius*. In adult males the chest is Cinnamon (fawn) and is largely or completely unstreaked; the underparts are never uniformly Cinnamon as in some examples of *F. s. sparverius*. Immature males lack most or all of the Cinnamon on the chest, and are finely streaked in this area. In males of all ages the throat is white and the rest of the underparts are white or whitish washed with pale Cinnamon, always with a variable but moderate quantity

of black spots on the upper abdomen and flanks. The Tawny crown patch is absent in only about one-third of the males (6 of 19) and its presence or absence is not correlated with age. In some males the Tawny color is present only as a trace. All females of all ages have at least a trace of Tawny in the crown. The darkness of the ventral striping in females varies individually, and in most it is no darker than the usual condition in *F. s. sparverius*.

Hellmayr and Conover (1949: 326) listed four specimens from Guatemala in the Field (Chicago) Museum collection and commented that "Griscom's measurements for the males are below normal, as shown in our specimens"; they gave the wing length as 180 to 185. I have examined these specimens, which are all males. One from Acatenango, Chimaltenango, has a wing measuring 192.4; this bird is referable to *F. s. sparverius*, and its wing measurement was evidently omitted for that reason by Hellmayr and Conover, although the specimen was inadvertently included in the list of *tropicalis* examined. The other three birds are larger than any summer-taken *tropicalis* males and are within the size range of *F. s. sparverius* as given by Bond (1943) and Friedmann (1950). CNHM 22387 from Tecpam (Tecpán), Sololá, 12 April 1906, wing 179.3, is very dark dorsally, has no Tawny crown patch, and may be a large example of *F. s. tropicalis*. CNHM 23334, Sierra Sta. Elena, Sololá, 15 December 1905, wing 180.6, has no Tawny crown patch and is probably a juvenal as it has heavy black barring dorsally and heavy black streaking on the chest; CNHM 93603, Volcán Tajamulco, San Marcos, 21 February 1934, wing 184.5, has some Tawny in the crown and is not very dark dorsally. These latter two birds are probably migrant *sparverius*, but none of these subspecific identifications can be considered certain.

Of six other males in the series before me, taken in Guatemala and Honduras from September to April, three can be assigned to *tropicalis* with reasonable certainty. These are USNM 348058, Subirana, Yoro, Honduras, 31 January 1933, wing 168.0; MCZ 193518, 7 mi. SE of San Jerónimo, elevation 3,300 ft., Baja Vera Paz, Guatemala, 10 January 1959, wing 176.0; and UMMZ 155237, 5 mi. S. San Jerónimo, 3,200 ft., Baja Vera Paz, Guatemala, 29 September 1958 (tenth and ninth primaries in molt; eighth, 166.0). USNM 396541, San José, Guatemala, 2 April 1947, weighed 115 and has a wing length of 187.0; it belongs with *F. s. sparverius*. The remaining two have identical wing lengths—179.5—but are very different in color. ANSP 63645, Quiriguá, Izabal, Guatemala, 4 April 1915, is uniform Cinnamon over the entire underparts, with virtually no streaks or spots. USNM 150764, Villa Nueva, Guatemala, 10 December 1890, is clear, unstreaked Cinnamon on the breast only, with the rest of the underparts whitish with a moderate amount of black spotting on the upper

abdomen and flanks. As the Quiriguá bird resembles in color many examples of *F. s. sparverius* but is unlike any specimen of unquestionable *tropicalis*, I place it with the former subspecies. The Villa Nueva bird matches *tropicalis* in color extremely well and I regard it as probably, but not certainly, *tropicalis*.

There are six females in the series besides the seven summer-taken birds, but only two of these have a date on the label. These two are both from Tegucigalpa, Honduras—MCZ 198252, 11 September 1937, wing 192.8, and MCZ 198253, 28 October 1937, wing 188.0. I place the former with *sparverius* on the basis of large size and coloration that matches that subspecies; the latter bird probably represents *sparverius* also, but it is slightly smaller and darker and could represent *tropicalis*. Two others are from Capetillo, Guatemala (MCZ 92773 and 92774, wings 187.5 and 182.8), and two are from Utiles Rock, Guatemala (USNM 103352 and 103353, wings 182.0 and 177.8). Both the latter have fresh remiges, with light tips still present, and they may be placed with *tropicalis* with reasonable assurance as they match females of that subspecies in color as well as size. MCZ 92774 from Capetillo fits well with *tropicalis* in color and size and may be referred to that subspecies. MCZ 92773 I am unable to place definitely as it is very pale dorsally, with all the colors diluted, and has a wing length in the zone of overlap between *tropicalis* and *sparverius*.

A reexamination of the seven males and nine females of *F. s. sparverius* from El Salvador that are now in the Dickey Collection, U.C.L.A., confirms van Rossem's statement that none of these is referable to *tropicalis* (Dickey and van Rossem, 1938).

The characteristics of *F. s. nicaraguensis* can now be compared with those of *tropicalis* in greater detail. *F. s. nicaraguensis* averages slightly paler dorsally in both sexes. In males, the crown and wing coverts are usually lighter and the back is less deeply Tawny. The back color in *nicaraguensis* contrasts with the Tawny Chestnut of the upper surface of the rectrices; in *tropicalis* the back is often concolor with the tail. Females of *nicaraguensis* usually have the dark barring of the back reduced and also paler, approaching Dark Gray rather than Blackish Gray or Black. Only one female out of nine is as dark dorsally as *tropicalis*. Six of the nine males of *nicaraguensis* have unstreaked, Cinnamon-colored chests; two others have a wash of Cinnamon and a slight amount of streaking, and a third has only a tinge of Cinnamon color and moderate streaking on the chest. In my series of *nicaraguensis*, none of the nine males has any trace of Tawny in the crown. Two of the females have a small Tawny crown patch, and one other has a few partly Tawny feathers in the crown. The other six females have gray crowns like the males. The tendency toward a masculoid color pattern in females is most marked in UCLA 51497, which

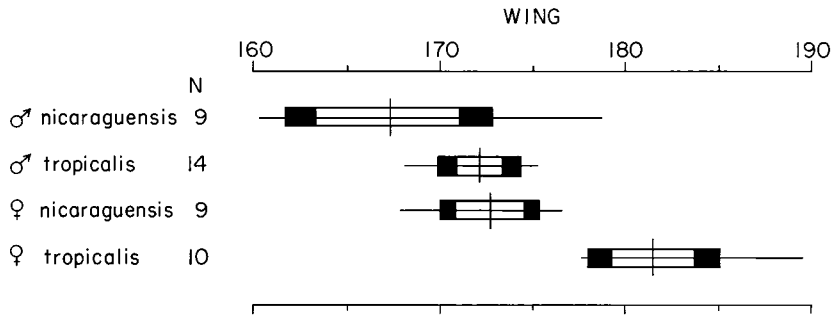

Figure 2. Wing lengths of *Falco sparverius nicaraguensis* and *F. s. tropicalis*. The horizontal lines represent the range of the sample; vertical lines represent the sample mean. The distance from the outer end of the dark rectangles to the mean equals the value of one standard deviation; the distance from the outer end of the white rectangles to the mean equals the value of twice the standard error of the mean.

has the barring of the scapulars and back reduced considerably and has largely Medium to Dark Gray wing converts and very narrow streaking on the underparts. This bird was one of a mated pair collected on 26 January 1962.

The reduction in color dimorphism in *nicaraguensis* is paralleled by a reduced difference in size between the sexes. Five males weighed 63.0, 73.0, 76.0, 76.8, and 78.0, and five females were recorded as weighing 75.0, 78.0, 79.5, 85.0, and 87.6. The longest-winged male (178.8) in the series of *nicaraguensis* exceeds the longest-winged female (176.6) in this dimension. *Nicaraguensis* averages smaller than any of the other subspecies of North and Middle America except for *caribaearum* of Puerto Rico and the Lesser Antilles. In color pattern, however, *nicaraguensis* shows no close resemblance to the West Indian forms and its closest affinities seem to be with *tropicalis*. In Figure 2, wing lengths of both sexes of *nicaraguensis* and *tropicalis* are compared. Only the measurements of summer-taken *tropicalis* males are utilized; the figures would be somewhat higher if winter-taken "probable" *tropicalis* were included. The measurements of three undated female specimens that appear to represent *tropicalis* are included as their wing lengths fall well within the extremes shown by the summer-taken females. The difference in mean wing length in the males is not quite significant, but the difference between the females is much greater and in the present series there is no overlap. The lesser degree of difference between the sexes in *nicaraguensis* as compared with *tropicalis* is also evident.

The remiges of several birds in the series of *nicaraguensis* are somewhat worn, but in even the most worn specimens the extent of abrasion is not

great enough to account for the relatively short measurements. Both the smallest and the largest males of *nicaraguensis* are in presumably subadult plumage as they have streaked chests. The remiges of the smallest bird appear to be moderately worn, but the next smallest, an unworn adult male, has a wing measuring only 1.4 mm longer. The male with the longest wing seems unusually large, as its measurement is 7 mm longer than that of the next largest male; in fact, only two of the nine males have wing lengths greater than 170. The type happens to have the shortest wing of any of the females, but the primaries of this bird appear to be quite fresh and unworn. This specimen, which was one of a mated pair, was chosen as the type because of its excellent plumage condition and its exemplification of the color characteristics of *nicaraguensis*; these factors, it is felt, outweigh the possible disadvantages of choosing a type with the shortest wing of the series.

The vocalizations and behavior of *nicaraguensis* are evidently like those of *F. s. sparverius* and presumably those of other North and Central American forms. It is of interest that *F. s. sparverius* is a common migrant and winter visitant on the Pacific slope of Nicaragua, where there is no resident form, but is much scarcer on the Caribbean slope. There is hardly any open habitat suitable for kestrels on the Caribbean slope except the pine savanna, where *nicaraguensis* is presumably resident. One specimen of *F. s. sparverius* was collected by M. G. Palmer at Sacklin (Saclín), Comarca de El Cabo, Nicaragua, on 22 February 1905 (AMNH 393223). This bird is an immature male with much Tawny in the crown and a wing length of 186. No other specimens of *F. s. sparverius* have been taken within the range of *nicaraguensis*, but we observed a large female kestrel that was almost surely *sparverius* in the town of Puerto Cabezas in January and February, 1962. It is tempting to suggest that wintering *F. s. sparverius* are rare in the pine savanna because of inability to compete successfully in that habitat with *nicaraguensis*, but there are insufficient data to support or refute this speculation. The larger *F. s. sparverius* would presumably be at an advantage in direct conflicts with *nicaraguensis*, but the smaller form might gain through more effective exploitation of the apparently limited food resources of the savanna.

The breeding populations of kestrels in Central America from Chiapas south appear to be restricted to pine forests, and *nicaraguensis* is probably derived from a montane, *tropicalis*-like population that established itself in the lowland pine savanna. Although this new form represents a southward extension of the known breeding range of the species, there is still a wide gap between the range of *nicaraguensis* and that of the closest mainland populations of *F. sparverius* in northern South America.

Amazilia cyanocephala chlorostephana, new subspecies

Type.—Adult female, UCLA no. 51577, taken 15 kilometers SSW of Waspam, elevation about 33 m (100 ft.), Comarca de El Cabo, Nicaragua, on 3 February 1962, by Thomas R. Howell; egg without shell in oviduct; original no. 2278.

Diagnosis.—Similar to *Amazilia cyanocephala guatemalensis* but with the crown glittering Green instead of Cobalt Ultramarine (blue); size smaller. Measurements of the type are as follows: wing, 54.1; tail, 28.8; culmen from nostril, 16.3.

Range.—Known thus far only from the lowland pine savanna and edge of adjacent broad-leaved forest of northeastern Nicaragua from the vicinity of Puerto Cabezas northwest to the Río Coco, but probably occurs throughout the savanna from extreme eastern Honduras to the vicinity of the Laguna de Perlas, Nicaragua.

Remarks.—A series of six males and eight females was collected in late January and early February in 1955, 1962, and 1963. This new form differs absolutely from other subspecies of *A. cyanocephala* on the basis of crown color and may represent a distinct species. I have described it as a subspecies, however, as it shows no other color difference and because of similarities in habitat preference. *A. c. cyanocephala* and *guatemalensis* are inhabitants of montane pine forests, and *chlorostephana* appears to be a lowland representative of this species.

I have examined a series of 82 *A. c. guatemalensis* from Guatemala, British Honduras, Honduras, El Salvador, and north central Nicaragua; this form reaches the southern limit of its range in the latter area. All of these specimens have Cobalt Ultramarine crowns, and none shows the slightest approach to the crown color of *chlorostephana.* MCZ 171961, female, Portillo Grande, Yoro, Honduras, 8 April 1934, has some sections of green in its otherwise blue crown, but the green areas are dull and do not resemble the brilliant, metallic green of the crown of *chlorostephana.* Two examples of the new form, UCLA 51567 and 51575, have a slight bluish tinge (approaching Emerald or Turquoise Emerald) on some of the crown feathers, but the over-all aspect is decidedly green, not blue. *A. c. chlorostephana* also differs, in the brilliant, glittering quality of its crown, from other green-crowned amazilias (such as *A. candida*) in which the crown is essentially concolor with the back. Except for the crown, I can detect no difference in color between *chlorostephana* and *guatemalensis.* In both forms the mandible in life is Rose for its proximal two-thirds or three-quarters, and the rest of the bill is black. Measurements of *chlorostephana* are: males: wing, 53.4–59.2 (56.4); tail, 29.3–33.2 (30.8); culmen from nostril, 16.0–17.7 (16.5); females: wing, 52.7–56.8 (54.7); tail, 28.8–33.2

(30.2); culmen from nostril, 16.3–17.8 (17.1). Ridgway's figures (1911) for *guatemalensis* are considerably higher for all three dimensions in both sexes, even taking into account that Ridgway's bill measurements are of the exposed culmen.

A. c. chlorostephana was the only hummingbird encountered in the pine forest proper, and it was frequently seen feeding at flowering epiphytes in the pines. However, these birds were most numerous in pines near stands of broad-leaved trees and shrubs along streams and were often seen perched or feeding in the streamside vegetation. The first part of February appears to be within the breeding season of part of the population, because three males and four females had enlarged gonads. The testes in the three males were from 1.5 to 2 mm in diameter; two of the females (including the type) had unshelled eggs in the oviduct, and two others had follicles 1.0 to 1.5 mm in diameter. Two nests were located on 4 and 5 February 1962, 15 km SSW of Waspam. Both were about 15 m above ground in large pines, and each nest was saddled on a small branch. The attending birds sat quietly on their nests for long intervals, and presumably they were incubating eggs. The nest sites were both within 10 m of a small stream bordered with broad-leaved vegetation.

Pyrocephalus rubinus pinicola, new subspecies

Type.—Adult female, UCLA no. 51537, taken at Leicus Creek, elevation about 65 m (200 ft.), 32 miles NW of Puerto Cabezas, Comarca de El Cabo, Nicaragua, on 21 January 1963, by Thomas R. Howell; weight 15.1 g; largest follicle 1 mm in diameter; original no. 2526.

Diagnosis.—Similar to *P. r. blatteus* but smaller (Table 1); males like *blatteus* in color, but females with broader streaking on breast and upper abdomen and red of underparts more orange, less pinkish, than in *blatteus*. Measurements of the type are as follows: wing, 69.5; tail, 51.7; tarsus, 15.3; culmen from nostril, 10.3; width of bill at nostril, 6.8.

Range.—Known thus far only from the lowland pine savanna of northeastern Nicaragua from the vicinity of Puerto Cabezas northwest to the Río Coco, but probably occurs throughout the savanna from extreme eastern Honduras south to the vicinity of the Laguna de Perlas, Nicaragua.

Remarks.—Seven males and eight females of this new form were obtained in 1962 and 1963, and Townsend's series of four adult males, one adult female, and one unsexed juvenal collected along the "Segovia R." from 12 June to 19 July 1887 (Ridgway, 1888) are referable to *pinicola* rather than to *blatteus* or *mexicanus*. A male in the Cornell University collection taken by M. G. Palmer along the Río Coco at Sacklin, Comarca de El Cabo, was not measured by me but almost certainly represents *pinicola*.

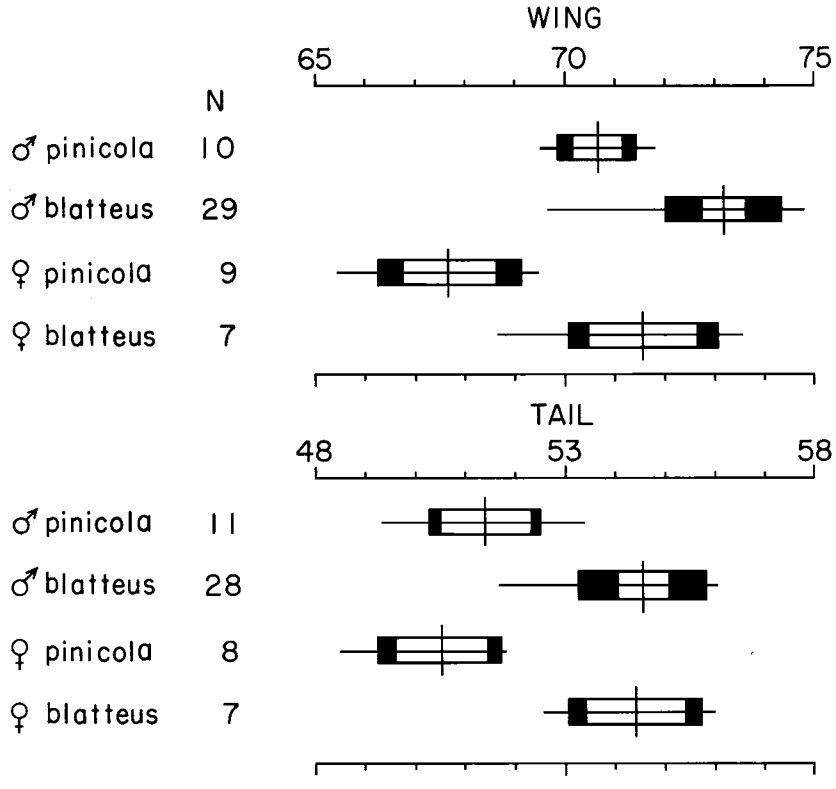

Figure 3. Wing and tail lengths of *Pyrocephalus rubinus pinicola* and *P. r. blatteus*. For explanation of symbols see Figure 2.

Size.—In Figure 3 the wing and tail lengths of all measurable examples of *P. r. pinicola* and of 29 males and 7 females of *P. r. blatteus* from Yucatán, Guatemala, and British Honduras are compared. In all specimens of *pinicola*, the longest primaries appear in good condition although the shorter, innermost ones are usually noticeably abraded. The rectrices in the series of *pinicola* do not show appreciable wear. The size differences are significant and are slightly greater between females than between males. In only two specimens of *blatteus* does the wing measure less than 70. These two were taken at La Libertad, Petén, Guatemala, on 26 April 1956: AMNH 706074, male, wing 69.7; AMNH 706075, female, wing 68.7. Both birds have moderately worn remiges. Except for the measurement obtained from AMNH 706075, there is no overlap in wing length between females of *blatteus* and *pinicola* in the present series. I have not examined the specimens of *blatteus* discussed by Bangs (1911), but his measurements of three males (wing 73–74, tail 53.3–55) are in accord with those

of the specimens discussed here. Peters (1913) described a female of *blatteus* with the wing 71 and the tail 56.3. The latter seems unusually long, but this specimen otherwise seems to match the present series of *blatteus*. I can detect no important difference in bill size between *pinicola* and *blatteus*. The width appears to be the same and measurements of culmen from nostril are as follows: *pinicola*: 11 males, 9.4–10.7 (9.9); eight females, 9.3–10.3 (10.0); *blatteus*: 17 males, 9.6–10.9 (10.1); three females, 10.0–10.2 (10.1). Weights of the two forms are also similar: *pinicola*: one male, 13.4; two females, 14.8–15.1; *blatteus*: males, 12.8–16.1; three females, 13.0–14.3 (Paynter, 1955).

Color.—There is no consistent color difference between the males of *pinicola* and *blatteus*, but the females differ appreciably. In *pinicola*, the pectoral streaks are generally broader, giving a more heavily marked aspect. The red color of the underparts in females of both subspecies varies somewhat, but the difference between the two forms is consistent. In *blatteus*, the color varies on the Ruby or pinkish side of Scarlet; in *pinicola*, the color varies toward Scarlet Orange and sometimes matches that color. The fact that most of the specimens of *blatteus* examined were collected at least 30 years ago might raise a suspicion that their more pinkish, less orange tone was the result of post-mortem fading. This is quite unlikely, however, for Peters (1913) described a freshly-taken female *blatteus* with the posterior underparts "brilliant scarlet-pink, shading to rose pink on the lower breast," and USNM 112162, a female *pinicola* collected by Townsend on 12 June 1887, matches perfectly in its Scarlet Orange color some females of *pinicola* taken in January and February of 1962 and 1963. The females of *pinicola* also tend to have the red distributed more uniformly over the abdomen than in *blatteus*, usually lacking the pale or whitish upper abdomen often shown by the latter subspecies.

These beautiful flycatchers are found almost exclusively in the pines although they are most often encountered in the vicinity of a small stream or an "island" of rain forest. They are the only small tyrannids occupying the pine savanna proper; the larger Tropical Kingbird (*Tyrannus melancholicus*) and Fork-tailed Flycatcher (*Muscivora tyrannus*) also occur in that habitat, but the relatively small Tropical Pewee (*Contopus cinereus*) and Yellow-bellied Elaenia (*Elaenia flavogaster*) are found only within, or at the edges of, the broad-leaved vegetation.

No nesting activity by Vermilion Flycatchers was seen in January and February, but the birds were usually paired. Testis size in males was from 2×1.5 to 5×3; five females had slightly enlarged follicles measuring 1 mm in diameter. The dates of collection of Townsend's specimens and the fact that they include a juvenal (USNM 112163) demonstrate that there is a breeding population of *P. rubinus* in the pine savanna.

As in the case of the kestrel, there is a hiatus in the breeding range of the Vermilion Flycatcher between northeastern Nicaragua and northern South America. This flycatcher is not found in any other part of Nicaragua and there are no records from Honduras other than those obtained along the Río Coco. The new form described here thus appears to be completely isolated from *blatteus* and marks a definite extension of the previously known range of the species in Central America.

Sialia sialis caribaea, new subspecies

Type.—Adult male, UCLA no. 51515, taken 4 miles NW of Leicus Creek (36 mi. NW of Puerto Cabezas), elevation about 65 m (200 ft.), Comarca de El Cabo, Nicaragua, on 22 January 1963, by Thomas R. Howell; weight 31.5 g; testes 2.5 × 1.5 mm; original no. 2538.

Diagnosis.—Similar to *S. s. meridionalis* but smaller (Table 1); males are like *meridionalis* in color, but females tend to be paler both dorsally and ventrally. Measurements of the type are as follows: wing, 96.6; tail, 62.5; tarsus, 20.2; culmen from nostril, 9.8.

Range.—Known thus far only from the lowland pine savanna of northeastern Nicaragua from the vicinity of Puerto Cabezas north and west into eastern Honduras (San Esteban, Olancho); probably occurs throughout the pine forests of eastern Honduras south through the lowland pine savanna to the Laguna de Perlas, Nicaragua.

Remarks.—In 1962 and 1963 nine males and six females of *S. s. caribaea* were collected in northeastern Nicaragua. These were compared with a series of 31 males and 22 females of *Sialia sialis* from British Honduras, Honduras, El Salvador (including the type of *meridionalis*) and northwestern and north central Nicaragua. Of this series, three males (CM 133642, 133644, 133645, wings 95.7, 93.8, 96.2, respectively) and one female (CM 133643, wing 93.1), all taken on 25 June 1948, at San Esteban, about 37 km NE of Catacamas, Olancho, Honduras, appear referable to *caribaea*. The tails of these four birds are too worn to permit valid measurements, but the remiges are not heavily abraded. The wing lengths fit well with those of *caribaea* from the lowland pine savanna, and San Esteban is the closest to that region of all the upland localities from which bluebird specimens are available; it is about 50 miles west of the margin of the savanna in eastern Honduras.

Of the other birds examined, 28 males and 19 females that are adults with wings in measurable condition are referable to *meridionalis*. These wing measurements are compared with those of *caribaea* in Figure 4; the differences are not great but the difference in means is significant at the $M \pm 2\sigma$ m level. Although the mean tail length is slightly smaller in *caribaea* than in *meridionalis* (Table 1), the difference is not significant.

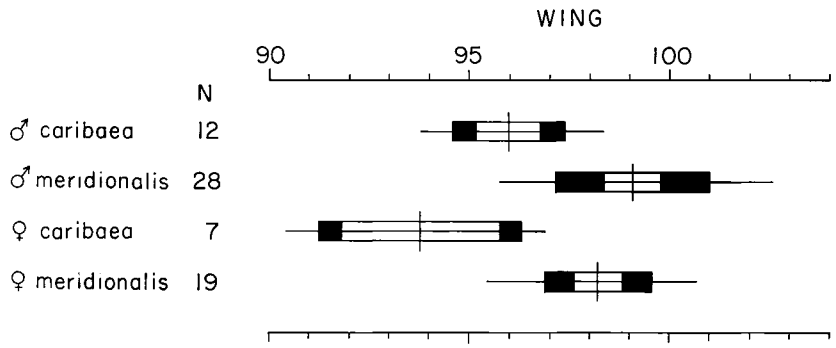

Figure 4. Wing lengths of *Sialia sialis caribaea* and *S. s. meridionalis*. For explanation of symbols see Figure 2.

Culmen length and tarsal length do not differ in *caribaea* and *meridionalis* in any significant way.

The following weights of *caribaea* from Nicaragua were recorded: four males, 26.0–31.5 (28.2); three females, 28.5–28.9 (28.7).

I can detect no consistent difference in color between males of *S. s. meridionalis* and *S. s. caribaea*, but 5 of 6 females of *caribaea* from Nicaragua are paler and grayer on the dorsal surface than all but 1 of the 19 adult females of *meridionalis*. Of the 6 Nicaraguan females, 4 are also very pale on the throat and breast. One of the females of *caribaea*, however, is just as dark dorsally and ventrally as are most *meridionalis*. The single female from San Esteban has body plumage that is too worn for color comparison. The consistency of the apparent color differences can be ascertained only by examination of a larger series of females of *caribaea*.

This new form is only slightly differentiated from *S. s. meridionalis*, as indicated by the C.D. for wing length of less than 1.28. However, the small difference in wing length appears to be meaningful, especially in the females. Apart from the two highest figures for 12 male *caribaea* (both 98.4) and the two lowest for 28 male *meridionalis* (both 95.7), there is no overlap between the two groups. Eighty-three per cent of the males of *caribaea* are therefore separable from 93 per cent of *meridionalis* males. Apart from the two lowest figures for 19 female *meridionalis* (95.4, 95.7), there is again no overlap with *caribaea*. The sample of females of *caribaea* is small, but 100 per cent of this sample is separable from 90 per cent of the females of *meridionalis*. I admit to some hesitancy in proposing a name for the savanna population, but feel that this action is justifiable on the following grounds: the generally smaller size of *caribaea*, reflected in both wing and tail length, is consistent with the tendency shown by most of the avian subspecies confined to the lowland pine savanna; this relatively

isolated population is peripheral for the species, and its characteristics thus merit some attention; alone among the generally small subspecies described here, these bluebirds evidently range into the highland pine forests and presumably come into contact with related populations there. The likelihood of some genetic interchange with *meridionalis* probably accounts for the lack of a more striking size difference between that form and *caribaea*.

The habits and vocalizations of *caribaea* do not appear to differ from those of other populations of *Sialia sialis*. The pine savanna provides the only open tree-and-grassland formation in northeastern Nicaragua, and in that region bluebirds are strictly confined to the savanna. No nesting activity by the bluebirds was noted and only a few seemed to be paired. No females had enlarged follicles, and the largest testis size in a male was 3 × 2.

Piranga flava savannarum, new subspecies

Type.—Adult male, UCLA no. 51550, taken 6 miles NW of Puerto Cabezas, elevation about 33 m (100 ft.), Department of Zelaya, Nicaragua, on 24 January 1962, by Thomas R. Howell; testes 2 × 2.5 mm; original no. 2230.

Diagnosis.—Most similar to *P. f. figlina* but smaller (Table 1); adult males with a brighter, more orange tone, especially ventrally; females brighter yellow ventrally, especially on throat and abdomen. Compared with *P. f. albifacies*, *P. f. savannarum* is much smaller; adult males are similar in color, but the auriculars of *savannarum* tend to be less whitish; females are clearer and brighter yellow on the throat and abdomen, these areas contrasting more strongly with the pectoral region and flanks than they do in *albifacies*; compared with *testacea*, *savannarum* averages slightly smaller, especially in tail length; adult males are less deeply colored dorsally, especially on pileum; both sexes differ from *testacea* in having the chin, malar area, lores, and crescentric mark under eye grayish and the auriculars with whitish shaft streaks; in *testacea* the grayish and whitish markings are much less extensive and often lacking altogether in the auriculars. Measurements of the type are as follows: wing, 86.5; tail, 67.9; tarsus, 22.0; culmen from nostril, 13.9.

Range.—Known thus far only from the lowland pine savanna of northeastern Nicaragua from the vicinity of Puerto Cabezas northwest to the Río Coco, but probably occurs throughout the savanna from extreme eastern Honduras south to the vicinity of the Laguna de Perlas, Nicaragua.

Remarks.—Six males and six females of *savannarum* were collected in northeastern Nicaragua in 1962. A male and a female (CNHM 66306, 66305) taken by M. G. Palmer at Sacklin, Comarca de El Cabo, Nicaragua, and a male and two females (USNM 112092, 112093, 112094) collected by

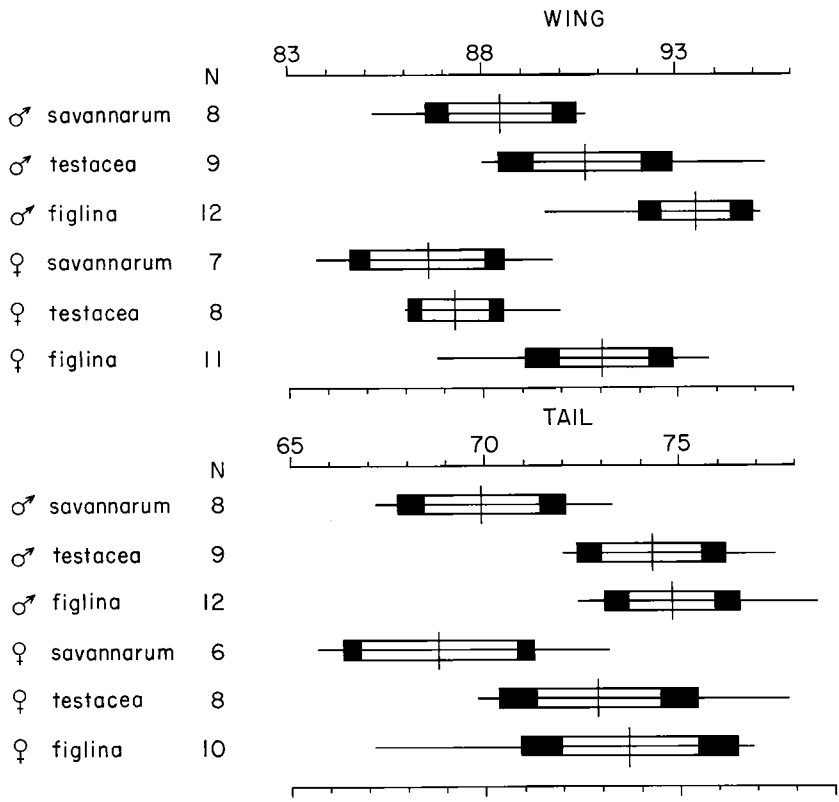

Figure 5. Wing and tail lengths of *Piranga flava savannarum, P. f. figlina*, and *P. f. testacea*. For explanation of symbols see Figure 2.

Townsend along the "Segovia R." are also referable to the new form. All these were compared with 12 males and 6 females of *albifacies* (including the type) from El Salvador and northwestern and north-central Nicaragua, 12 males and 11 females of *figlina* from British Honduras, and 9 males and 8 females of *testacea* from Costa Rica and Panamá. In Table 1, the wing and tail measurements of each of the four subspecies are given, as determined from the series listed above. It will be seen that *savannarum* is the smallest of the four and indeed the smallest of any of the North and Central American forms of *Piranga flava*. In Figure 5, measurements of *savannarum, figlina*, and *testacea* are diagrammed; *albifacies* is not included, because a close comparison of this large form with *savannarum* is unnecessary. *P. f. savannarum* is also distinguishable from *albifacies, figlina*, and *testacea* on the basis of color, as pointed out in the diagnosis.

This new form has not hitherto been detected for two reasons: (1) lack of an adequate series in good plumage, and the consequent assignment of specimens from along the Río Coco to *figlina*; and (2) the single published record of *testacea* from Chontales, Nicaragua, and the consequent assumption that this form met and intergraded with *albifacies* or *figlina*, or both. These two points may be dealt with in that order.

Ridgway (1902) pointed out long ago that birds from the "Segovia River" were much smaller than *figlina* from British Honduras, but he had only three specimens, all taken in July and August, and the difference could have been attributed to wear. Zimmer (1929), in his review of the races of *Piranga flava*, commented on the difficulty of placing Río Coco specimens subspecifically and suggested that they showed affinity to *testacea* and *albifacies*, although he assigned them to *figlina*. Both Ridgway and Zimmer included the short measurements of these Río Coco birds with their series of figures for *figlina*, thus lowering the extremes and the means of wing and tail lengths given for that form. All the specimens from the Río Coco available to these authors, a total of two males and three females, have been re-examined; all are poorly prepared or in poor plumage, or both, and accurate comparison with the other subspecies was and is difficult.

The inclusion of Chontales, Nicaragua, within the range of *testacea* is based on a single specimen recorded by Salvin and Godman (1883) that is said to have been taken in that locality by Thomas Belt. Both Ridgway (1902) and Zimmer (1929) commented that this specimen (which is in the British Museum) should be reexamined; their point is still valid, for no other examples of *testacea* have been collected north of Costa Rica, and there are no other records of *P. flava* from Nicaragua outside the pine forest regions. The Department of Chontales includes arid Pacific slope lowlands on the east side of Lake Nicaragua as well as Caribbean slope rain forest, but it lies south of the pine-forested areas. Dr. Derek Goodwin of the British Museum kindly consented to examine the specimen in question, and he has sent me the following information.

1. The bird was received in exchange from H. Seebohm in 1888. It does not have an original collector's label, and the only data on the label that it does have are "Chontales, Nicaragua (T. Belt)."

2. It is in very worn plumage, largely red but with patches of green. Some new feathers were coming in, and these are mostly red but some are tinged with green.

3. Measurements are: wing (chord), 93 mm; tail, 72 mm. These figures are within the range of *P. f. testacea* but also within that of *P. f. albifacies*, especially if wear is taken into consideration.

Dr. Goodwin is understandably reluctant to attempt a positive subspecific identification of such a specimen, but he feels that it probably represents *albifacies*. If the bird was actually taken by Belt, it may have been

obtained in the vicinity of Matagalpa, Nicaragua, an area he is known to have visited (Belt, 1874) and one where *albifacies* is resident. Or, the bird may have been a vagrant of either *albifacies* or *testacea* that wandered to Chontales. In any case, there is no evidence whatever that *testacea* occurs regularly or breeds anywhere north of Costa Rica or that any form of *P. flava* occurs regularly or breeds in Nicaragua south of the pine-oak or pine forest habitats. Thus, *testacea* appears to be completely separated from the more northern populations of *P. flava*, and the characteristics of Nicaraguan populations cannot safely be attributed to intergradation with *testacea*.

Although *P. f. savannarum* is most similar to *P. f. testacea* in size, its closest affinities seem to be with *albifacies* and *figlina*. *P. f. savannarum* is a bird of the lowland pine savanna; individuals often move into the edge of adjacent broad-leaved woodlands, but those that I observed never penetrated deeply into this habitat and soon returned to the pines. *P. f. savannarum* therefore seems similar ecologically to *albifacies* and *figlina*, which are also primarily birds of the pine forest, although at generally higher elevations.

This tanager is one of the most abundant and widespread of the pine savanna birds, and is often encountered in pure stands of pine far from any streamside broad-leaved vegetation. In late January and February these tanagers were almost always paired but I noted no singing or nesting activity. The gonads of the males collected showed only slight indications of enlargement, and the largest testes measured 2 × 2.5. No females had follicles greater than 1 mm in diameter.

Aimophila botterii spadiconigrescens, new subspecies

Type.—Adult male, UCLA no. 51563, taken 15 kilometers SSW of Waspam, elevation about 33 m (100 ft.), Comarca de El Cabo, Nicaragua, on 5 February 1962, by Thomas R. Howell; testes 2 × 2.5 mm; original no. 2290.

Diagnosis.—Most similar to *A. b. petenica*, but with a browner, less grayish tone over the blackish dorsal region, this appearance resulting from a preponderance of Chestnut rather than Medium to Dark Gray peripheral to the blackish central portion of the feathers of the dorsum; differs from *A. b. sartorii* (see below) in a similar manner and also in having the edge and bend of the wing whitish or Cream rather than Light Yellow, with only a slight (or no) yellowish suffusion on the lesser coverts; differs from both *petenica* and *sartorii* in having the pectoral band contrasting more strongly with a whitish throat and pure white abdomen; similar to *petenica* and *sartorii* in size; males: wing, 54.4–58.2 (56.0); tail, 51.8–57.9 (54.0);

females: wing, 53.5–55.9 (54.7); tail, 53.9–55.1 (54.5); smaller as well as much darker than *vulcanica* or *vantynei*. Measurements of type: wing, 54.4; tail, 53.7; tarsus, 19.0; culmen from nostril, 8.6.

Range.—Known thus far only from the type locality, but probably occurs at least locally throughout the savanna from extreme eastern Honduras south to the vicinity of the Laguna de Perlas, Nicaragua.

Remarks.—Webster (1959) has recently reviewed the systematics of this species and discussed the evidence for the conspecificity of *petenica* and *botterii*. The new form described here is based on a series of five males and two females collected from 2 to 6 February 1962. This population presumably breeds in the savanna, because all the males taken had enlarged testes (up to 7 × 5 mm) and most of the birds appeared to be paired. February is probably early in the breeding season, however, for the two females collected did not have enlarged follicles and no nesting activity was seen.

A. b. spadiconigrescens appears to be a well isolated subspecies, but future collecting will doubtless narrow the gap between its presently known range in northeastern Nicaragua and the range of *petenica* to the north and west. The closest recorded populations of *A. b. petenica* are those in British Honduras (LSU; 10 specimens) and Petén, Guatemala, both about 350 miles away. No form of *A. botterii* has yet been recorded from Honduras, but it is highly likely that the species will be found at least locally along the Caribbean slope of that country. *A. b. vulcanica* is known in Nicaragua only from the upper slopes of Volcán San Cristóbal, Chinandega, an isolated peak near the Pacific coast that is separated from the Caribbean lowland savanna by a wide expanse of habitat unsuitable for this species. *A. b. spadiconigrescens* is smaller and darker than *A. b. vulcanica*, and resembles much more closely the other Gulf and Caribbean lowland populations (all currently referred to *petenica*) that range from eastern Veracruz to northern Guatemala and British Honduras. I have assembled and examined 33 specimens from all parts of this area. Unfortunately, many of the birds identified as *petenica* are in heavily worn plumage and are virtually useless for comparative purposes. Further difficulties are caused by the fact that in many specimens the collector tucked the bend of the wing back into the skin for support, thus making it impossible to examine the color of this region or even to measure the wing accurately without doing violence to the specimen.

The seven Nicaraguan examples of *spadiconigrescens*, all taken in February, are in fresh, unfaded plumage. The only examples of *petenica* in comparable condition are found in a series of eight birds from the vicinity of Hill Bank, elevation about 45 ft., Orange Walk District, British Honduras, taken from 21 November to 1 April. I have assumed that these

birds represent true *petenica*, the type locality of which appears to be the pine ridge of Poctum (Poctún), Petén, Guatemala (Sharpe, 1888), about 100 mi. SSE of Hill Bank, in an apparently similar ecological situation. I do not know the basis for Webster's (1959) designation of the type locality as La Libertad, Petén. There are four birds in the British Honduras series taken in November (LSU 22259–22262); these have not completed their molt and lack most of the rectrices and the innermost secondaries, but the other remiges and the body feathers are very fresh. The other four specimens were taken on 28 February (two; LSU 21504, 21505), 23 March (LSU 20870), and 1 April (LSU 20869). Dorsally, the Nicaraguan specimens are more brownish, less grayish, than even the freshest (November) specimens from British Honduras. This more brownish appearance is also evident when the edgings of the remiges and coverts of the two groups are compared, but fading of the margins of these feathers seems to be very rapid and this character may not be reliable. Ventrally, the pectoral band is more distinct in *spadiconigrescens* than in the British Honduras birds. In *spadiconigrescens* the band is Light Grayish Buffy Brown, contrasting with a whitish throat and a pure white abdomen. The freshest (November) *petenica* have a more buffy pectoral band (approaching Grayish Buffy Yellow) and a faint buffy wash over most of the abdomen; the February-March *petenica* have a paler, more grayish band than that of *spadiconigrescens*; in more worn examples of *petenica* the band is even paler and grayer, and the buffy wash on the abdomen is lacking. In *spadiconigrescens*, the flanks are darker (approximately Buffy Brown) than in any but the November-taken *petenica*.

The lower mandibles of six of the seven *spadiconigrescens* are darker and grayer than those of the series of *petenica* from British Honduras, but this could be the result of post-mortem change—the Nicaraguan birds were taken in 1962, and all but two of those from British Honduras were obtained in 1955 and 1956. The two exceptions were taken on 19 June 1963 (LSU 31217, 31218), and their lower mandibles are grayer than the other British Honduras birds but not as dark as those of the Nicaraguan series.

Three birds from eastern Veracruz (UMMZ 151555, UK 24313, ML 59458), one from northern Oaxaca (ML 52742), and one from Tabasco (UK 35318), México, are decidedly Light Yellow on the edge and bend of the wing and have a distinct yellow suffusion on the lesser coverts; five from Chiapas appear similar although slightly paler, but these cannot be adequately examined because of the "tucking in" of the wing by the collector. Seven specimens from Yucatán appear still paler but are so badly worn and faded that any comparison is tenuous. Three adults and a juvenal from La Libertad, Petén, were taken in August and September and are in extremely

poor plumage; no valid color comparisons can be made. In the fresh-plumaged *petenica* from British Honduras and in *spadiconigrescens*, however, the edge and bend of the wing are usually whitish or Cream rather than Light Yellow, with only a slight yellowish suffusion on the lesser coverts, or none. *A. b. spadiconigrescens* tends to have even less yellow on the bend of the wing and lesser coverts than *petenica* from British Honduras (in some of the latter specimens the bend of the wing is tucked in and not visible). The generally yellowish color of the bend-of-wing region in the birds from the lowlands of Veracruz, Oaxaca, and Tabasco is quite noticeable and readily distinguishes this population from *petenica* as represented by the British Honduras specimens. The name *sartorii* Ridgway 1898 (type locality Huatusco, near Mirador, Veracruz) is available for these birds from the Gulf lowlands of México, and I think that this population constitutes a recognizable subspecies. Ridgway (1901: 259) evidently noticed the more yellow bend-of-wing region in *sartorii* but did not emphasize it; *sartorii* is otherwise extremely close to *petenica* in size and color.

The subspecies *vulcanica* and *vantynei* are both larger and paler than *petenica* or *spadiconigrescens*. I have examined the topotypical series of *vulcanica* from Volcán de Chinandega (Volcán San Cristóbal) in the AMNH and have recorded the following measurements: 10 males: wing, 60.4–65.0 (63.0); tail, 61.5–65.0 (63.2); 2 females: wing, 59.6, 59.8; tail, 60.0, 63.2.

The measurements of the single male of *vulcanica* (CM 27172; wing 62, tail 60) from Miravalles in the Cordillera de Guanacaste, Costa Rica, that was examined by Webster (1959) correspond closely to the above figures. This subspecies inhabits grasslands at high elevations, but the estimated altitude of 6,000 feet given on the labels of five of the specimens from Volcán San Cristóbal is somewhat too high, as the mountain is barely over 5,800 feet at its peak. Compared with *spadiconigrescens*, *vulcanica* is not as dark dorsally; the pectoral region is paler and the abdomen not as white; the edge of the wing and bend of the wing are more yellowish and the lesser coverts are extensively yellowish. *A. b. vantynei*, based on three specimens, seems to differ similarly from *A. b. spadiconigrescens*, but is even paler and browner dorsally. It is also larger, although my measurements of an adult male (AMNH 397939) of *vantynei* from Antigua, Guatemala, are somewhat smaller than those of Webster (1959)—wing 64 instead of 67; tail 65 instead of 66.

In view of the pronounced changes in color and in wing and tail measurements in this species resulting from wear, the acquisition and comparison of a larger series in good plumage of all the populations from southeastern México to Costa Rica is highly desirable.

DISCUSSION

The existence of a group of apparently distinct populations outside the previously known breeding range of each of the species involved is of taxonomic and distributional significance, but in this case there are some additional points of interest. The populations described here appear to be residents of a lowland pine savanna that is completely isolated from other similar habitats. This savanna is also the southernmost example of this type of habitat and of any kind of naturally occurring pine forest in the western hemisphere. The proposed new subspecies of birds either represent terminal populations in the range of the respective species or the southernmost populations north of a considerable hiatus in the range. Mayr (1963: 545–546) has stressed the potential evolutionary importance of geographical isolates at the periphery of the species range, and the new forms discussed above exemplify such peripheral isolates.

These lowland pine savanna birds are most similar to the geographically closest conspecific populations to the north and west, most of which inhabit montane or submontane pine forest. With the exception of *Amazilia cyanocephala*, all the species considered are also found in some parts of their ranges in habitats other than pine forests. These species all seem to require a habitat of relatively open aspect, with trees or shrubs sparsely distributed over a substrate covered only with low growth, and these conditions are provided by a variety of Neotropical habitats, including certain arid regions, most pine-oak and montane pine forests, and the lowland pine savanna. The savanna differs from some of these other habitats by its low elevation and from all of them by its very wet climate; there is a three-month dry season, but the mean annual rainfall ranges from 2600 to 3500 mm (Taylor, 1963). The Nicaraguan savanna may be a marginal habitat ecologically as well as geographically, for its biota seems to be rather impoverished and most of the avian subspecies restricted to this region are smaller than those to which they appear to be most clearly related.

Of special interest is the opinion, strongly supported by Taylor (1963), that the Nicaraguan lowland pine savanna is a disclimax community resulting from human disturbance—probably clearing and burning of dense broad-leaved forest by aboriginal Indians. If so, the new subspecies described here must be of relatively recent origin and would constitute an exceptional example of differentiation in higher vertebrates in association with habitat alteration by man.

APPENDIX

Ornithologists have been leaders in standardizing color nomenclature, but the equally important specification of conditions under which colors are examined is usually neglected. It is traditional to examine specimens in light from a slightly overcast north

sky, because of its presumably constant quality, and this procedure is generally assumed to have been followed in taxonomic work unless otherwise specified. In actuality, light from the north sky varies considerably according to a number of conditions (Taylor and Kerr, 1941), and artificial light sources are now available that approach closely the spectral energy distribution of natural daylight at a specific color temperature. The Illuminating Engineering Society (Tobias, Macbeth, *et al.*, 1957) recommends for color appraisal a light source approximating daylight at a color temperature of 7,400° K (Abbot-Gibson daylight). Two such sources that are claimed to be very close to this standard were available to me—the Macbeth Examolite (filtered combination of fluorescent and incandescent light, Macbeth Corp., Newburgh, New York) and a new unfiltered fluorescent tube made by the Duro-Test Corp., North Bergen, New Jersey. For my critical color comparisons I used both of these as well as natural daylight, facing north under a light overcast sky at mid-morning on 26 January 1964, at Los Angeles. Specimens were arranged on a neutral gray background; the daylight examination was made on a flat rooftop to minimize the influence of reflection from surroundings, and the examination under artificial sources was made in an otherwise dark room so that such reflection was negligible. Color comparisons were also made under General Electric Cool White and Verd-a-Ray North White fluorescent tubes (which do not closely approximate Abbot-Gibson daylight) under similar circumstances. The subspecific color differences discussed above were readily apparent (although not qualitatively identical) under each of these lighting conditions; the final designation of the colors by name was made on the basis of the daylight examination in accordance with tradition. However, the development of modern artificial light sources that closely approximate a standard of natural daylight suggests that taxonomists should give serious thought to proposing standard conditions of illumination for color comparison that would be constant, readily reproduced, and thus superior to the highly variable natural light that is utilized in many museums.

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